US009026080B2

(12) **United States Patent**
**Moran et al.**

(10) **Patent No.: US 9,026,080 B2**
(45) **Date of Patent: May 5, 2015**

(54) **MODULAR WIRELESS COMMUNICATOR**

(71) Applicant: **Google Inc.**, Mountain View, CA (US)

(72) Inventors: **Dov Moran**, Kfar Saba (IL); **Itay Sherman**, Hod Hasharon (IL); **Eyal Bychkov**, Hod Hasharon (IL); **Itay Cohen**, Raanana (IL); **Yaron Segalov**, Tel Aviv (IL); **Tamir Demri**, Herzilya (IL); **Eran Miller**, Givataim (IL); **Uri Ron**, Kfar Saba (IL); **Tal Engelstein**, Ramat Gan (IL); **Hagay Katz**, Moshav Herut (IL); **Hagit Perry**, Herzilya (IL)

(73) Assignee: **Google Inc.**, Mountain View, CA (US)

( * ) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **14/282,332**

(22) Filed: **May 20, 2014**

(65) **Prior Publication Data**

US 2014/0289522 A1 Sep. 25, 2014

**Related U.S. Application Data**

(63) Continuation of application No. 13/761,188, filed on Feb. 7, 2013, now Pat. No. 8,750,928, which is a continuation of application No. 13/471,751, filed on May 15, 2012, now Pat. No. 8,391,921, which is a

(Continued)

(51) **Int. Cl.**
***H04M 1/66*** (2006.01)
***H04M 1/68*** (2006.01)
(Continued)

(52) **U.S. Cl.**
CPC ..... ***H04W 12/06*** (2013.01); ***H04M 1/21*** (2013.01); ***H04M 1/0256*** (2013.01); ***H04M 1/72527*** (2013.01); ***H04L 9/32*** (2013.01)

(58) **Field of Classification Search**
CPC ..... H04W 12/08; H04W 12/12; H04W 88/02; H04M 1/72522; H04M 1/72527; H04L 9/03; H04L 9/08; H04L 63/08; H04L 63/0428
USPC ..... 455/410, 411, 550.1, 556.1, 556.2, 557, 455/558; 380/30, 44; 713/168
See application file for complete search history.

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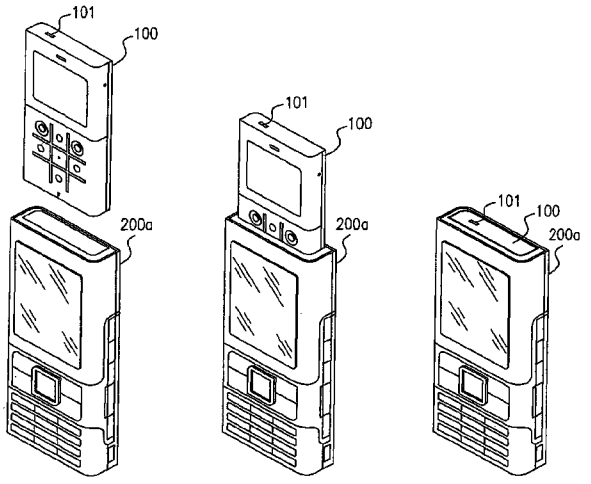
*Primary Examiner* — Nhan Le
(74) *Attorney, Agent, or Firm* — Soquel Group LLC

(57) **ABSTRACT**

A wireless communicator including a housing, wireless communication functionality located within the housing, and pouching responsive electrical interconnection functionality responsive to pouching orientation of the housing in a pouch of an enhanced function device for causing the wireless communication functionality to authenticate itself to the enhanced function device by (i) generating a random number, A, (ii) encrypting A using a public key of the enhanced function device, (iii) transmitting the encrypted A to the enhanced function device, (iv) receiving an encrypted number, B, from the enhanced function device, encrypted using a public key of the wireless communicator, (iv) decrypting B using a private key of the wireless communicator, (v) encrypting the product A*B using the public key of the enhanced function device, and (vi) transmitting the encrypted A*B to the enhanced function device.

**4 Claims, 80 Drawing Sheets**



**Related U.S. Application Data**

continuation of application No. 12/525,820, filed as application No. PCT/IL2008/000164 on Feb. 6, 2008, now Pat. No. 8,180,395.

(60) Provisional application No. 60/901,353, filed on Feb. 13, 2007, provisional application No. 60/901,368, filed on Feb. 13, 2007, provisional application No. 60/918,943, filed on Mar. 20, 2007, provisional application No. 60/918,966, filed on Mar. 20, 2007, provisional application No. 60/918,967, filed on Mar. 20, 2007, provisional application No. 60/918,968, filed on Mar. 20, 2007, provisional application No. 60/919,112, filed on Mar. 20, 2007, provisional application No. 60/919,243, filed on Mar. 21, 2007, provisional application No. 60/920,037, filed on Mar. 26, 2007, provisional application No. 60/933,780, filed on Jun. 8, 2007, provisional application No. 60/933,792, filed on Jun. 8, 2007, provisional application No. 60/933,793, filed on Jun. 8, 2007, provisional application No. 60/964,233, filed on Aug. 9, 2007, provisional application No. 60/964,872, filed on Aug. 14, 2007, provisional application No. 60/995,575, filed on Sep. 26, 2007, provisional application No. 61/009,523, filed on Dec. 28, 2007, provisional application No. 61/062,171, filed on Jan. 23, 2008, provisional application No. 61/063,668, filed on Feb. 5, 2008.

(51) **Int. Cl.**

| | |
|---|---|
| ***H04M 3/16*** | (2006.01) |
| ***H04W 12/06*** | (2009.01) |
| ***H04M 1/21*** | (2006.01) |
| ***H04M 1/02*** | (2006.01) |
| ***H04M 1/725*** | (2006.01) |
| ***H04L 9/32*** | (2006.01) |

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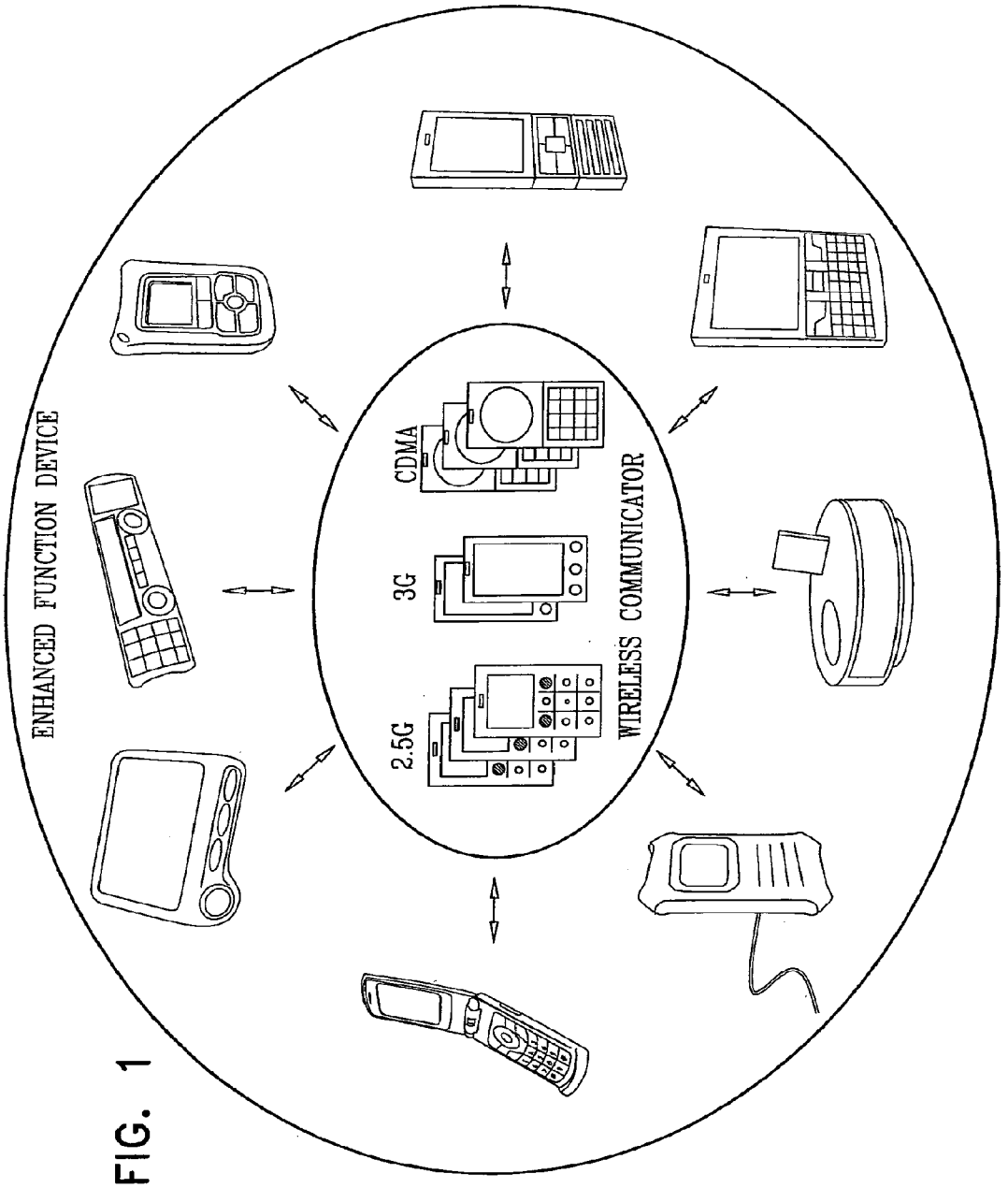
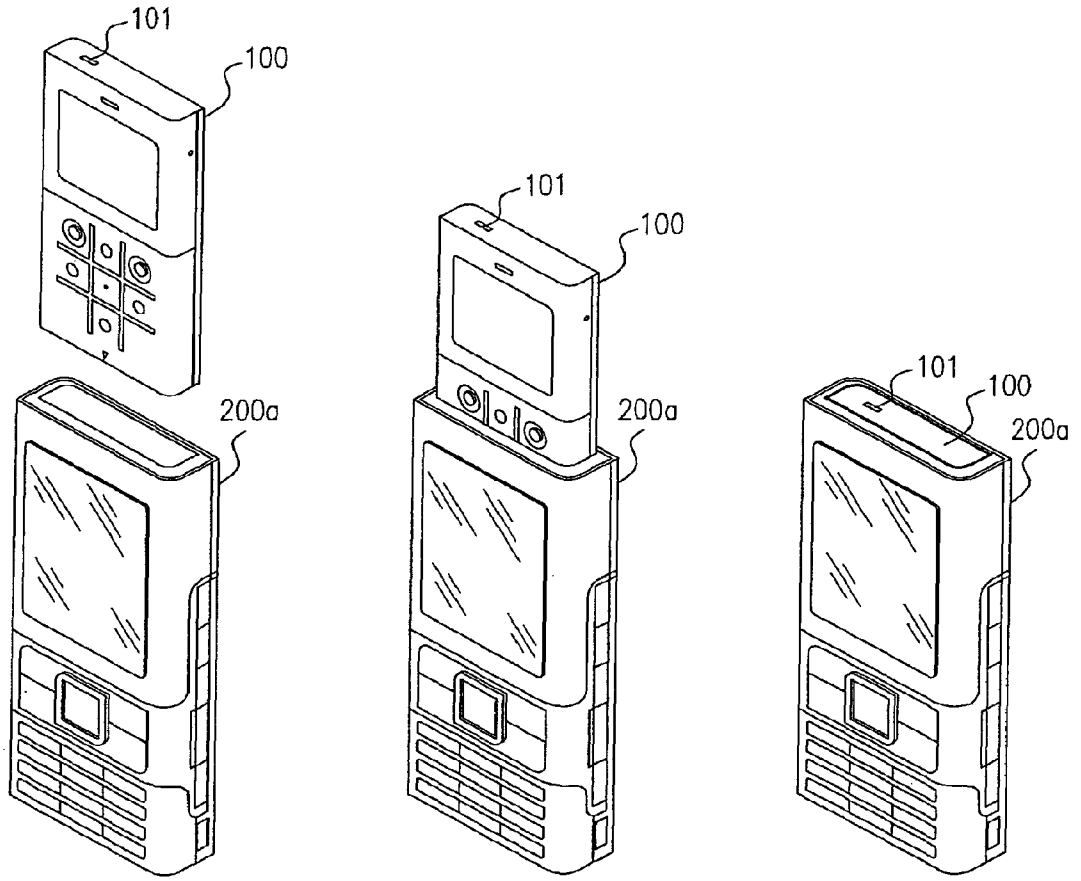

ENHANCED FUNCTION DEVICE
CDMA
3G
2.5G
WIRELESS COMMUNICATOR

FIG. 1

FIG. 2A



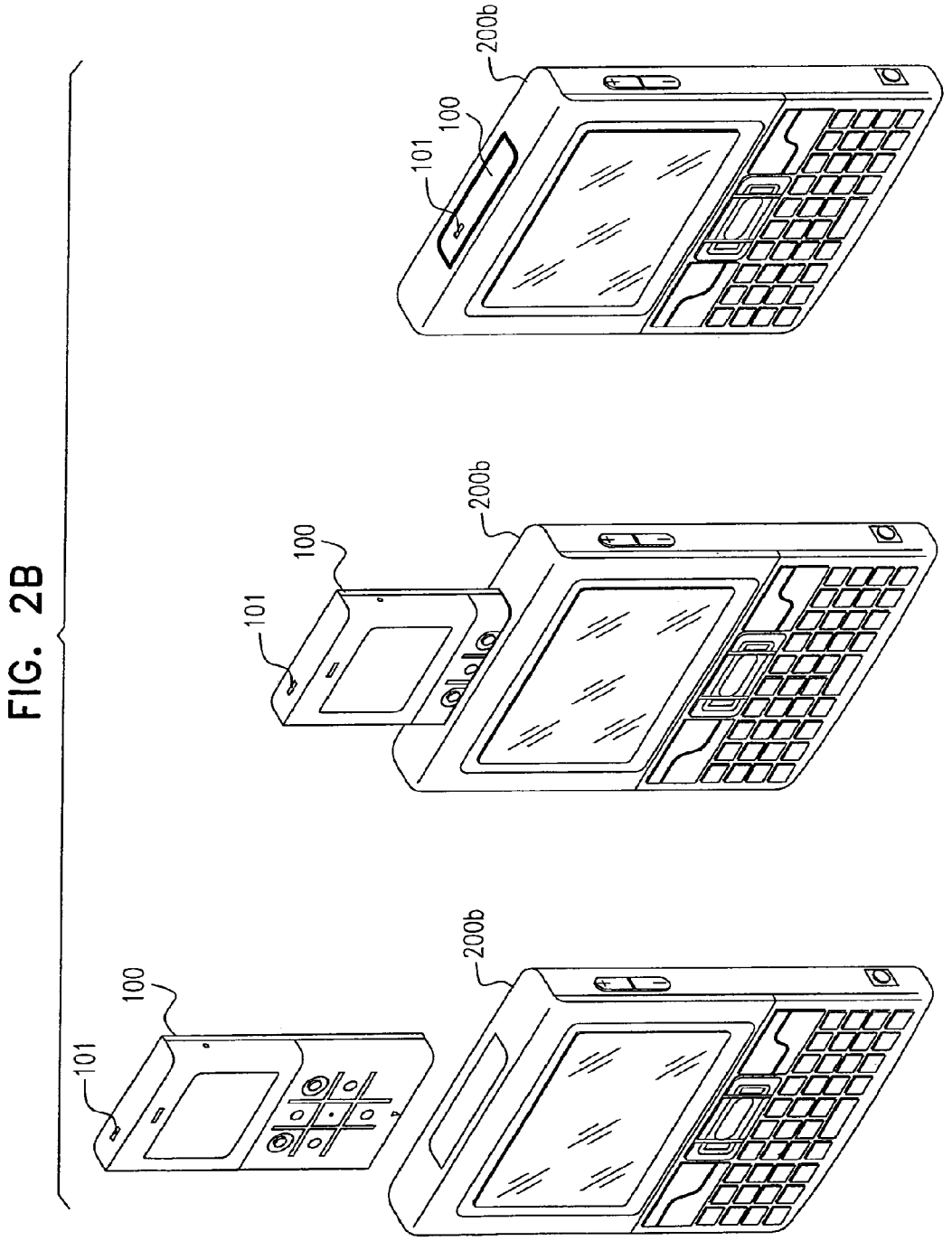



FIG. 2B

FIG. 3A

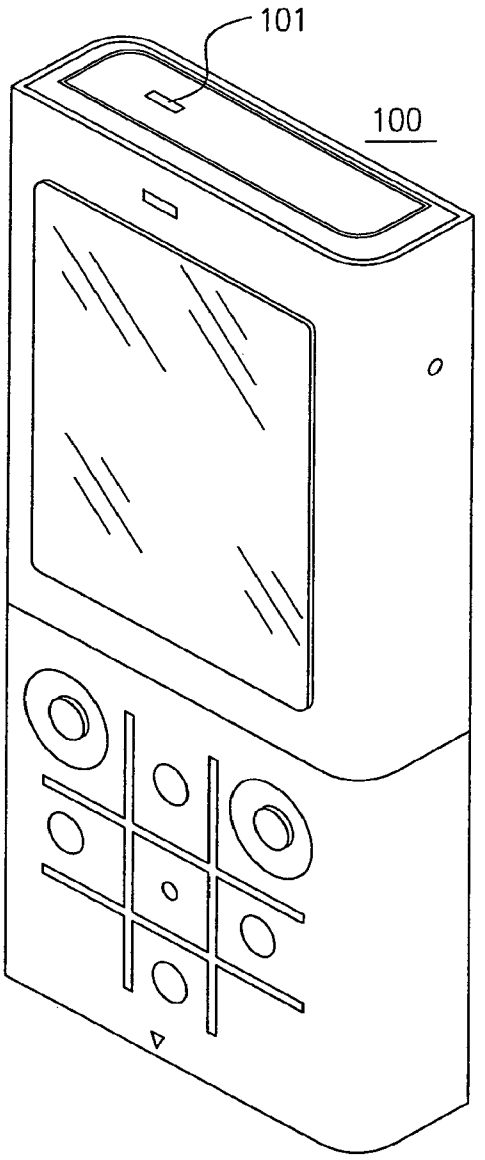


FIG. 3B

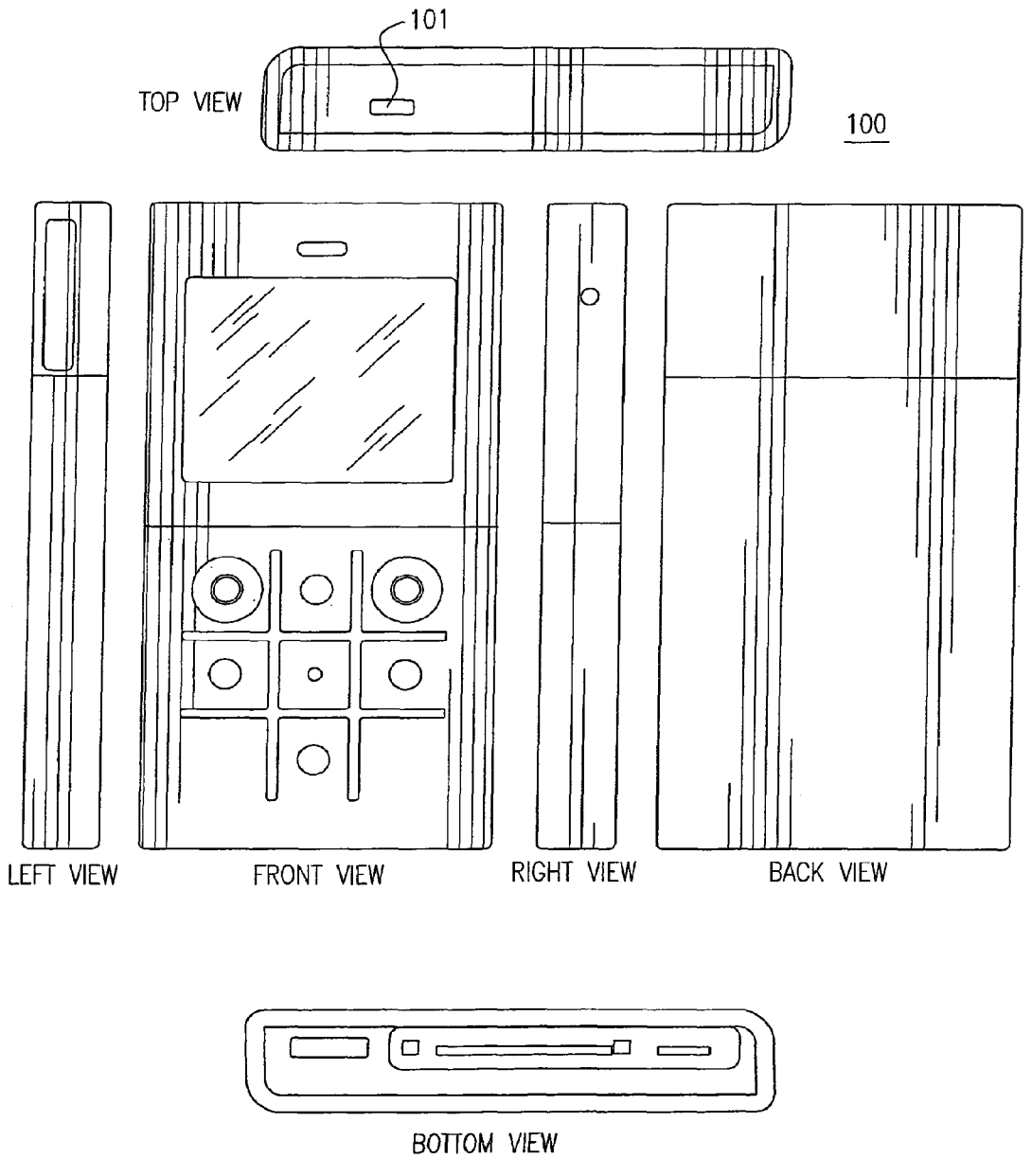

101
TOP VIEW
100
LEFT VIEW
FRONT VIEW
RIGHT VIEW
BACK VIEW
BOTTOM VIEW

FIG. 4A

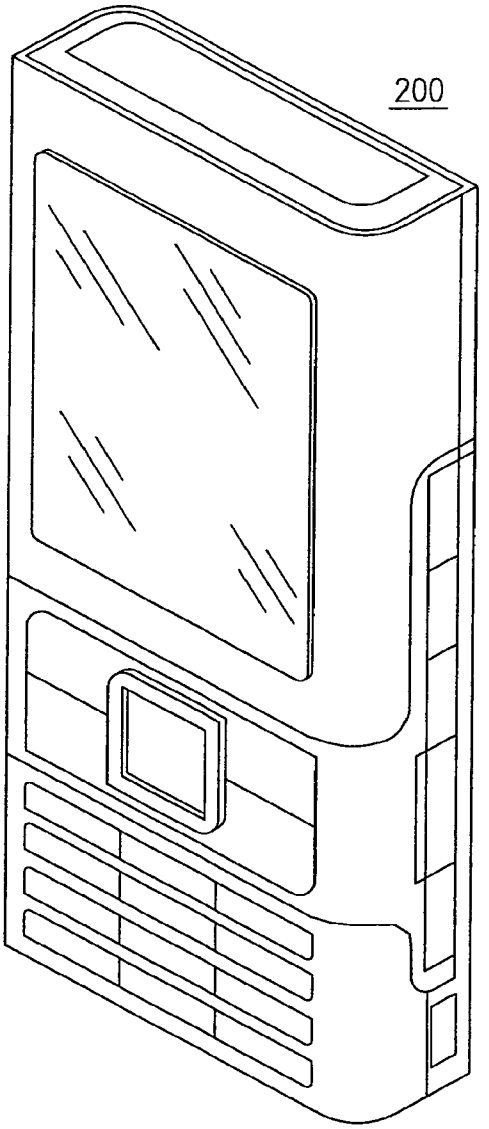
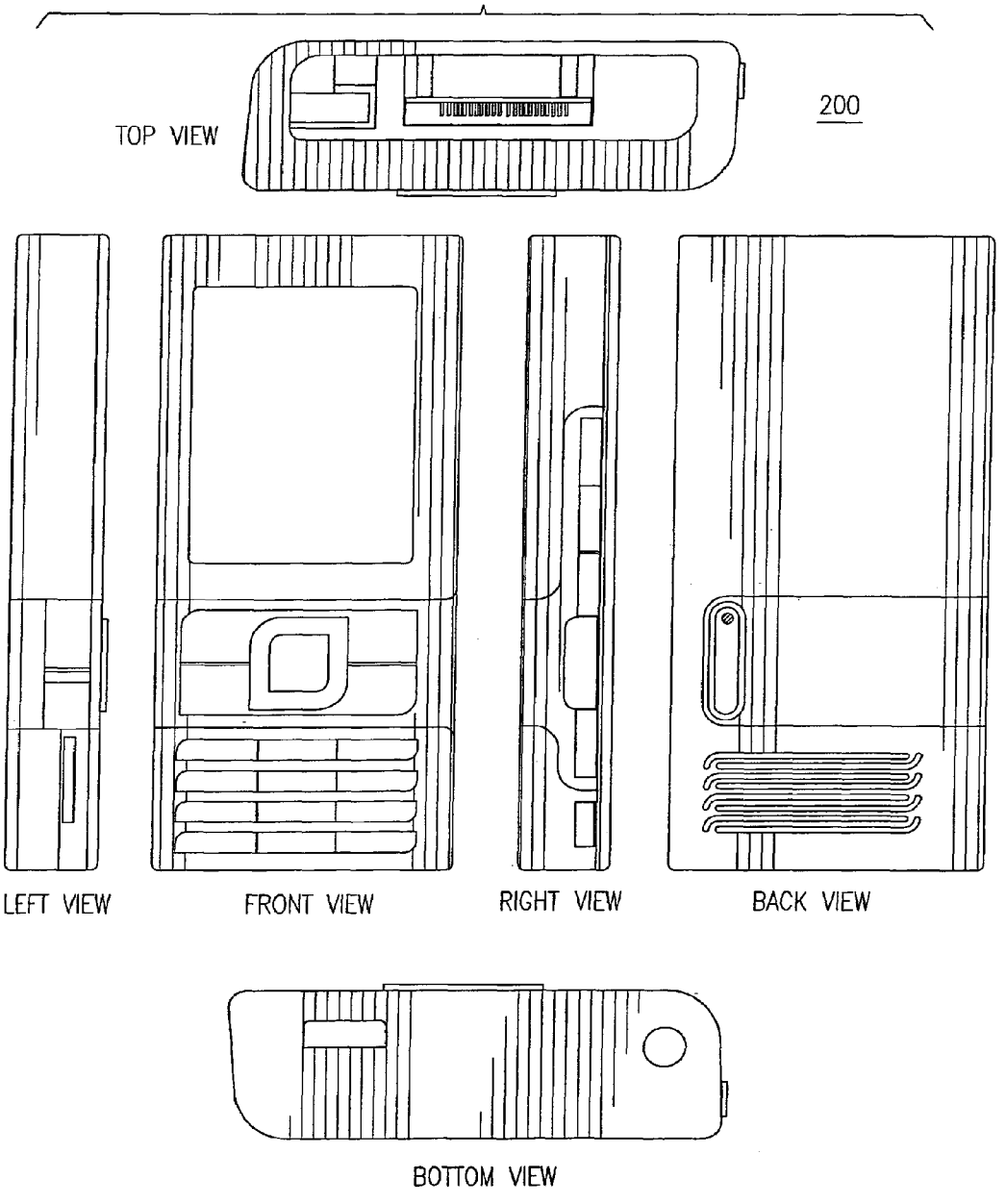


FIG. 4B


TOP VIEW
200
LEFT VIEW
FRONT VIEW
RIGHT VIEW
BACK VIEW
BOTTOM VIEW

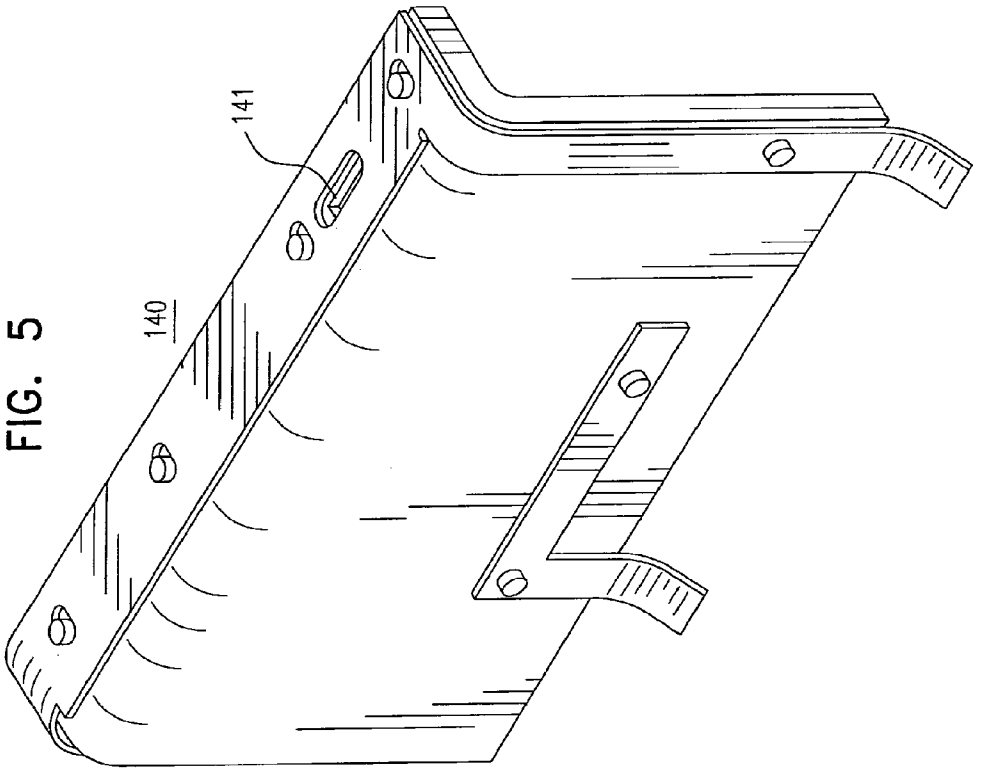



FIG. 5

FIG. 6

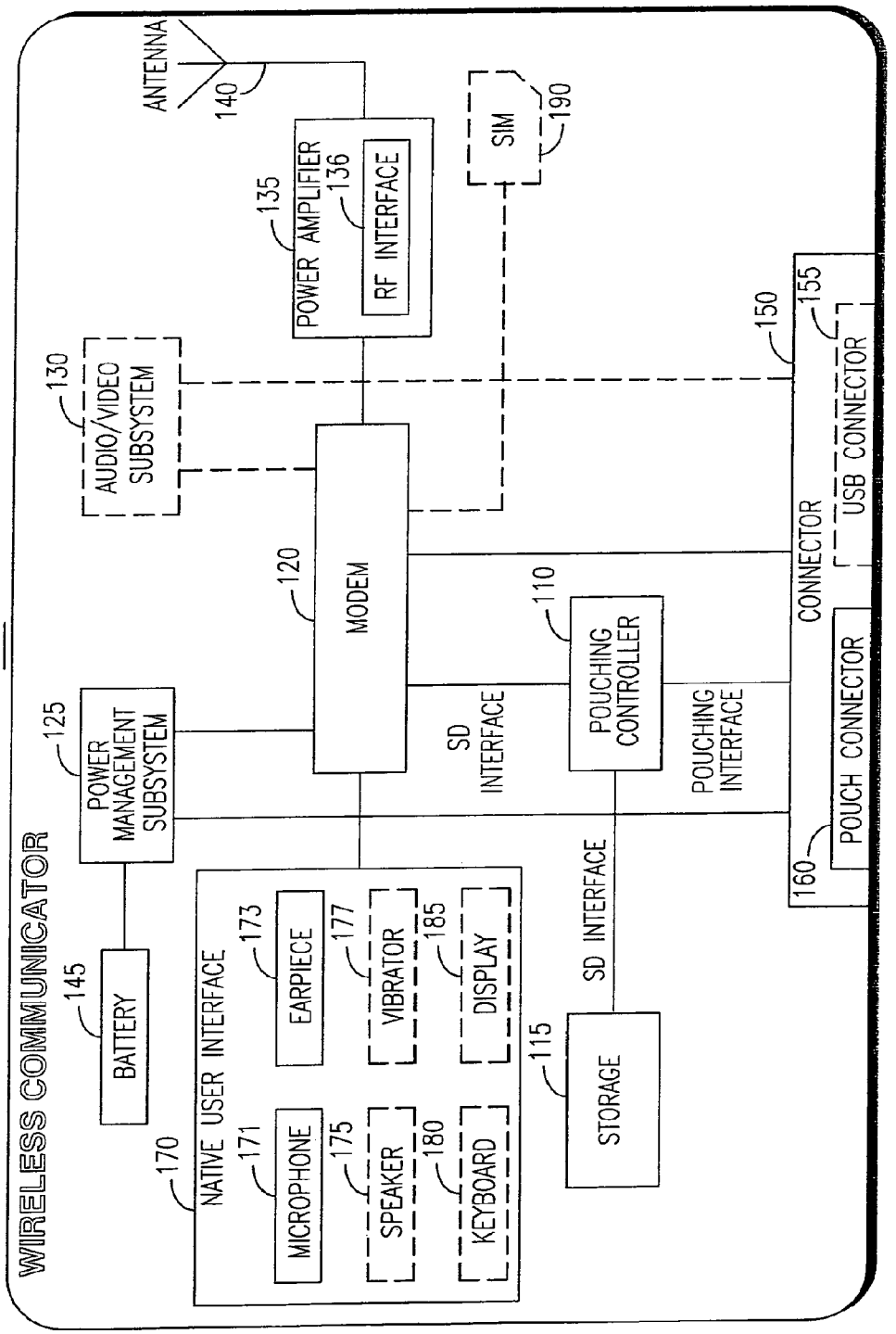

100
WIRELESS COMMUNICATOR
ANTENNA
140
POWER AMPLIFIER
135
RF INTERFACE
136
SIM
190
AUDIO/VIDEO SUBSYSTEM
130
MODEM
120
POWER MANAGEMENT SUBSYSTEM
125
SD INTERFACE
POUCHING CONTROLLER
110
POUCHING INTERFACE
150
CONNECTOR
155
USB CONNECTOR
POUCH CONNECTOR
160
BATTERY
145
NATIVE USER INTERFACE
170
MICROPHONE
171
SPEAKER
175
KEYBOARD
180
EARPIECE
173
VIBRATOR
177
DISPLAY
185
SD INTERFACE
STORAGE
115

FIG. 7A

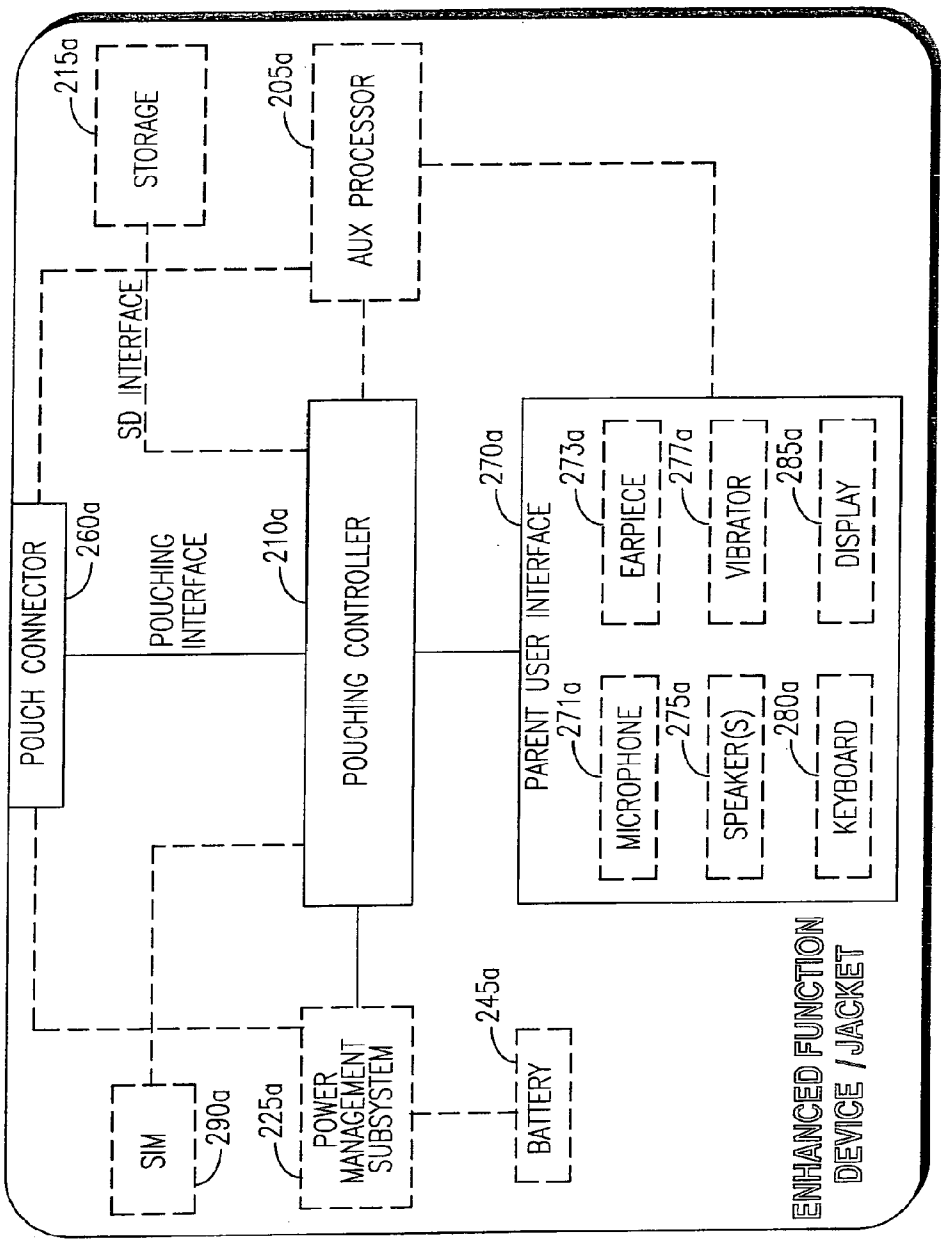

ENHANCED FUNCTION DEVICE / JACKET
POUCH CONNECTOR
260a
POUCHING INTERFACE
210a
POUCHING CONTROLLER
SD INTERFACE
STORAGE
215a
AUX PROCESSOR
205a
PARENT USER INTERFACE
270a
MICROPHONE
271a
EARPIECE
273a
SPEAKER(S)
275a
VIBRATOR
277a
KEYBOARD
280a
DISPLAY
285a
SIM
290a
POWER MANAGEMENT SUBSYSTEM
225a
BATTERY
245a
200a

FIG. 7B

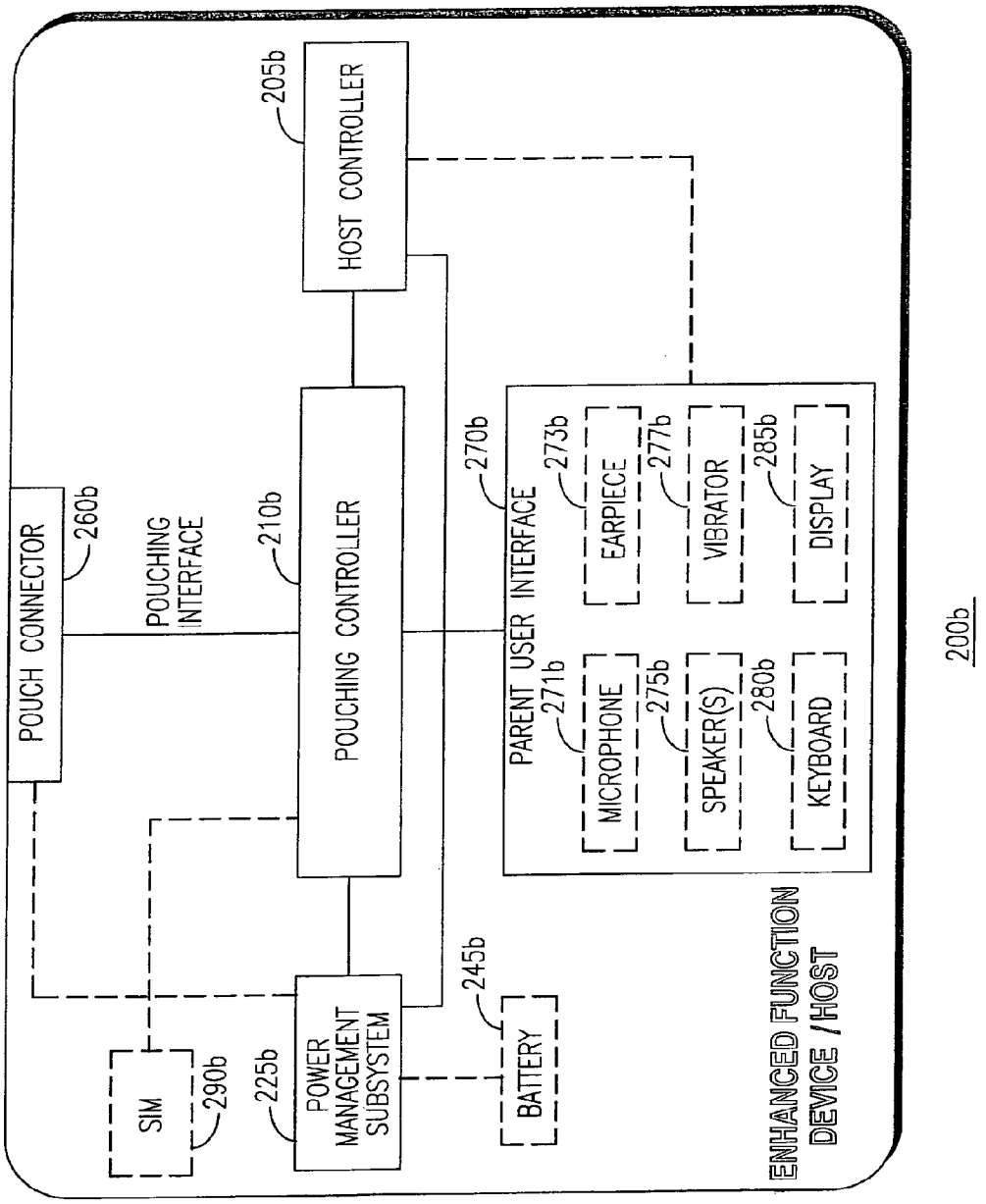

ENHANCED FUNCTION DEVICE / HOST
200b
HOST CONTROLLER
205b
POUCH CONNECTOR
260b
POUCHING INTERFACE
210b
POUCHING CONTROLLER
270b
PARENT USER INTERFACE
273b
EARPIECE
277b
VIBRATOR
285b
DISPLAY
271b
MICROPHONE
275b
SPEAKER(S)
280b
KEYBOARD
SIM
290b
225b
POWER MANAGEMENT SUBSYSTEM
245b
BATTERY

FIG. 8A

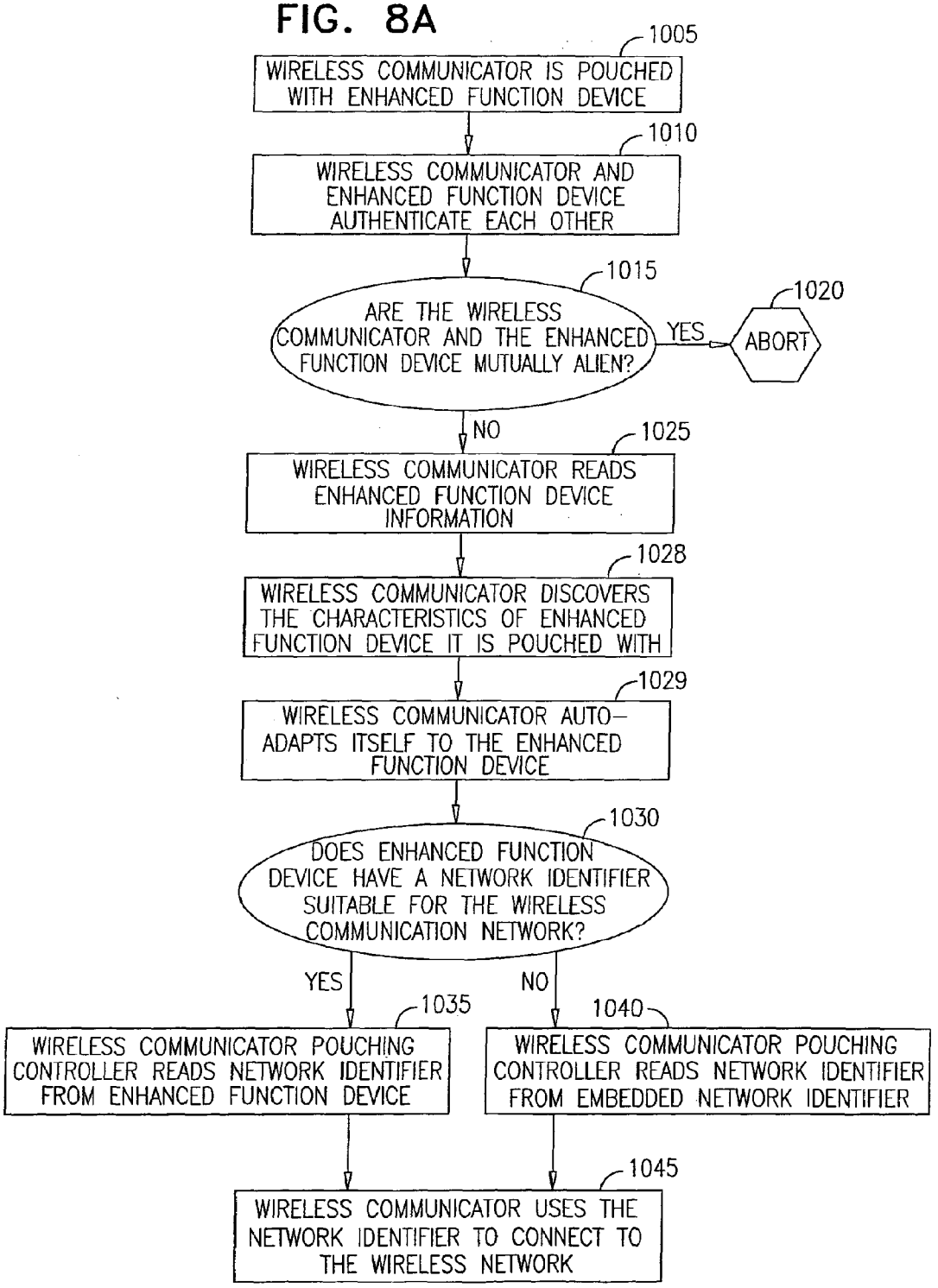

1005
WIRELESS COMMUNICATOR IS POUCHED WITH ENHANCED FUNCTION DEVICE
1010
WIRELESS COMMUNICATOR AND ENHANCED FUNCTION DEVICE AUTHENTICATE EACH OTHER
1015
ARE THE WIRELESS COMMUNICATOR AND THE ENHANCED FUNCTION DEVICE MUTUALLY ALIEN?
YES
1020
ABORT
NO
1025
WIRELESS COMMUNICATOR READS ENHANCED FUNCTION DEVICE INFORMATION
1028
WIRELESS COMMUNICATOR DISCOVERS THE CHARACTERISTICS OF ENHANCED FUNCTION DEVICE IT IS POUCHED WITH
1029
WIRELESS COMMUNICATOR AUTO-ADAPTS ITSELF TO THE ENHANCED FUNCTION DEVICE
1030
DOES ENHANCED FUNCTION DEVICE HAVE A NETWORK IDENTIFIER SUITABLE FOR THE WIRELESS COMMUNICATION NETWORK?
YES
NO
1035
WIRELESS COMMUNICATOR POUCHING CONTROLLER READS NETWORK IDENTIFIER FROM ENHANCED FUNCTION DEVICE
1040
WIRELESS COMMUNICATOR POUCHING CONTROLLER READS NETWORK IDENTIFIER FROM EMBEDDED NETWORK IDENTIFIER
1045
WIRELESS COMMUNICATOR USES THE NETWORK IDENTIFIER TO CONNECT TO THE WIRELESS NETWORK

FIG. 8B

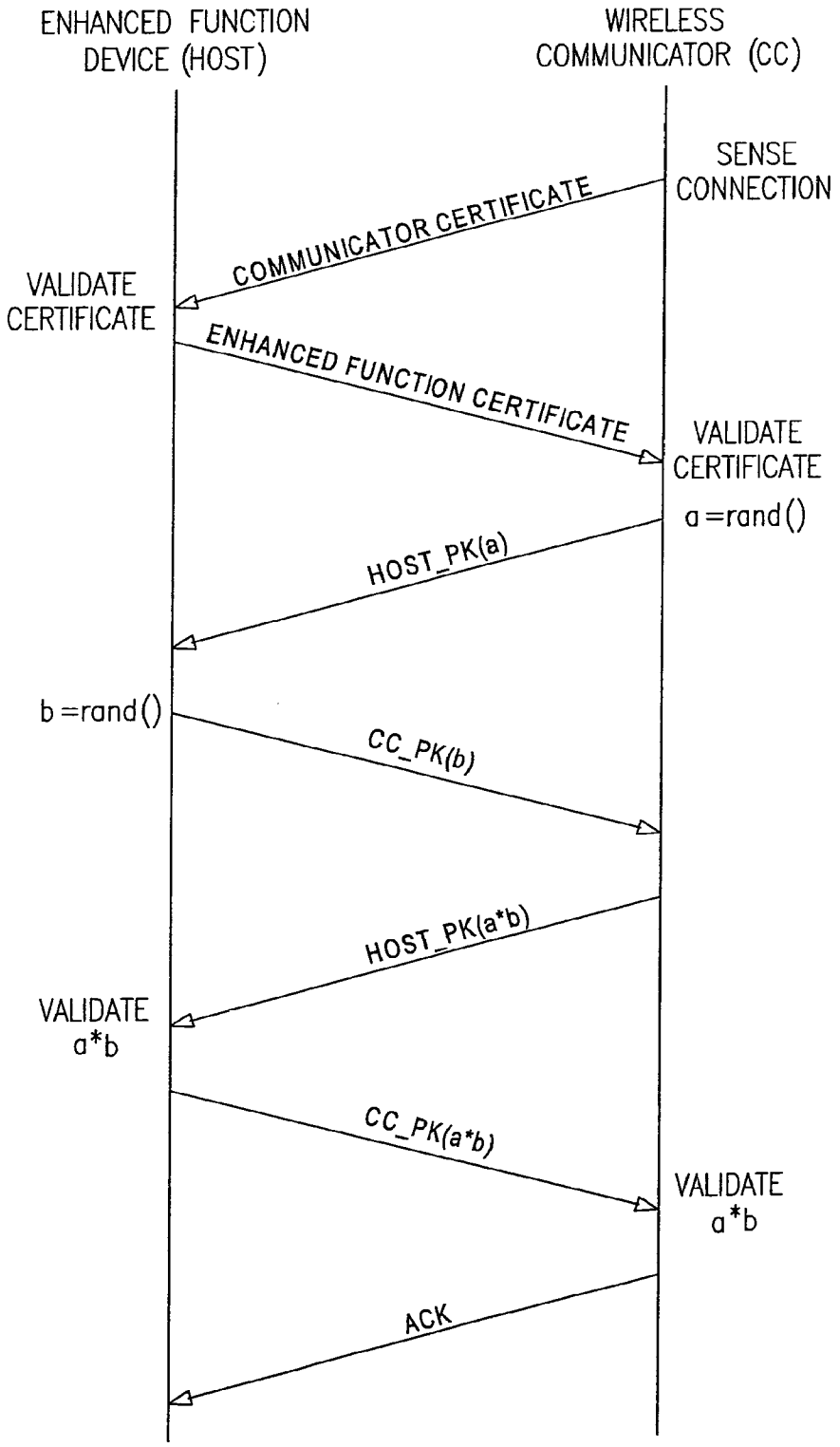
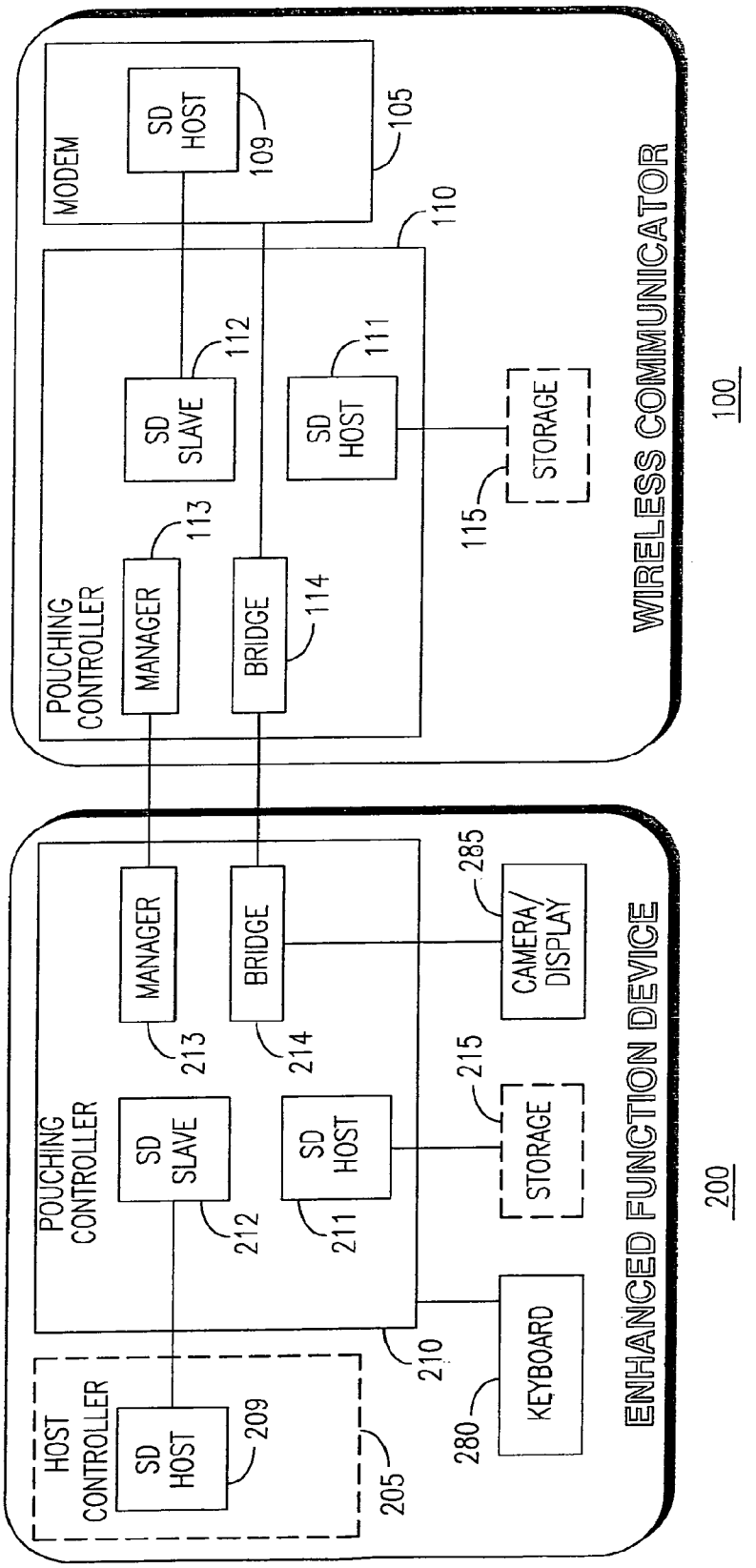

ENHANCED FUNCTION DEVICE (HOST)
WIRELESS COMMUNICATOR (CC)
SENSE CONNECTION
COMMUNICATOR CERTIFICATE
VALIDATE CERTIFICATE
ENHANCED FUNCTION CERTIFICATE
VALIDATE CERTIFICATE
a =rand()
HOST_PK(a)
b =rand()
CC_PK(b)
HOST_PK(a*b)
VALIDATE a*b
CC_PK(a*b)
VALIDATE a*b
ACK

FIG. 9


WIRELESS COMMUNICATOR
100
MODEM
SD HOST
109
105
110
POUCHING CONTROLLER
MANAGER
113
BRIDGE
114
SD SLAVE
112
SD HOST
111
115
STORAGE
ENHANCED FUNCTION DEVICE
200
MANAGER
213
BRIDGE
214
285
CAMERA/ DISPLAY
POUCHING CONTROLLER
SD SLAVE
212
SD HOST
211
215
STORAGE
210
HOST CONTROLLER
SD HOST
209
205
280
KEYBOARD

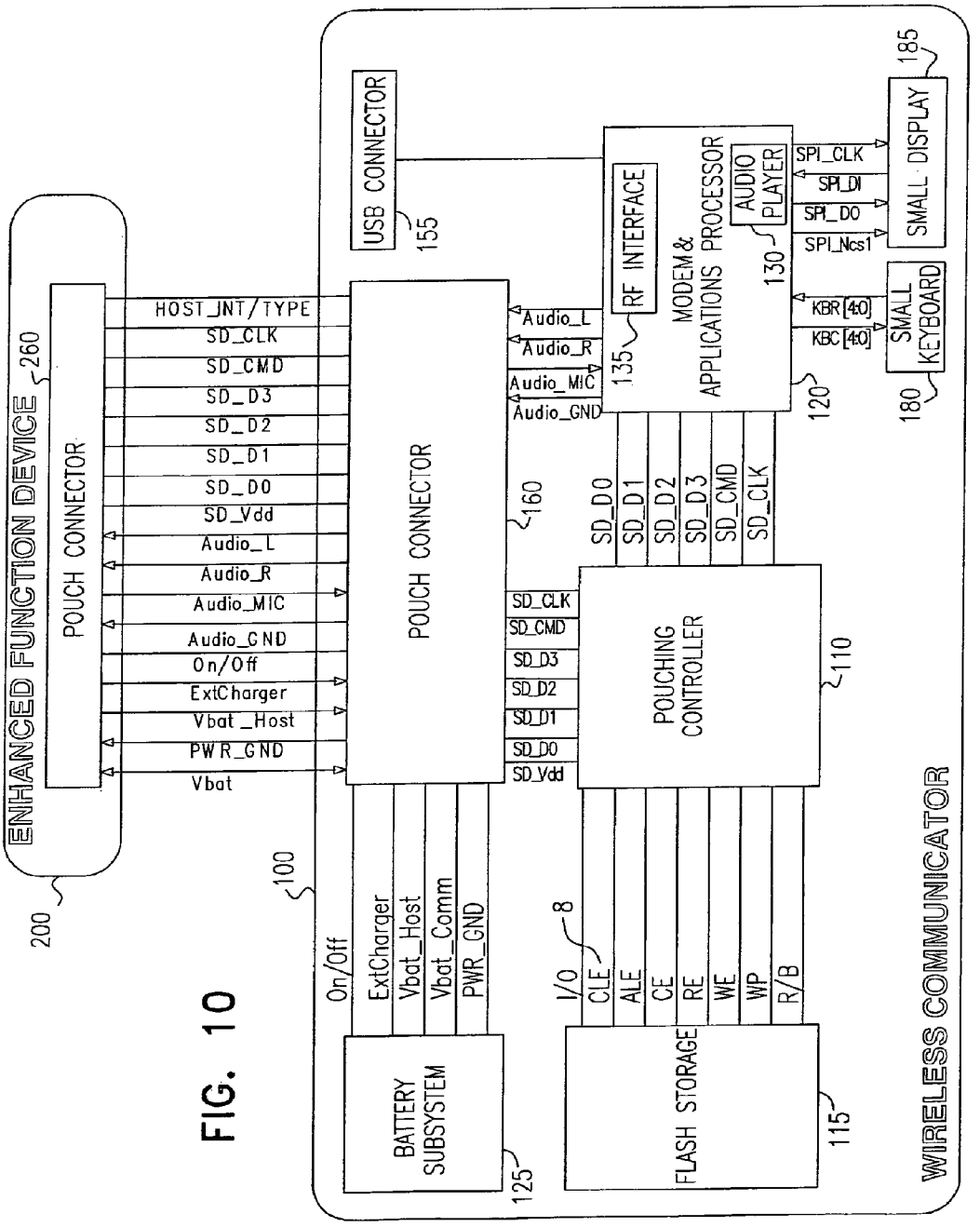

ENHANCED FUNCTION DEVICE
200
260
POUCH CONNECTOR
HOST_INT/TYPE
SD_CLK
SD_CMD
SD_D3
SD_D2
SD_D1
SD_D0
SD_Vdd
Audio_L
Audio_R
Audio_MIC
Audio_GND
On/Off
ExtCharger
Vbat_Host
PWR_GND
Vbat
100
WIRELESS COMMUNICATOR
USB CONNECTOR
155
POUCH CONNECTOR
160
Audio_L
Audio_R
Audio_MIC
Audio_GND
RF INTERFACE
135
MODEM & APPLICATIONS PROCESSOR
120
AUDIO PLAYER
130
SPI_CLK
SPI_DI
SPI_DO
SPI_Ncs1
SMALL DISPLAY
185
KBR[4:0]
KBC[4:0]
SMALL KEYBOARD
180
SD_D0
SD_D1
SD_D2
SD_D3
SD_CMD
SD_CLK
POUCHING CONTROLLER
110
SD_CLK
SD_CMD
SD_D3
SD_D2
SD_D1
SD_D0
SD_Vdd
On/Off
ExtCharger
Vbat_Host
Vbat_Comm
PWR_GND
BATTERY SUBSYSTEM
125
I/O
8
CLE
ALE
CE
RE
WE
WP
R/B
FLASH STORAGE
115

FIG. 10

FIG. 11

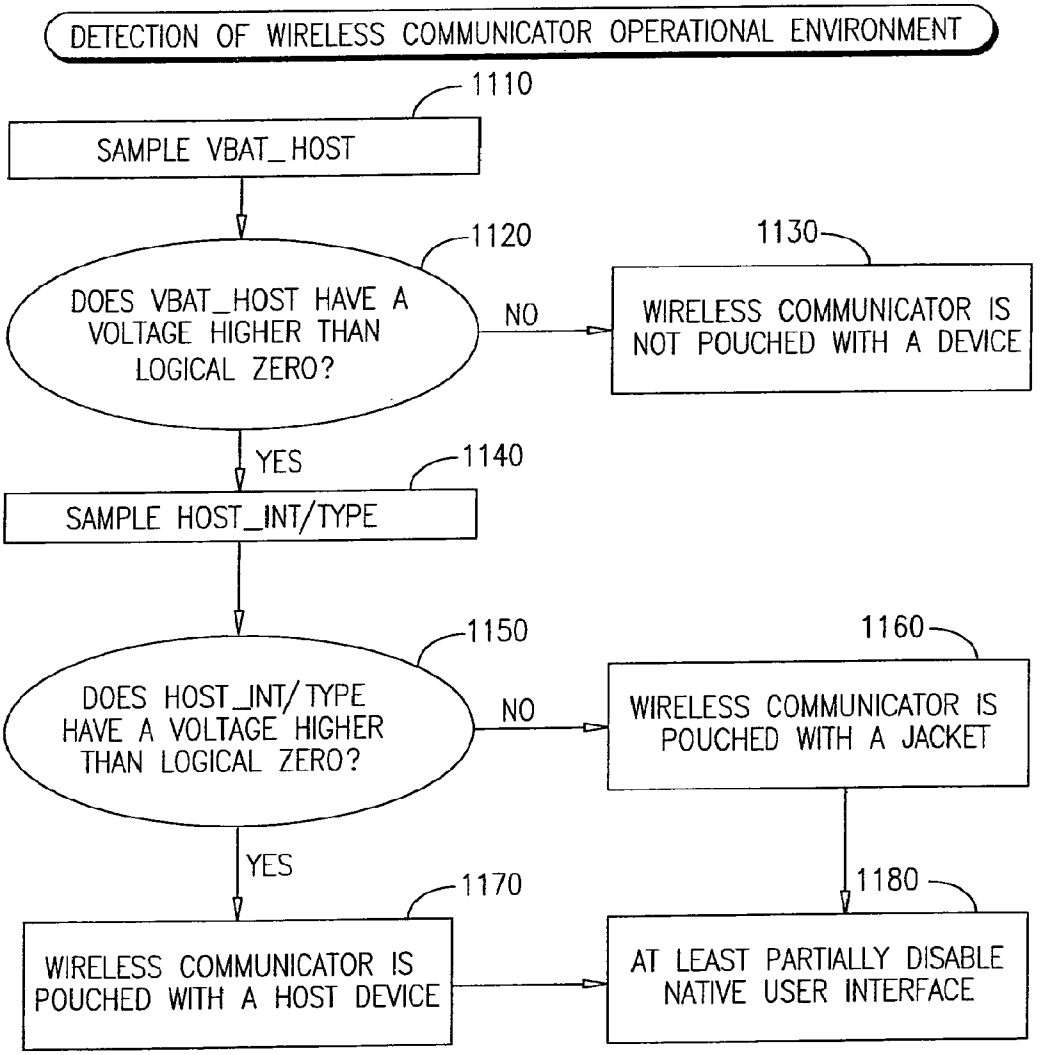

DETECTION OF WIRELESS COMMUNICATOR OPERATIONAL ENVIRONMENT
1110
SAMPLE VBAT_HOST
1120
DOES VBAT_HOST HAVE A VOLTAGE HIGHER THAN LOGICAL ZERO?
NO
1130
WIRELESS COMMUNICATOR IS NOT POUCHED WITH A DEVICE
YES
1140
SAMPLE HOST_INT/TYPE
1150
DOES HOST_INT/TYPE HAVE A VOLTAGE HIGHER THAN LOGICAL ZERO?
NO
1160
WIRELESS COMMUNICATOR IS POUCHED WITH A JACKET
YES
1170
WIRELESS COMMUNICATOR IS POUCHED WITH A HOST DEVICE
1180
AT LEAST PARTIALLY DISABLE NATIVE USER INTERFACE

FIG. 12

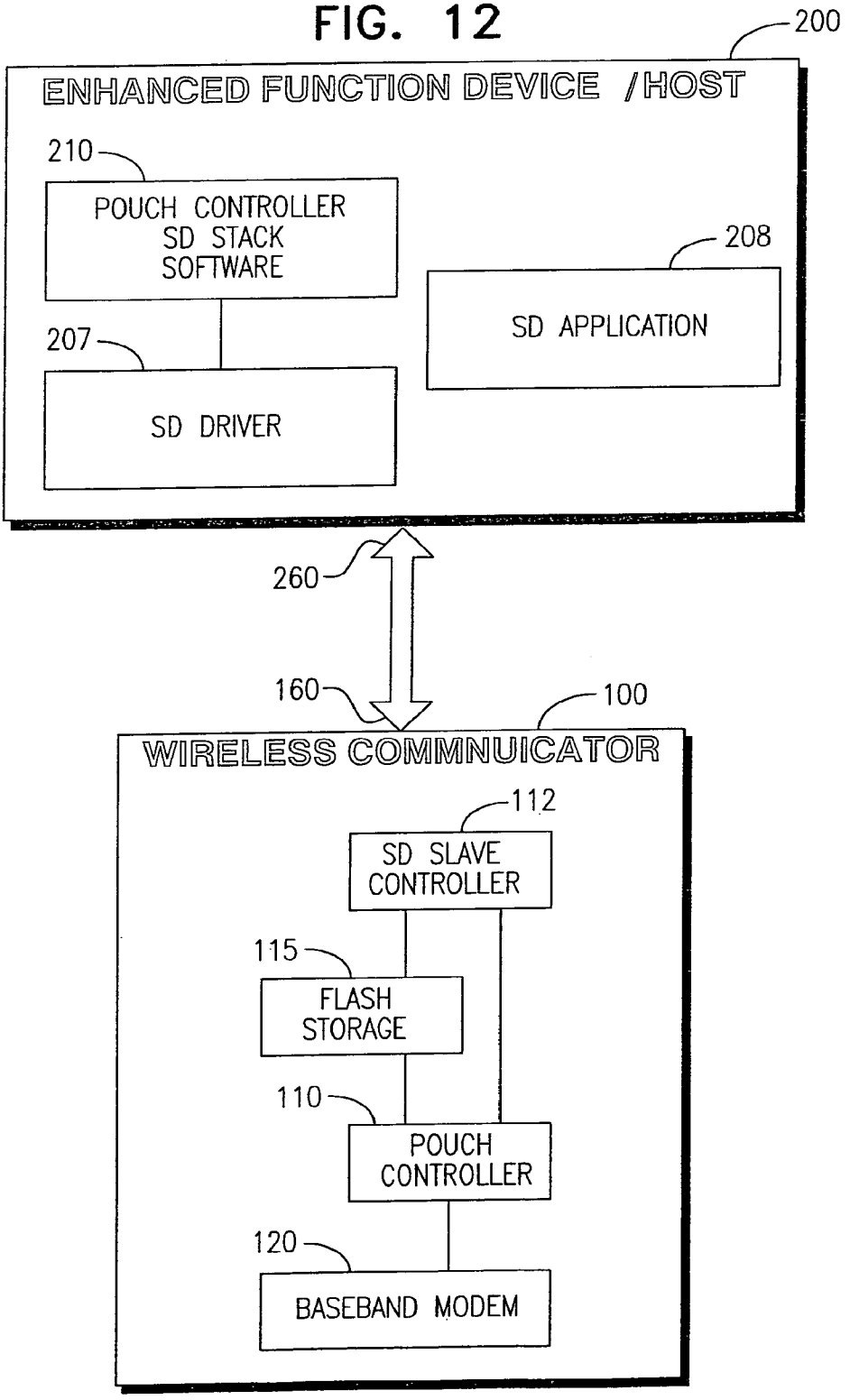
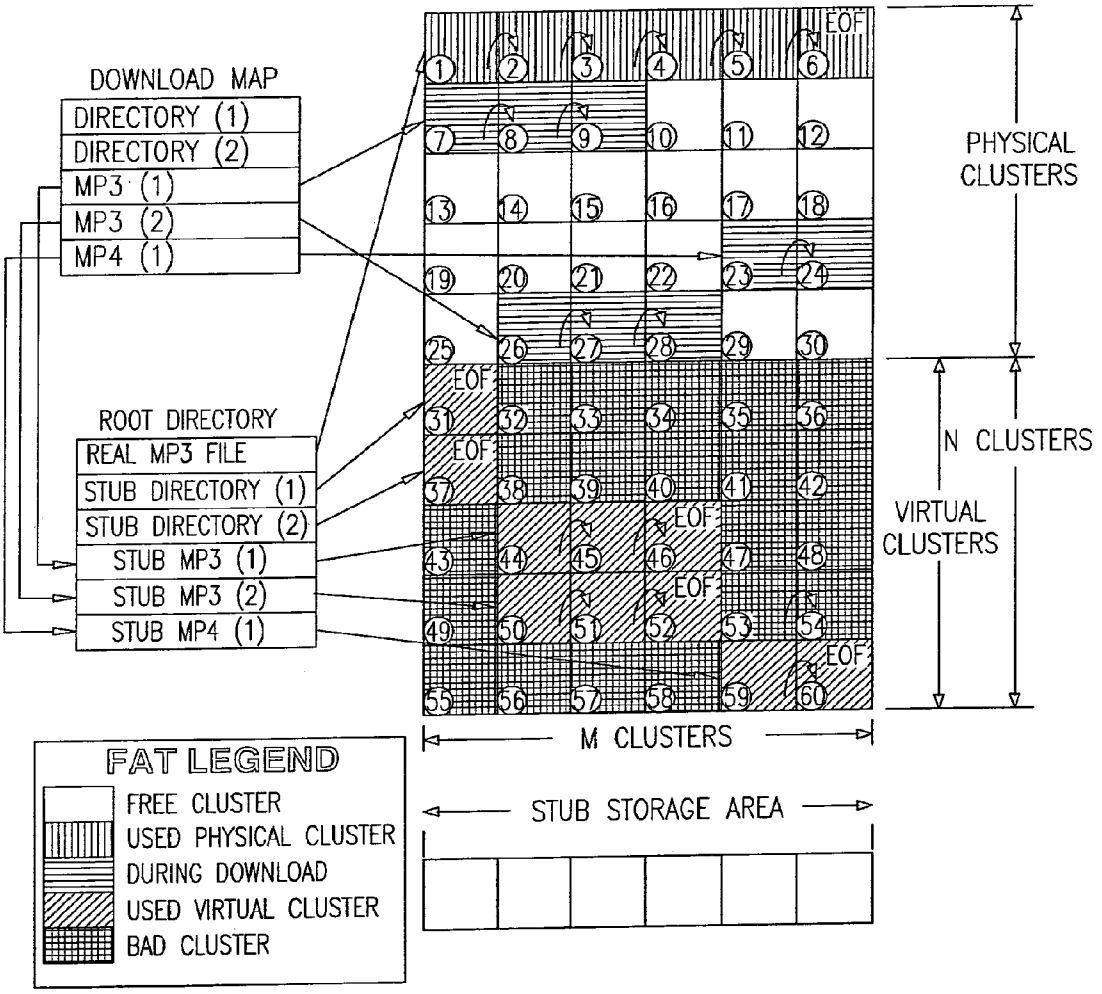

200
ENHANCED FUNCTION DEVICE /HOST
210
POUCH CONTROLLER SD STACK SOFTWARE
208
SD APPLICATION
207
SD DRIVER
260
160
100
WIRELESS COMMNUICATOR
112
SD SLAVE CONTROLLER
115
FLASH STORAGE
110
POUCH CONTROLLER
120
BASEBAND MODEM

FIG. 13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DIRECTORY (1)
DIRECTORY (2)
MP3 (1)
MP3 (2)
MP4 (1)
ROOT DIRECTORY
REAL MP3 FILE
STUB DIRECTORY (1)
STUB DIRECTORY (2)
STUB MP3 (1)
STUB MP3 (2)
STUB MP4 (1)
PHYSICAL CLUSTERS
N CLUSTERS
VIRTUAL CLUSTERS
M CLUSTERS
STUB STORAGE AREA
FAT LEGEND
FREE CLUSTER
USED PHYSICAL CLUSTER
DURING DOWNLOAD
USED VIRTUAL CLUSTER
BAD CLUSTER
EOF

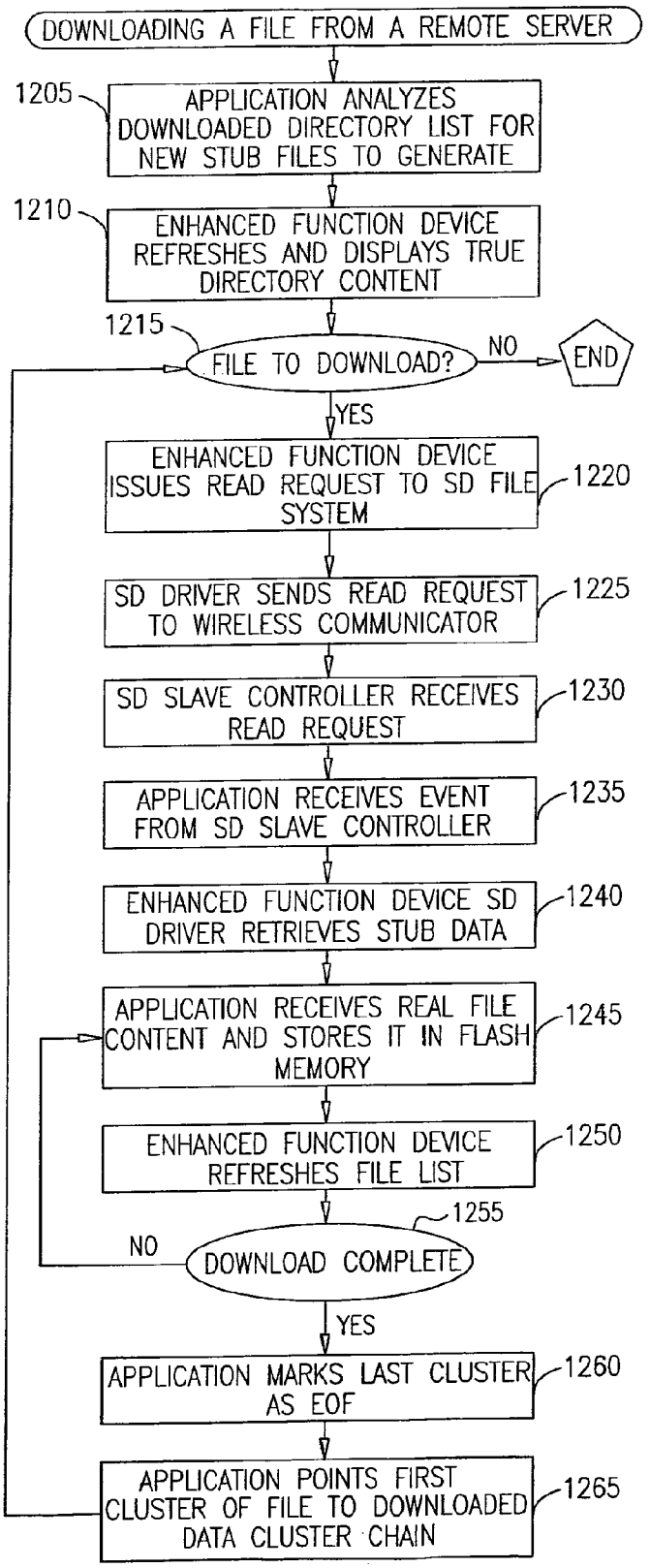

DOWNLOADING A FILE FROM A REMOTE SERVER
1205
APPLICATION ANALYZES DOWNLOADED DIRECTORY LIST FOR NEW STUB FILES TO GENERATE
1210
ENHANCED FUNCTION DEVICE REFRESHES AND DISPLAYS TRUE DIRECTORY CONTENT
1215
FILE TO DOWNLOAD?
NO
END
YES
ENHANCED FUNCTION DEVICE ISSUES READ REQUEST TO SD FILE SYSTEM
1220
SD DRIVER SENDS READ REQUEST TO WIRELESS COMMUNICATOR
1225
SD SLAVE CONTROLLER RECEIVES READ REQUEST
1230
APPLICATION RECEIVES EVENT FROM SD SLAVE CONTROLLER
1235
ENHANCED FUNCTION DEVICE SD DRIVER RETRIEVES STUB DATA
1240
APPLICATION RECEIVES REAL FILE CONTENT AND STORES IT IN FLASH MEMORY
1245
ENHANCED FUNCTION DEVICE REFRESHES FILE LIST
1250
1255
NO
DOWNLOAD COMPLETE
YES
APPLICATION MARKS LAST CLUSTER AS EOF
1260
APPLICATION POINTS FIRST CLUSTER OF FILE TO DOWNLOADED DATA CLUSTER CHAIN
1265

FIG. 14

FIG. 15A

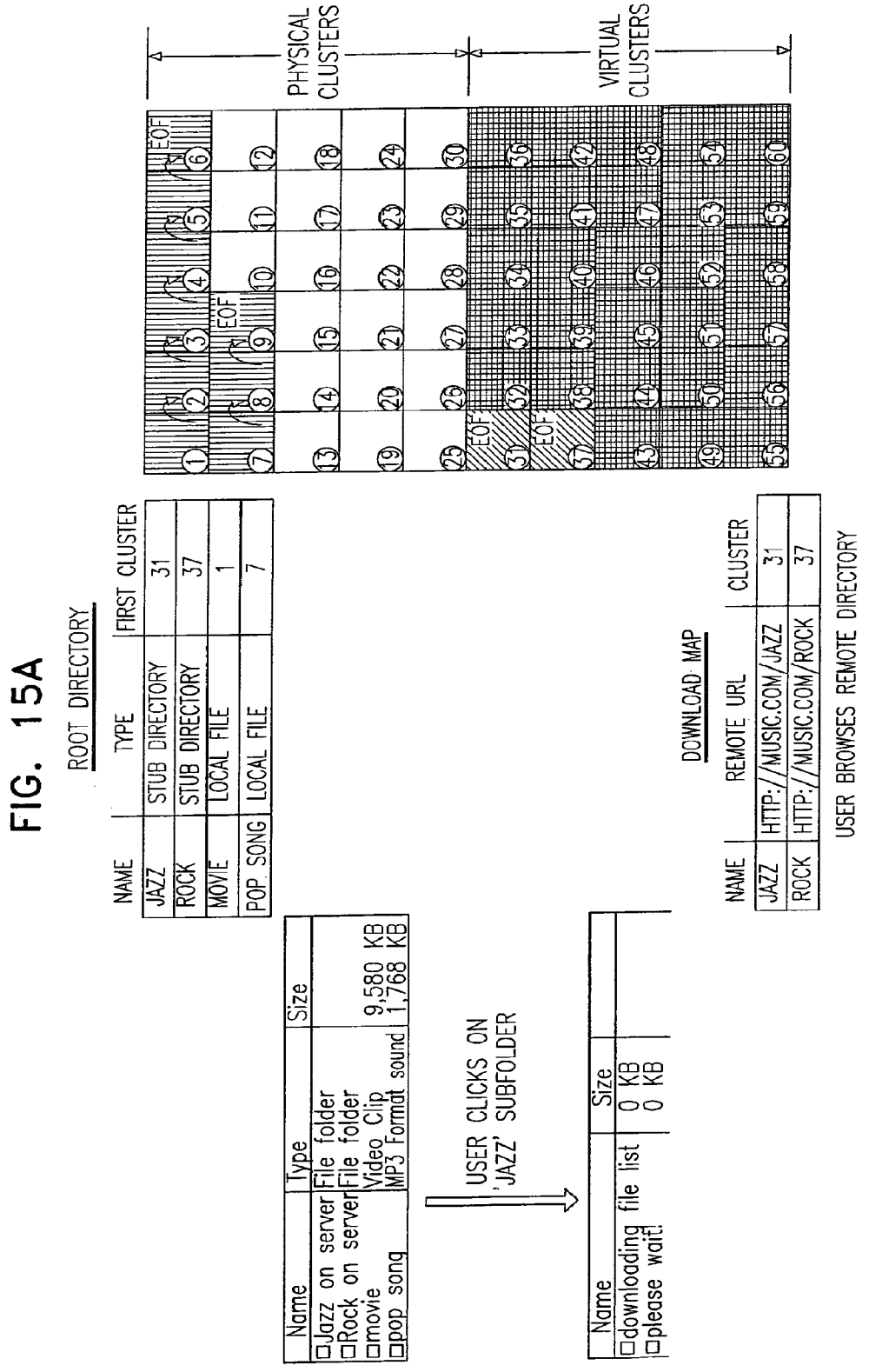

ROOT DIRECTORY
NAME | TYPE | FIRST CLUSTER
JAZZ | STUB DIRECTORY | 31
ROCK | STUB DIRECTORY | 37
MOVIE | LOCAL FILE | 1
POP SONG | LOCAL FILE | 7
PHYSICAL CLUSTERS
VIRTUAL CLUSTERS
EOF
Name | Type | Size
Jazz on server | File folder
Rock on server | File folder
movie | Video Clip | 9,580 KB
pop song | MP3 Format sound | 1,768 KB
USER CLICKS ON 'JAZZ' SUBFOLDER
Name | Size
downloading file list | 0 KB
please wait! | 0 KB
DOWNLOAD MAP
NAME | REMOTE URL | CLUSTER
JAZZ | HTTP://MUSIC.COM/JAZZ | 31
ROCK | HTTP://MUSIC.COM/ROCK | 37
USER BROWSES REMOTE DIRECTORY

FIG. 15B

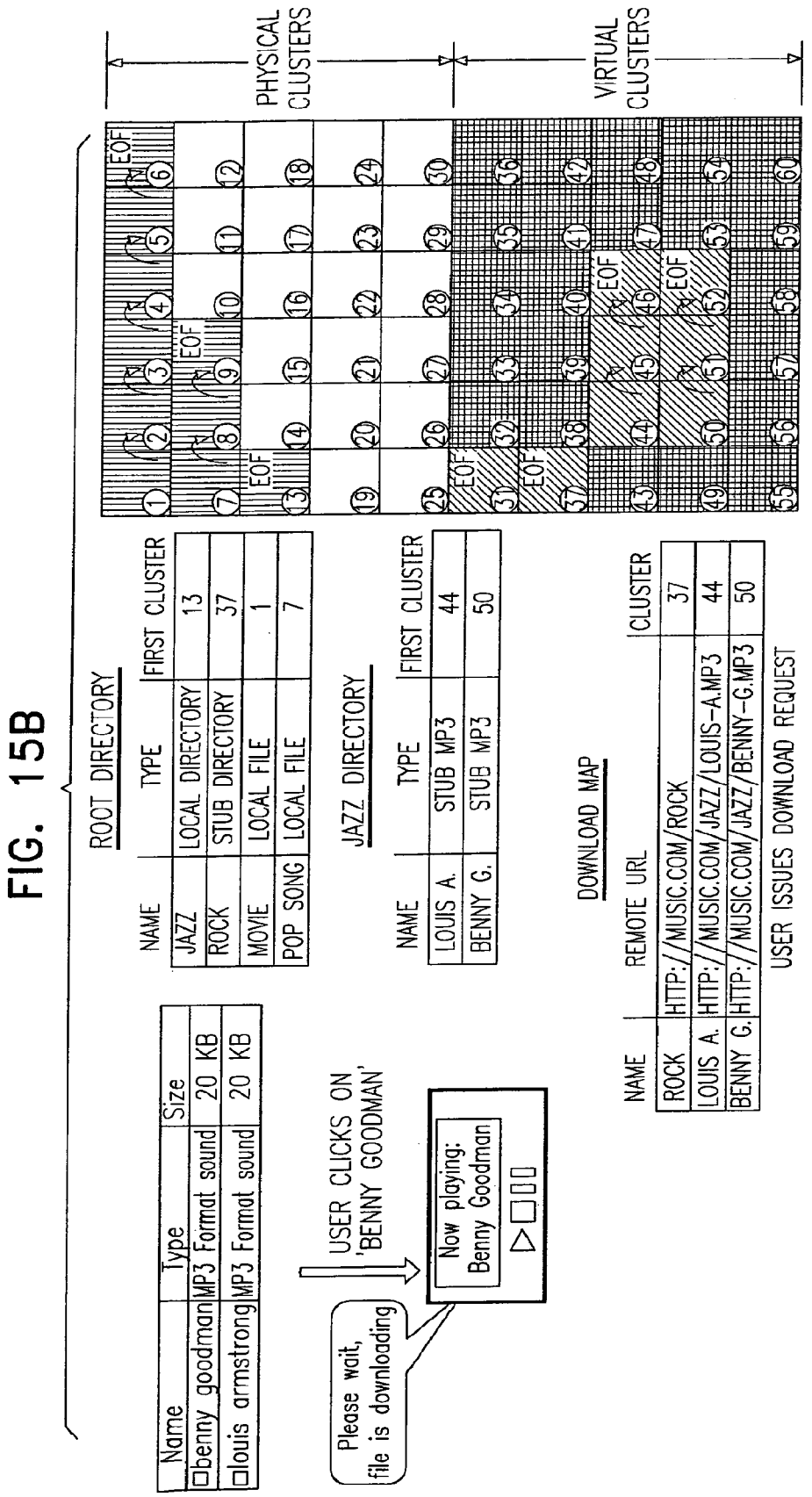

PHYSICAL CLUSTERS
VIRTUAL CLUSTERS
EOF
ROOT DIRECTORY
NAME | TYPE | FIRST CLUSTER
JAZZ | LOCAL DIRECTORY | 13
ROCK | STUB DIRECTORY | 37
MOVIE | LOCAL FILE | 1
POP SONG | LOCAL FILE | 7
JAZZ DIRECTORY
NAME | TYPE | FIRST CLUSTER
LOUIS A. | STUB MP3 | 44
BENNY G. | STUB MP3 | 50
DOWNLOAD MAP
NAME | REMOTE URL | CLUSTER
ROCK | HTTP://MUSIC.COM/ROCK | 37
LOUIS A. | HTTP://MUSIC.COM/JAZZ/LOUIS-A.MP3 | 44
BENNY G. | HTTP://MUSIC.COM/JAZZ/BENNY-G.MP3 | 50
USER ISSUES DOWNLOAD REQUEST
Name | Type | Size
benny goodman | MP3 Format sound | 20 KB
louis armstrong | MP3 Format sound | 20 KB
USER CLICKS ON 'BENNY GOODMAN'
Please wait, file is downloading
Now playing: Benny Goodman

FIG. 15C

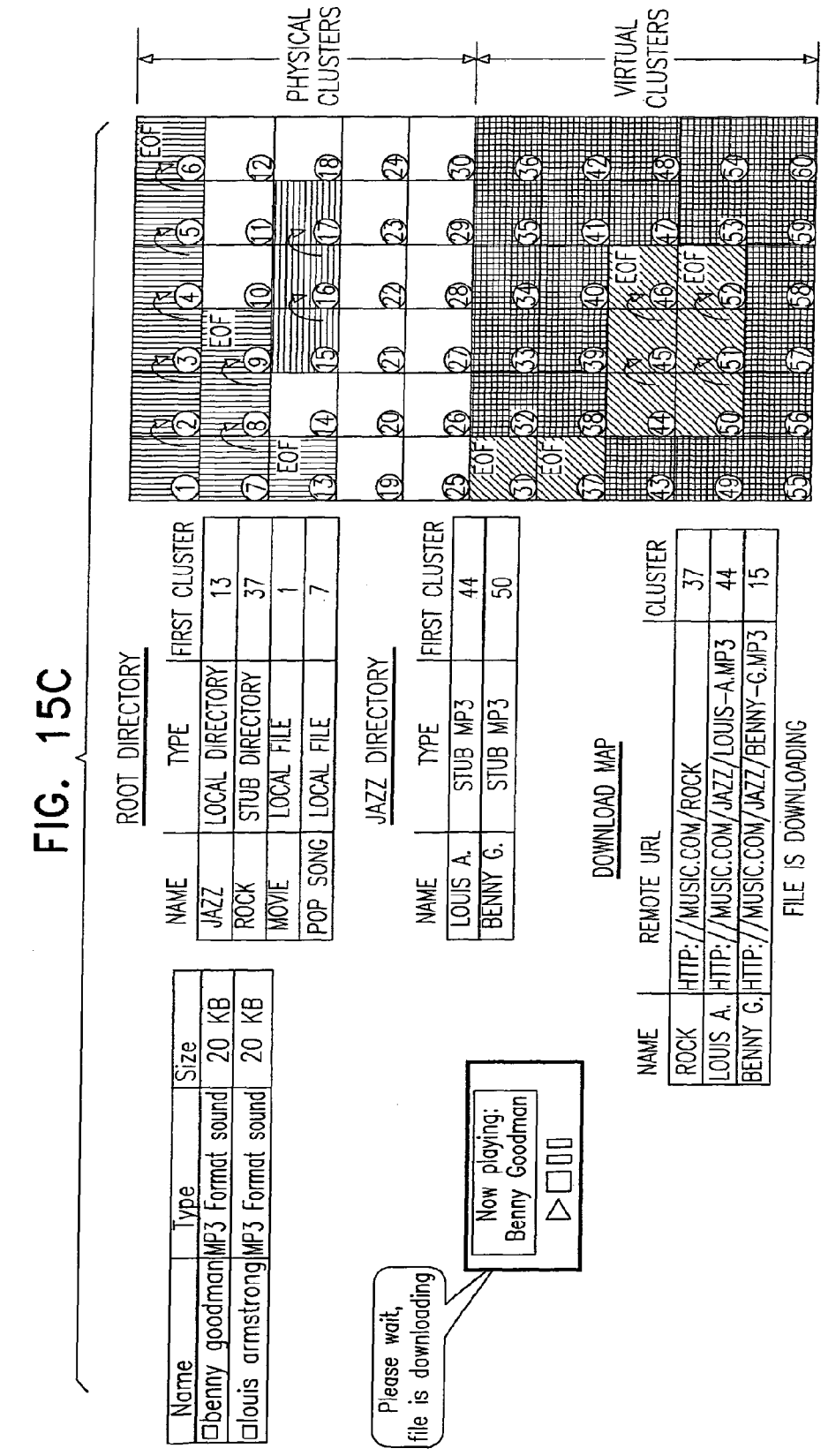

PHYSICAL CLUSTERS
VIRTUAL CLUSTERS
EOF
ROOT DIRECTORY
NAME | TYPE | FIRST CLUSTER
JAZZ | LOCAL DIRECTORY | 13
ROCK | STUB DIRECTORY | 37
MOVIE | LOCAL FILE | 1
POP SONG | LOCAL FILE | 7
JAZZ DIRECTORY
NAME | TYPE | FIRST CLUSTER
LOUIS A. | STUB MP3 | 44
BENNY G. | STUB MP3 | 50
Name | Type | Size
benny goodman | MP3 Format sound | 20 KB
louis armstrong | MP3 Format sound | 20 KB
Please wait, file is downloading
Now playing: Benny Goodman
DOWNLOAD MAP
NAME | REMOTE URL | CLUSTER
ROCK | HTTP://MUSIC.COM/ROCK | 37
LOUIS A. | HTTP://MUSIC.COM/JAZZ/LOUIS-A.MP3 | 44
BENNY G. | HTTP://MUSIC.COM/JAZZ/BENNY-G.MP3 | 15
FILE IS DOWNLOADING

FIG. 15D

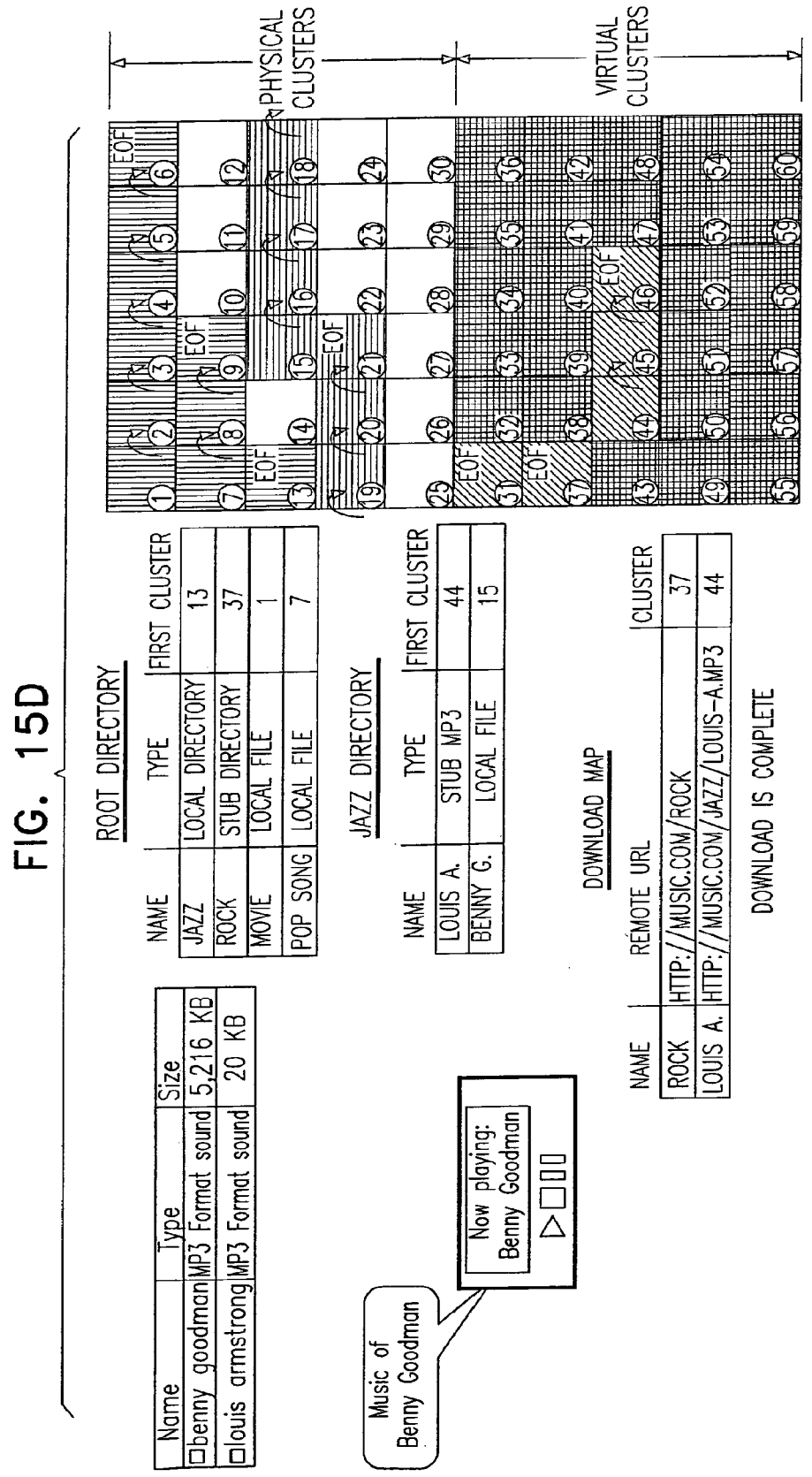

PHYSICAL CLUSTERS
VIRTUAL CLUSTERS
EOF
ROOT DIRECTORY
NAME | TYPE | FIRST CLUSTER
JAZZ | LOCAL DIRECTORY | 13
ROCK | STUB DIRECTORY | 37
MOVIE | LOCAL FILE | 1
POP SONG | LOCAL FILE | 7
JAZZ DIRECTORY
NAME | TYPE | FIRST CLUSTER
LOUIS A. | STUB MP3 | 44
BENNY G. | LOCAL FILE | 15
Name | Type | Size
benny goodman | MP3 Format sound | 5,216 KB
louis armstrong | MP3 Format sound | 20 KB
Music of Benny Goodman
Now playing: Benny Goodman
DOWNLOAD MAP
NAME | REMOTE URL | CLUSTER
ROCK | HTTP://MUSIC.COM/ROCK | 37
LOUIS A. | HTTP://MUSIC.COM/JAZZ/LOUIS-A.MP3 | 44
DOWNLOAD IS COMPLETE

FIG. 16

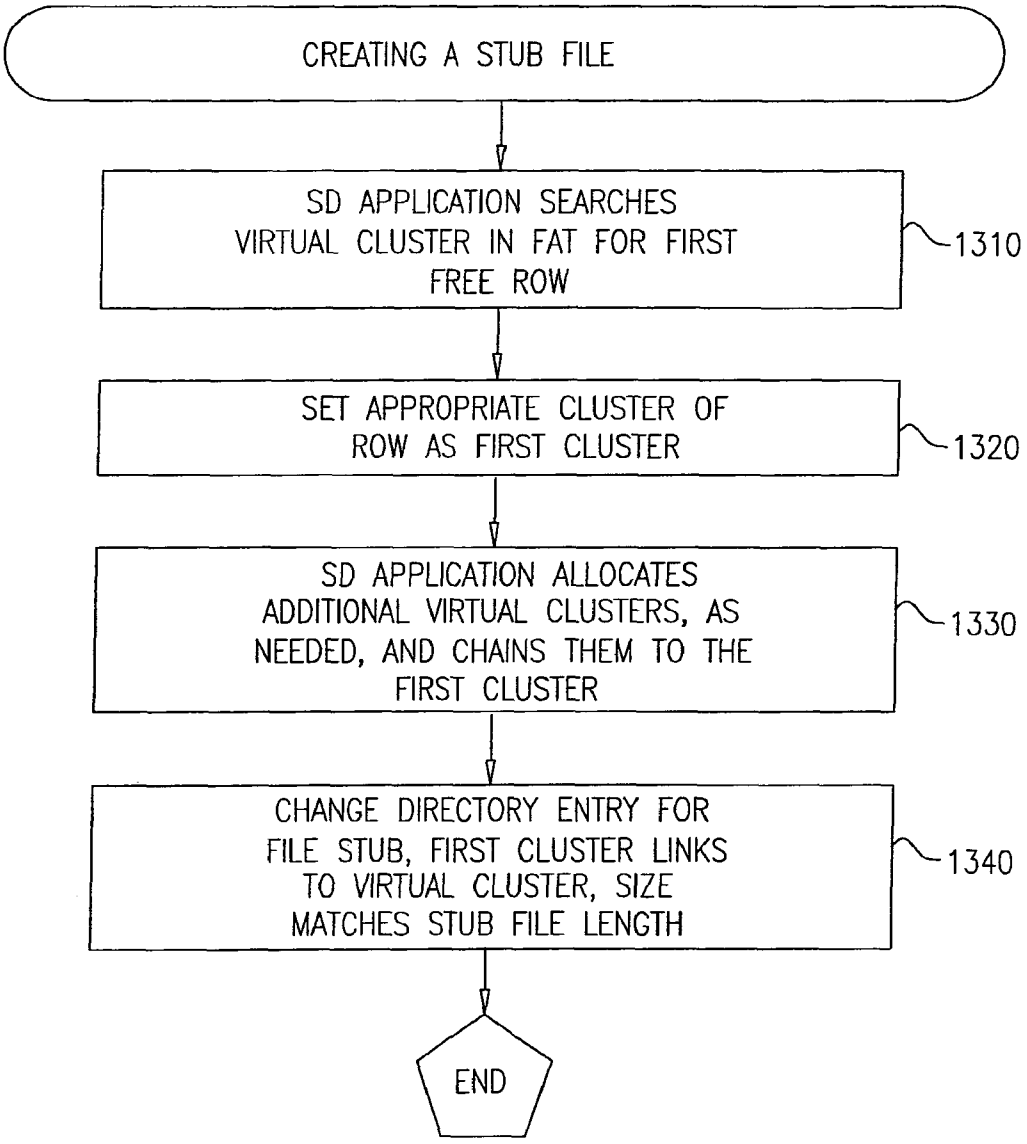

CREATING A STUB FILE
SD APPLICATION SEARCHES VIRTUAL CLUSTER IN FAT FOR FIRST FREE ROW
1310
SET APPROPRIATE CLUSTER OF ROW AS FIRST CLUSTER
1320
SD APPLICATION ALLOCATES ADDITIONAL VIRTUAL CLUSTERS, AS NEEDED, AND CHAINS THEM TO THE FIRST CLUSTER
1330
CHANGE DIRECTORY ENTRY FOR FILE STUB, FIRST CLUSTER LINKS TO VIRTUAL CLUSTER, SIZE MATCHES STUB FILE LENGTH
1340
END

FIG. 17

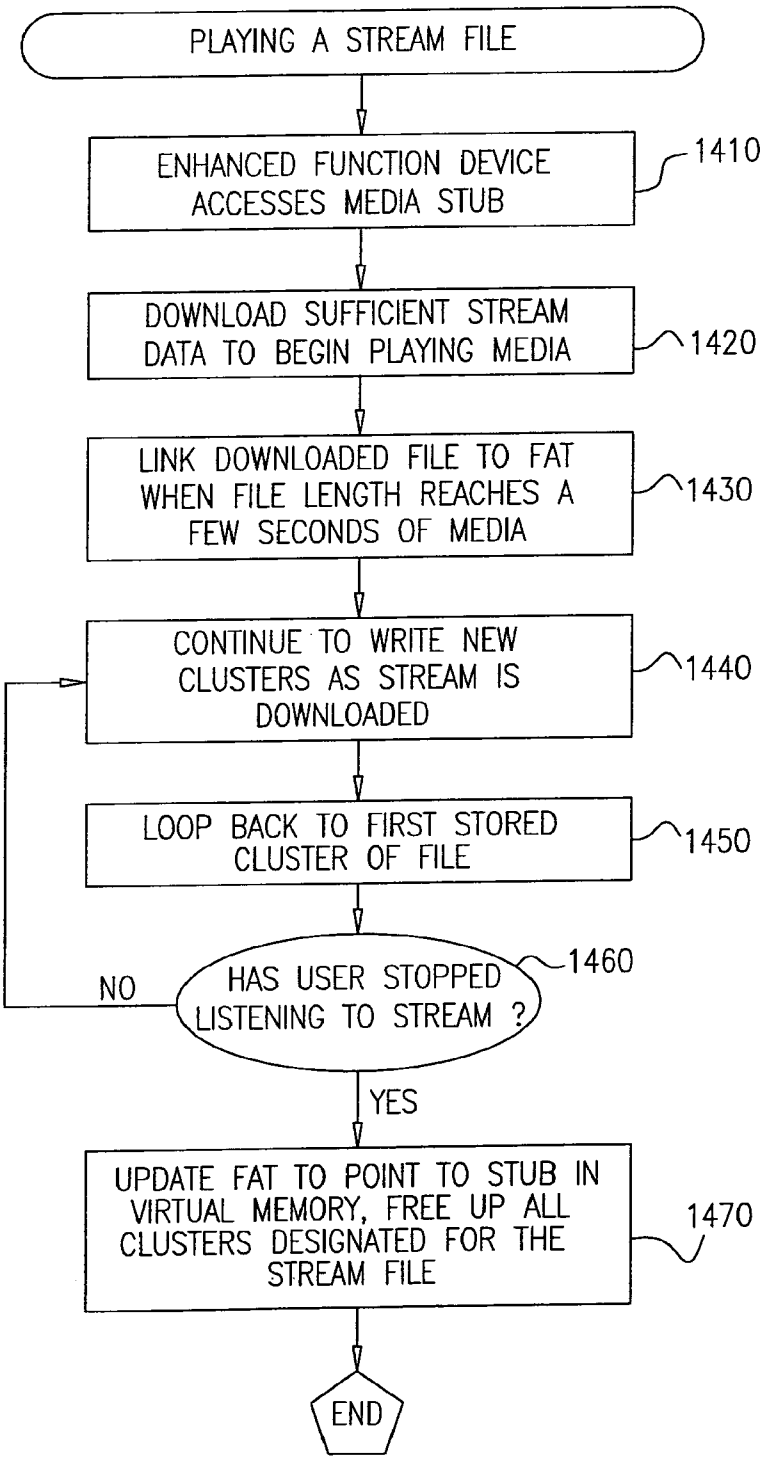

PLAYING A STREAM FILE
ENHANCED FUNCTION DEVICE ACCESSES MEDIA STUB
1410
DOWNLOAD SUFFICIENT STREAM DATA TO BEGIN PLAYING MEDIA
1420
LINK DOWNLOADED FILE TO FAT WHEN FILE LENGTH REACHES A FEW SECONDS OF MEDIA
1430
CONTINUE TO WRITE NEW CLUSTERS AS STREAM IS DOWNLOADED
1440
LOOP BACK TO FIRST STORED CLUSTER OF FILE
1450
HAS USER STOPPED LISTENING TO STREAM ?
1460
NO
YES
UPDATE FAT TO POINT TO STUB IN VIRTUAL MEMORY, FREE UP ALL CLUSTERS DESIGNATED FOR THE STREAM FILE
1470
END

FIG. 18

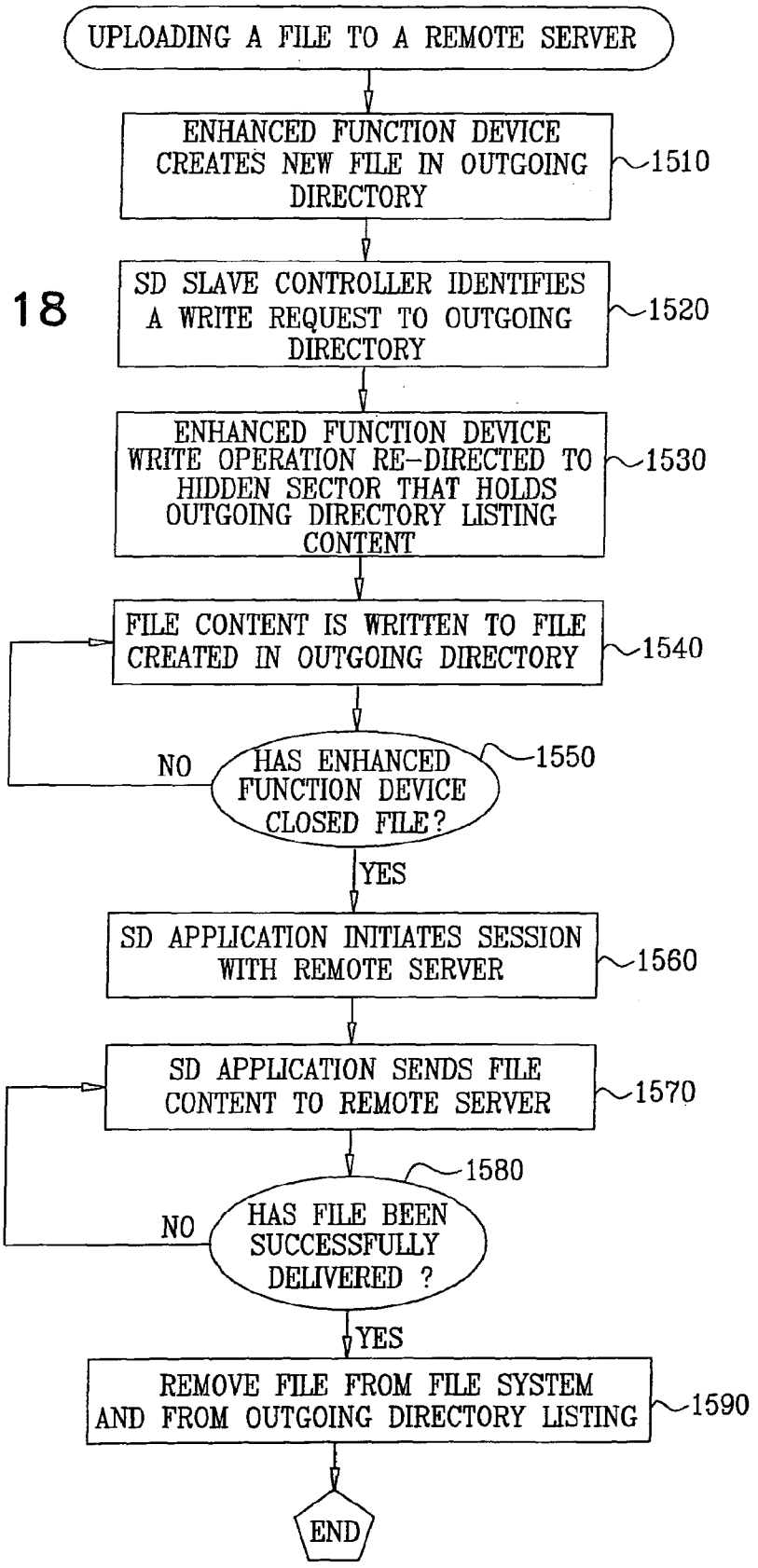

UPLOADING A FILE TO A REMOTE SERVER
ENHANCED FUNCTION DEVICE CREATES NEW FILE IN OUTGOING DIRECTORY
1510
SD SLAVE CONTROLLER IDENTIFIES A WRITE REQUEST TO OUTGOING DIRECTORY
1520
ENHANCED FUNCTION DEVICE WRITE OPERATION RE-DIRECTED TO HIDDEN SECTOR THAT HOLDS OUTGOING DIRECTORY LISTING CONTENT
1530
FILE CONTENT IS WRITTEN TO FILE CREATED IN OUTGOING DIRECTORY
1540
NO
HAS ENHANCED FUNCTION DEVICE CLOSED FILE?
1550
YES
SD APPLICATION INITIATES SESSION WITH REMOTE SERVER
1560
SD APPLICATION SENDS FILE CONTENT TO REMOTE SERVER
1570
1580
NO
HAS FILE BEEN SUCCESSFULLY DELIVERED ?
YES
REMOVE FILE FROM FILE SYSTEM AND FROM OUTGOING DIRECTORY LISTING
1590
END

FIG. 19

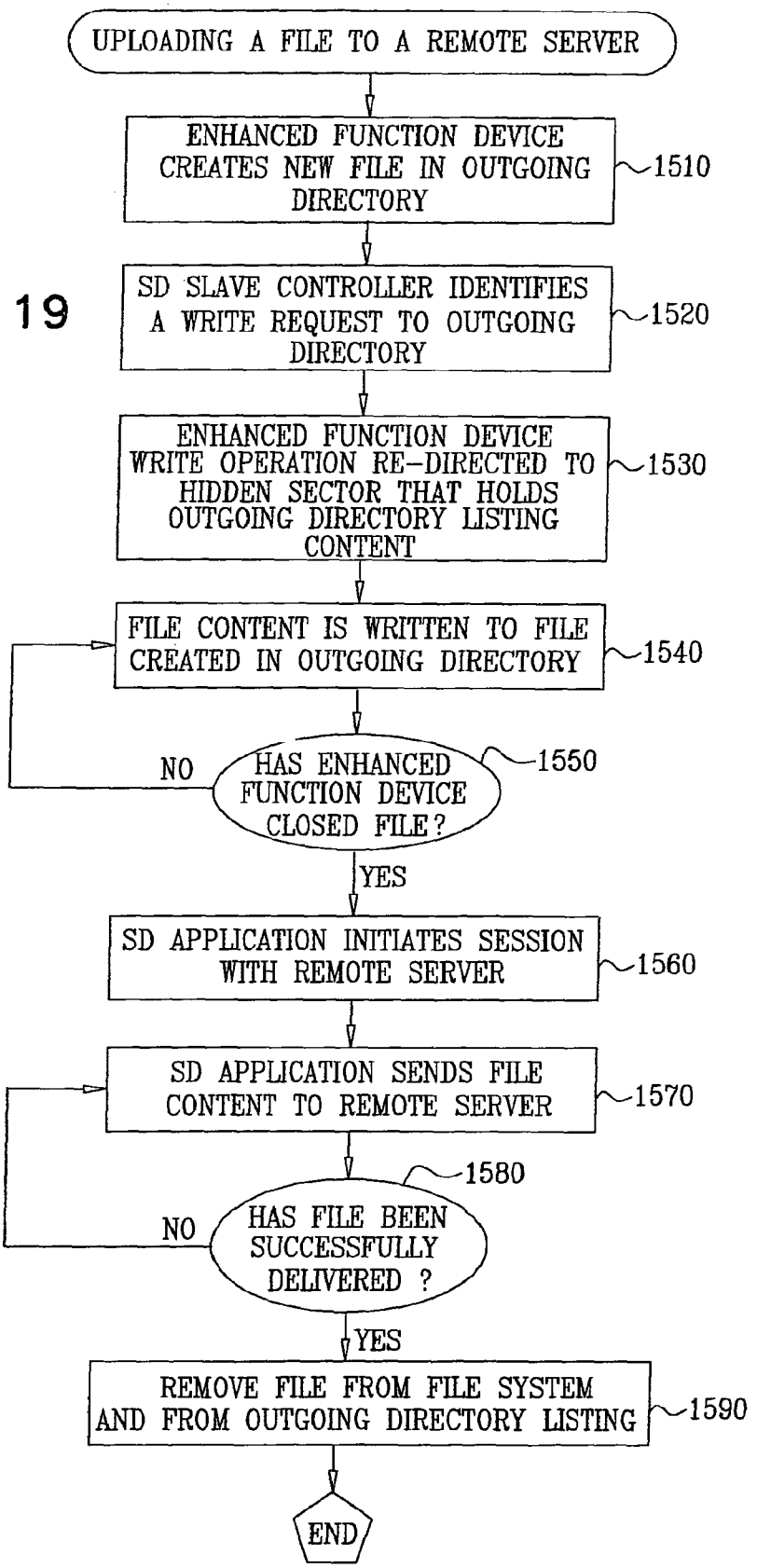

UPLOADING A FILE TO A REMOTE SERVER
ENHANCED FUNCTION DEVICE CREATES NEW FILE IN OUTGOING DIRECTORY
1510
SD SLAVE CONTROLLER IDENTIFIES A WRITE REQUEST TO OUTGOING DIRECTORY
1520
ENHANCED FUNCTION DEVICE WRITE OPERATION RE-DIRECTED TO HIDDEN SECTOR THAT HOLDS OUTGOING DIRECTORY LISTING CONTENT
1530
FILE CONTENT IS WRITTEN TO FILE CREATED IN OUTGOING DIRECTORY
1540
NO
HAS ENHANCED FUNCTION DEVICE CLOSED FILE?
1550
YES
SD APPLICATION INITIATES SESSION WITH REMOTE SERVER
1560
SD APPLICATION SENDS FILE CONTENT TO REMOTE SERVER
1570
1580
NO
HAS FILE BEEN SUCCESSFULLY DELIVERED ?
YES
REMOVE FILE FROM FILE SYSTEM AND FROM OUTGOING DIRECTORY LISTING
1590
END

FIG. 20A

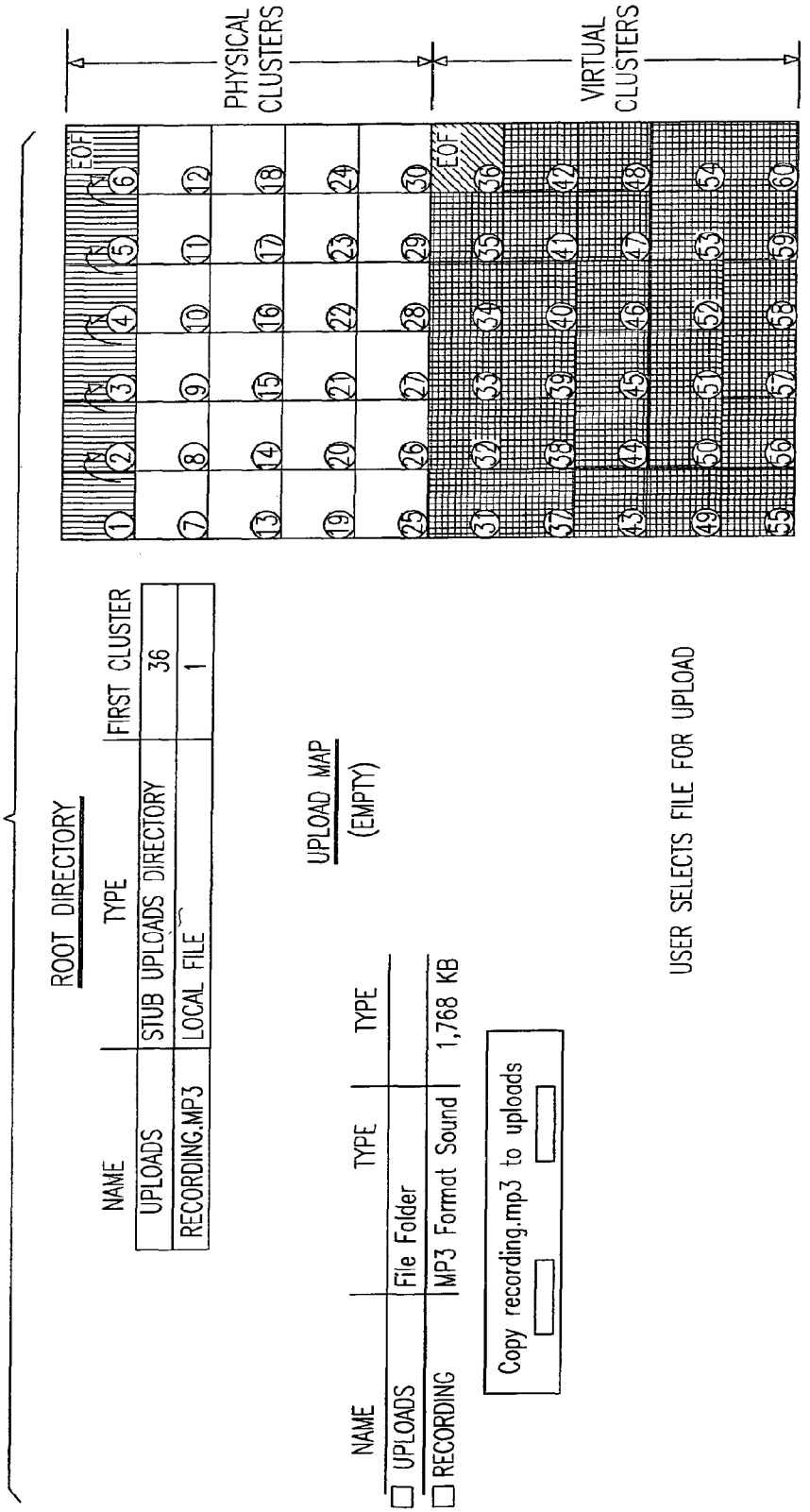

PHYSICAL CLUSTERS
VIRTUAL CLUSTERS
EOF
EOF
ROOT DIRECTORY
NAME
TYPE
FIRST CLUSTER
UPLOADS
STUB UPLOADS DIRECTORY
36
RECORDING.MP3
LOCAL FILE
1
UPLOAD MAP
(EMPTY)
NAME
TYPE
TYPE
UPLOADS
File Folder
RECORDING
MP3 Format Sound
1,768 KB
Copy recording.mp3 to uploads
USER SELECTS FILE FOR UPLOAD

FIG. 20B

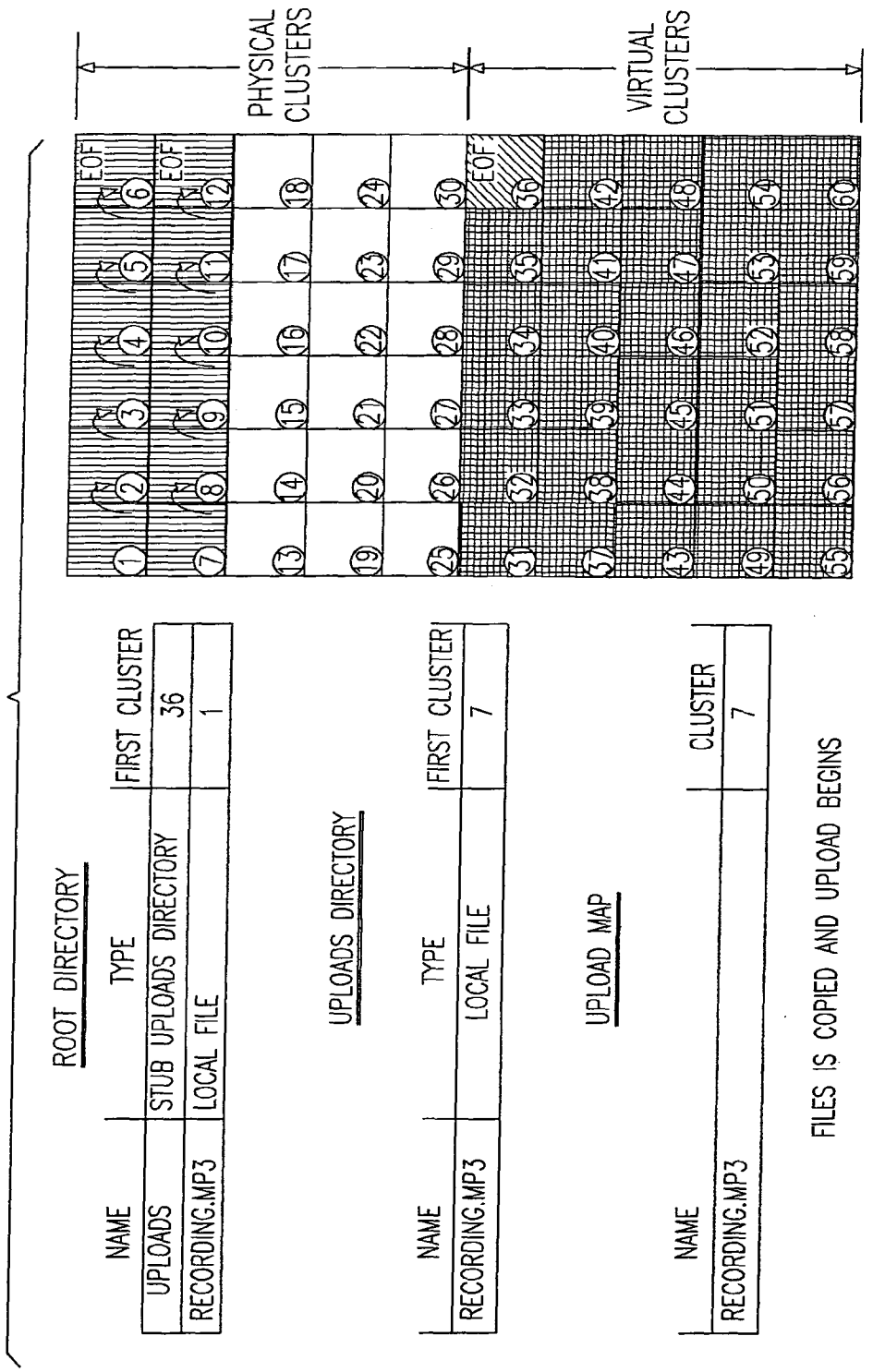

PHYSICAL CLUSTERS
VIRTUAL CLUSTERS
EOF
EOF
EOF
ROOT DIRECTORY
NAME
TYPE
FIRST CLUSTER
UPLOADS
STUB UPLOADS DIRECTORY
36
RECORDING.MP3
LOCAL FILE
1
UPLOADS DIRECTORY
NAME
TYPE
FIRST CLUSTER
RECORDING.MP3
LOCAL FILE
7
UPLOAD MAP
NAME
CLUSTER
RECORDING.MP3
7
FILES IS COPIED AND UPLOAD BEGINS

FIG. 21A

BEFORE POUCHING
WIRELESS COMMUNICATOR

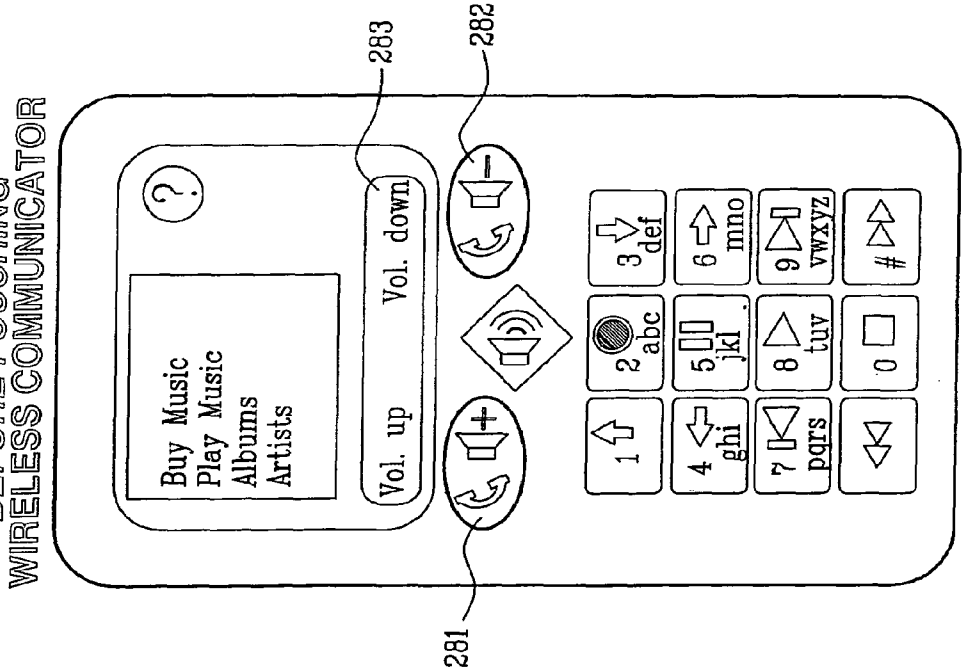



FIG. 21B

AFTER POUCHING
WIRELESS COMMUNICATOR

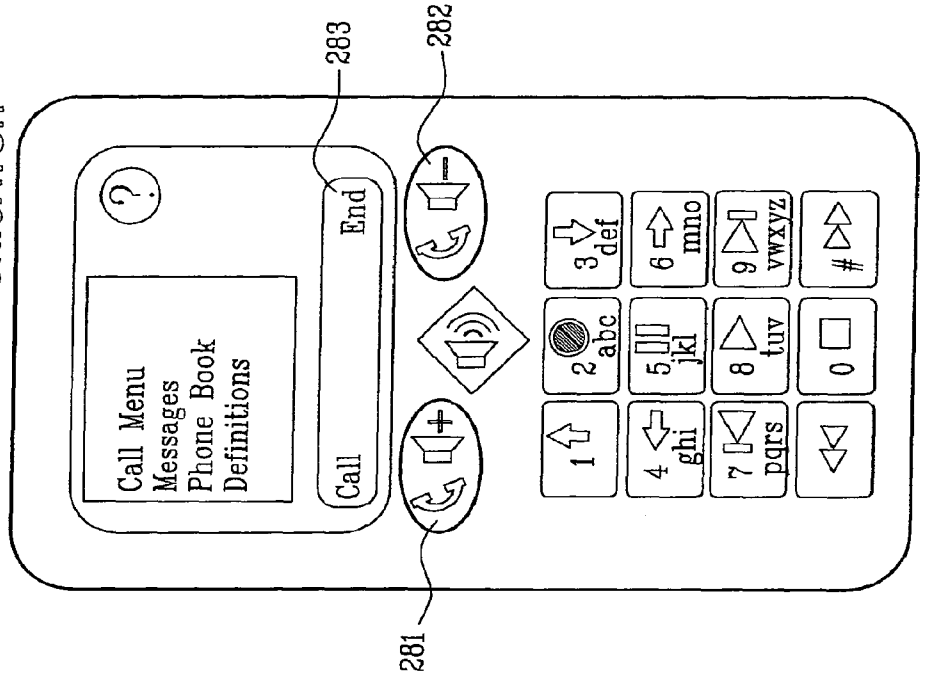


FIG. 22A
BEFORE POUCHING
WIRELESS COMMUNICATOR

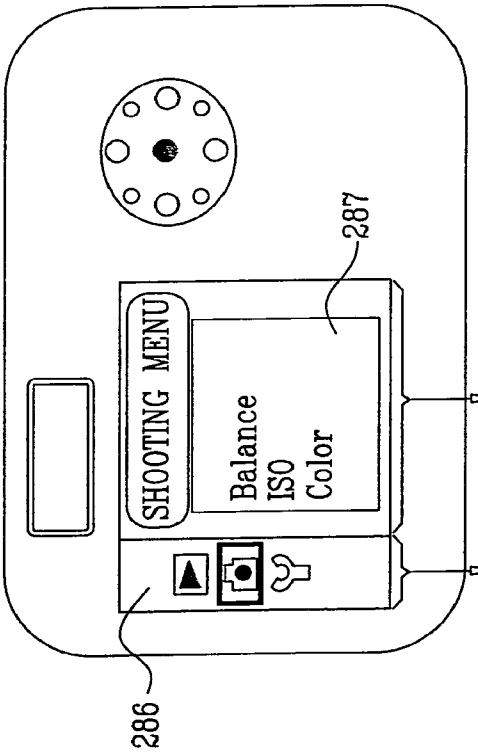



FIG. 22B
AFTER POUCHING
WIRELESS COMMUNICATOR

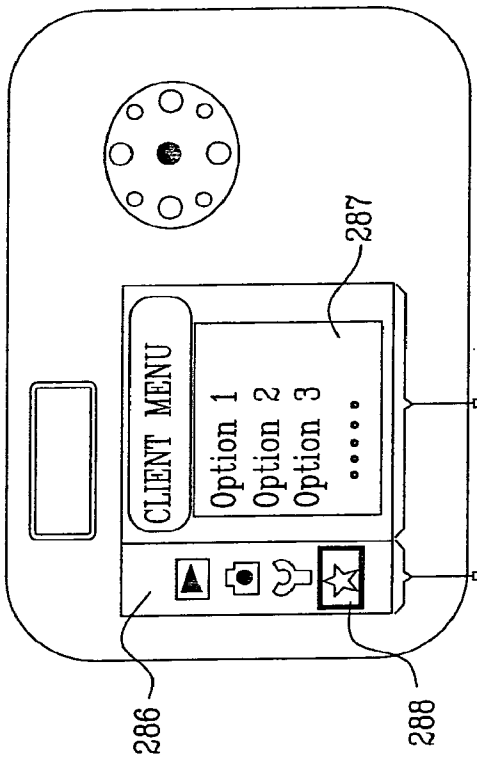


FIG. 23B
AFTER POUCHING
WIRELESS COMMUNICATOR

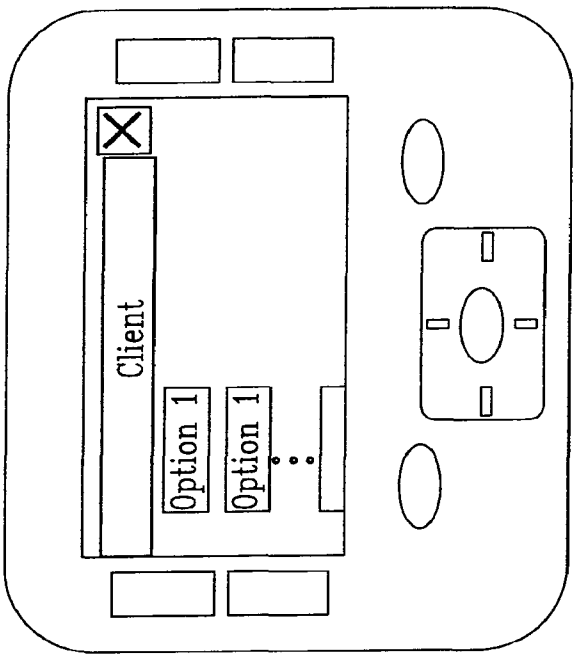



FIG. 23A
BEFORE POUCHING
WIRELESS COMMUNICATOR

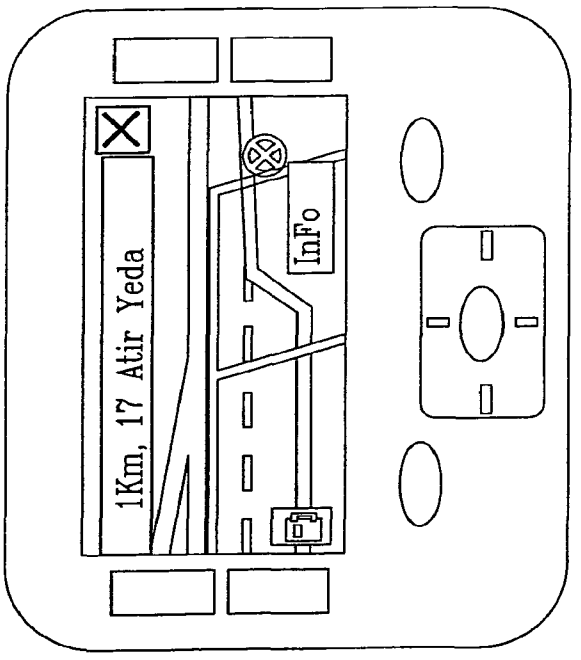
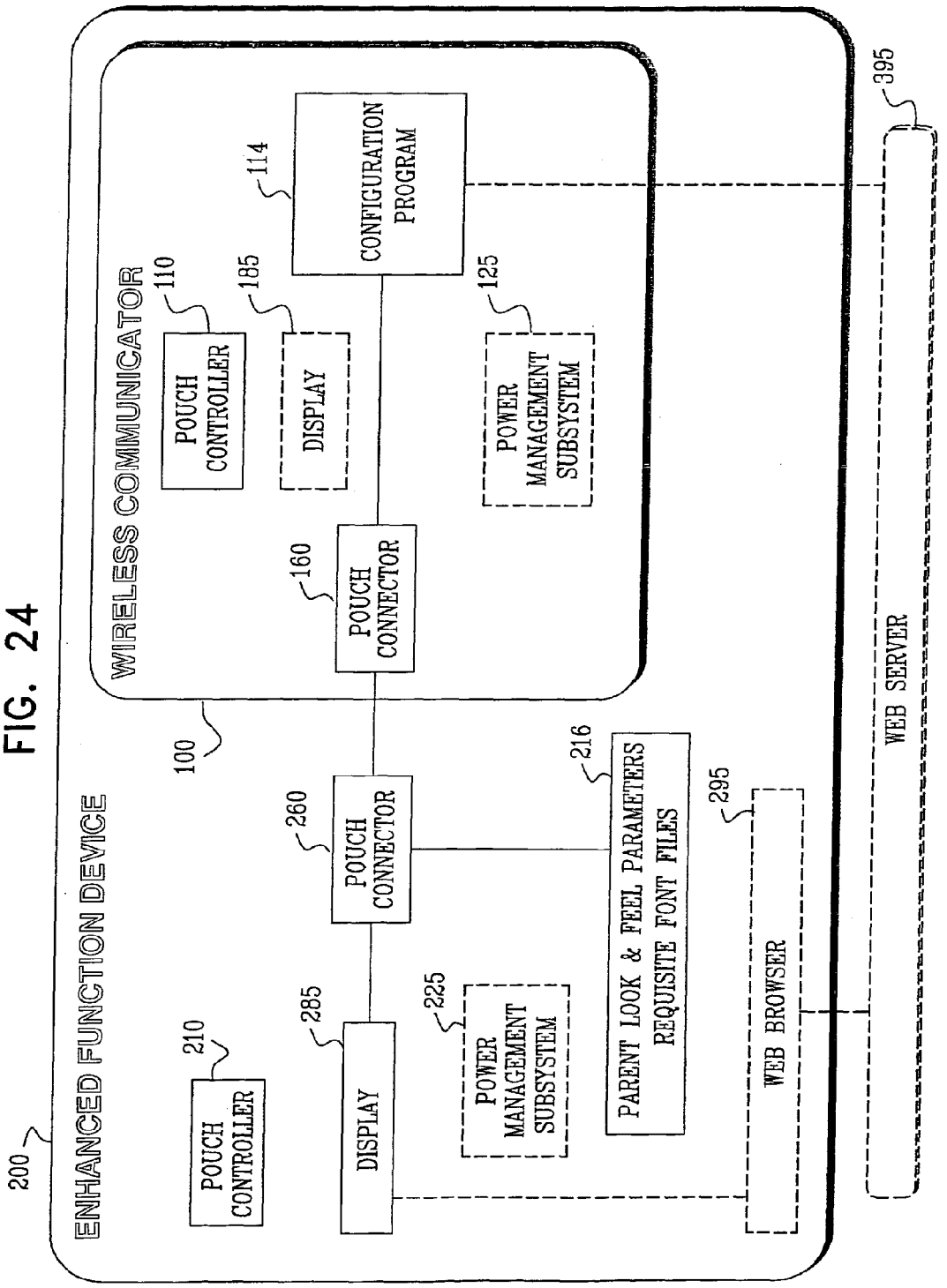


FIG. 24


200
ENHANCED FUNCTION DEVICE
100
WIRELESS COMMUNICATOR
110
POUCH CONTROLLER
185
DISPLAY
114
CONFIGURATION PROGRAM
125
POWER MANAGEMENT SUBSYSTEM
160
POUCH CONNECTOR
260
POUCH CONNECTOR
216
PARENT LOOK & FEEL PARAMETERS REQUISITE FONT FILES
210
POUCH CONTROLLER
285
DISPLAY
225
POWER MANAGEMENT SUBSYSTEM
295
WEB BROWSER
395
WEB SERVER

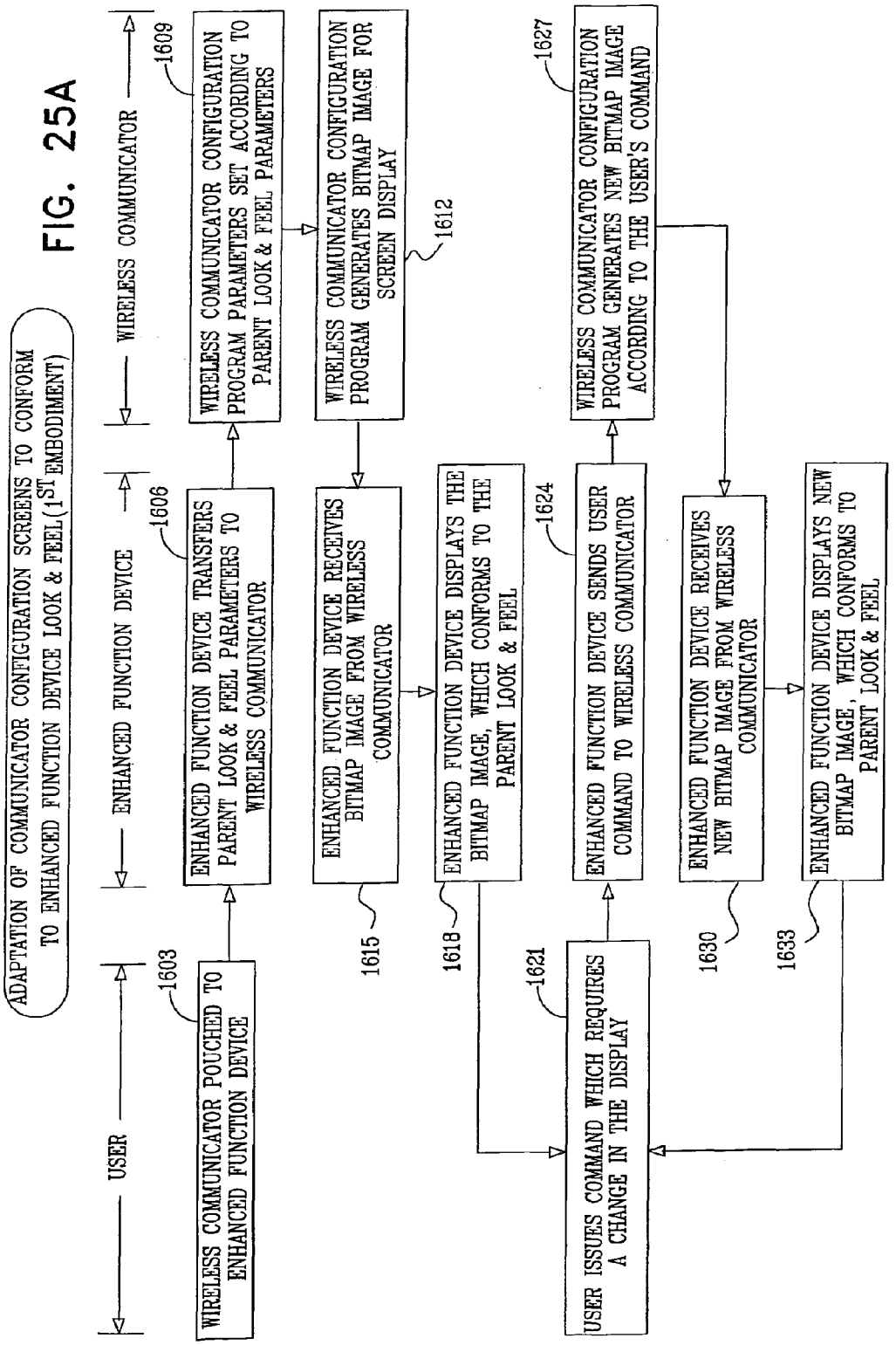
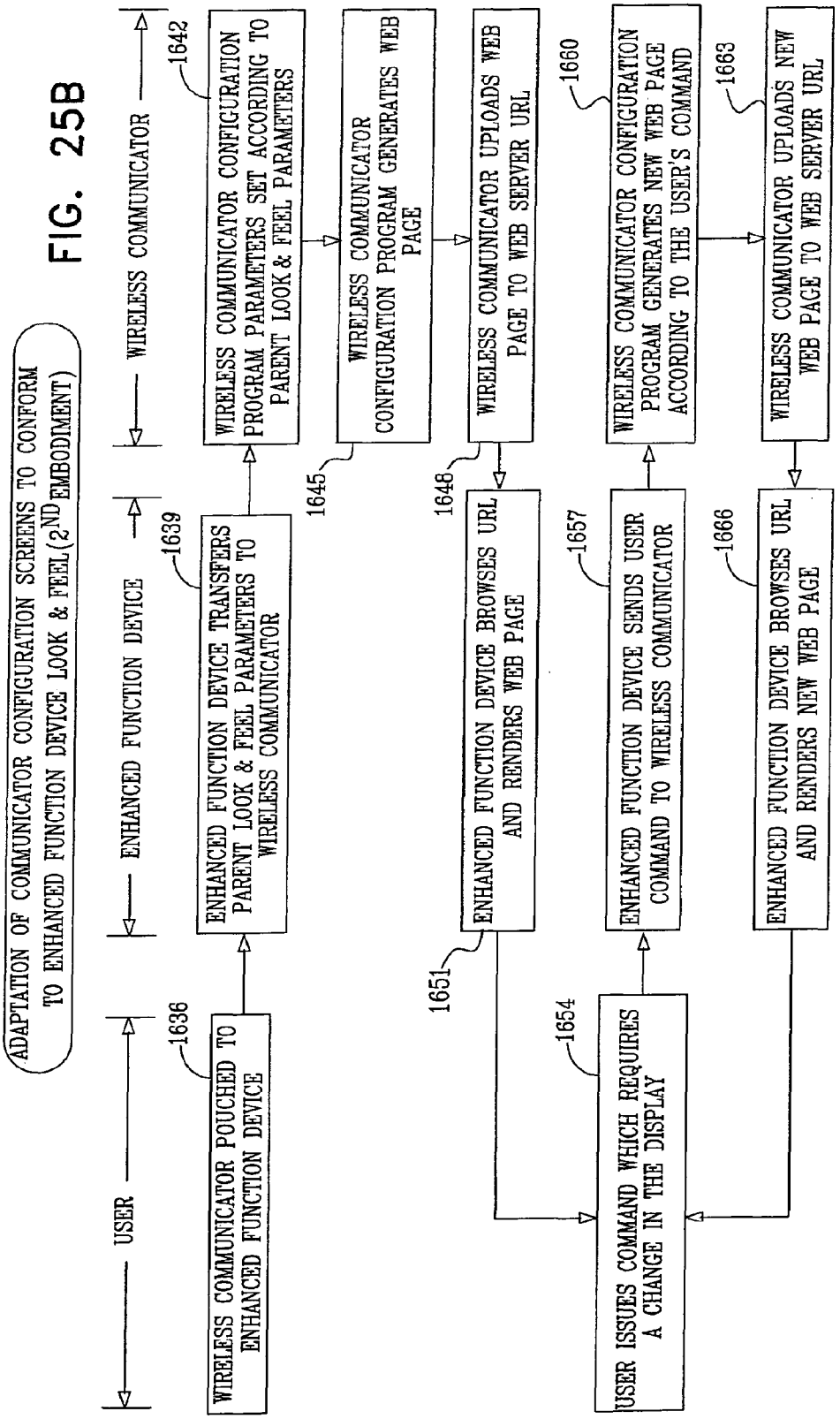

ADAPTATION OF COMMUNICATOR CONFIGURATION SCREENS TO CONFORM TO ENHANCED FUNCTION DEVICE LOOK & FEEL (1ST EMBODIMENT)
USER
ENHANCED FUNCTION DEVICE
WIRELESS COMMUNICATOR
1603
WIRELESS COMMUNICATOR POUCHED TO ENHANCED FUNCTION DEVICE
1606
ENHANCED FUNCTION DEVICE TRANSFERS PARENT LOOK & FEEL PARAMETERS TO WIRELESS COMMUNICATOR
1609
WIRELESS COMMUNICATOR CONFIGURATION PROGRAM PARAMETERS SET ACCORDING TO PARENT LOOK & FEEL PARAMETERS
1612
WIRELESS COMMUNICATOR CONFIGURATION PROGRAM GENERATES BITMAP IMAGE FOR SCREEN DISPLAY
1615
ENHANCED FUNCTION DEVICE RECEIVES BITMAP IMAGE FROM WIRELESS COMMUNICATOR
1618
ENHANCED FUNCTION DEVICE DISPLAYS THE BITMAP IMAGE, WHICH CONFORMS TO THE PARENT LOOK & FEEL
1621
USER ISSUES COMMAND WHICH REQUIRES A CHANGE IN THE DISPLAY
1624
ENHANCED FUNCTION DEVICE SENDS USER COMMAND TO WIRELESS COMMUNICATOR
1627
WIRELESS COMMUNICATOR CONFIGURATION PROGRAM GENERATES NEW BITMAP IMAGE ACCORDING TO THE USER'S COMMAND
1630
ENHANCED FUNCTION DEVICE RECEIVES NEW BITMAP IMAGE FROM WIRELESS COMMUNICATOR
1633
ENHANCED FUNCTION DEVICE DISPLAYS NEW BITMAP IMAGE, WHICH CONFORMS TO PARENT LOOK & FEEL

FIG. 25A

FIG. 25B


ADAPTATION OF COMMUNICATOR CONFIGURATION SCREENS TO CONFORM TO ENHANCED FUNCTION DEVICE LOOK & FEEL (2ND EMBODIMENT)
USER
ENHANCED FUNCTION DEVICE
WIRELESS COMMUNICATOR
WIRELESS COMMUNICATOR POUCHED TO ENHANCED FUNCTION DEVICE
1636
ENHANCED FUNCTION DEVICE TRANSFERS PARENT LOOK & FEEL PARAMETERS TO WIRELESS COMMUNICATOR
1639
WIRELESS COMMUNICATOR CONFIGURATION PROGRAM PARAMETERS SET ACCORDING TO PARENT LOOK & FEEL PARAMETERS
1642
WIRELESS COMMUNICATOR CONFIGURATION PROGRAM GENERATES WEB PAGE
1645
ENHANCED FUNCTION DEVICE BROWSES URL AND RENDERS WEB PAGE
1648
WIRELESS COMMUNICATOR UPLOADS WEB PAGE TO WEB SERVER URL
1651
USER ISSUES COMMAND WHICH REQUIRES A CHANGE IN THE DISPLAY
1654
ENHANCED FUNCTION DEVICE SENDS USER COMMAND TO WIRELESS COMMUNICATOR
1657
WIRELESS COMMUNICATOR CONFIGURATION PROGRAM GENERATES NEW WEB PAGE ACCORDING TO THE USER'S COMMAND
1660
ENHANCED FUNCTION DEVICE BROWSES URL AND RENDERS NEW WEB PAGE
1666
WIRELESS COMMUNICATOR UPLOADS NEW WEB PAGE TO WEB SERVER URL
1663

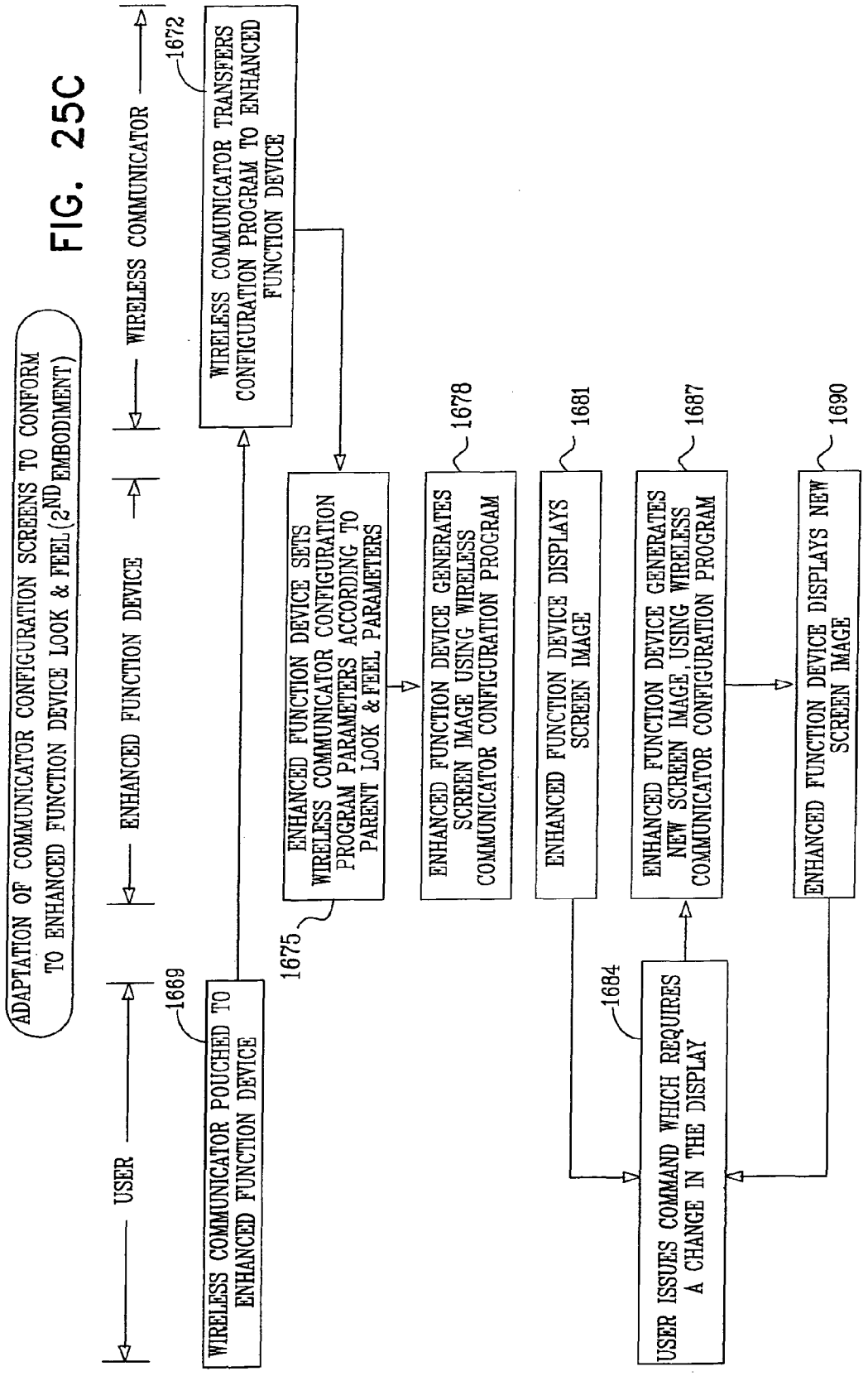

ADAPTATION OF COMMUNICATOR CONFIGURATION SCREENS TO CONFORM TO ENHANCED FUNCTION DEVICE LOOK & FEEL (2ND EMBODIMENT)
USER
ENHANCED FUNCTION DEVICE
WIRELESS COMMUNICATOR
1669
WIRELESS COMMUNICATOR POUCHED TO ENHANCED FUNCTION DEVICE
1672
WIRELESS COMMUNICATOR TRANSFERS CONFIGURATION PROGRAM TO ENHANCED FUNCTION DEVICE
1675
ENHANCED FUNCTION DEVICE SETS WIRELESS COMMUNICATOR CONFIGURATION PROGRAM PARAMETERS ACCORDING TO PARENT LOOK & FEEL PARAMETERS
1678
ENHANCED FUNCTION DEVICE GENERATES SCREEN IMAGE USING WIRELESS COMMUNICATOR CONFIGURATION PROGRAM
1681
ENHANCED FUNCTION DEVICE DISPLAYS SCREEN IMAGE
1684
USER ISSUES COMMAND WHICH REQUIRES A CHANGE IN THE DISPLAY
1687
ENHANCED FUNCTION DEVICE GENERATES NEW SCREEN IMAGE, USING WIRELESS COMMUNICATOR CONFIGURATION PROGRAM
1690
ENHANCED FUNCTION DEVICE DISPLAYS NEW SCREEN IMAGE

FIG. 25C

FIG. 26

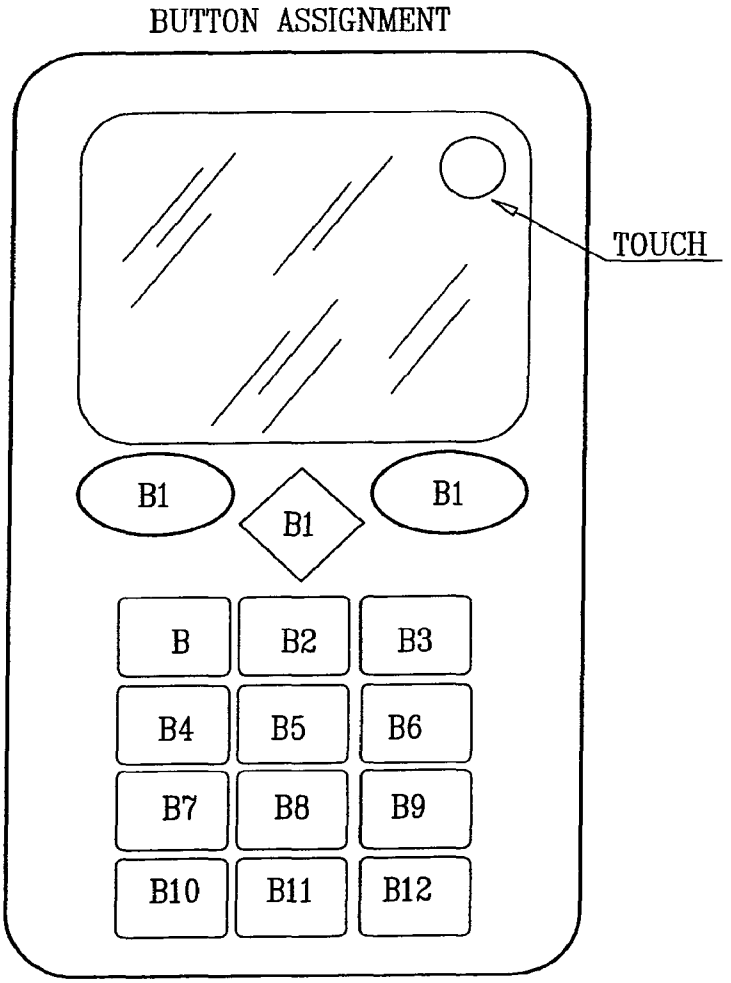
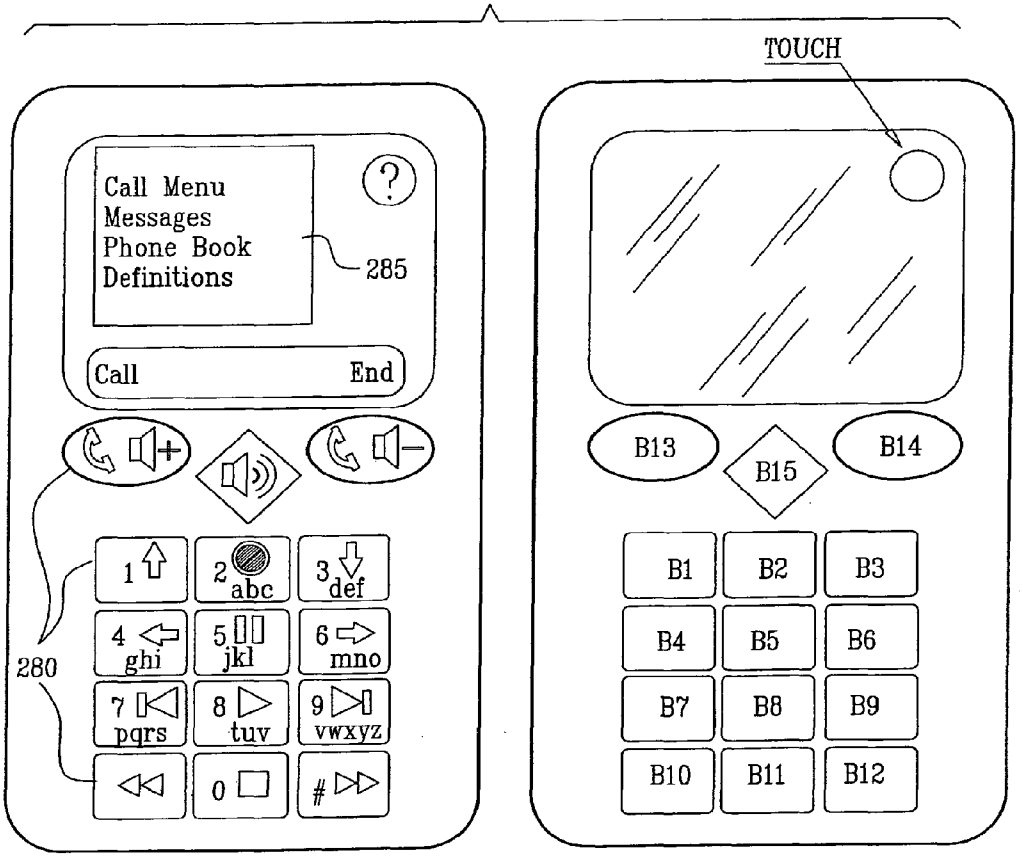
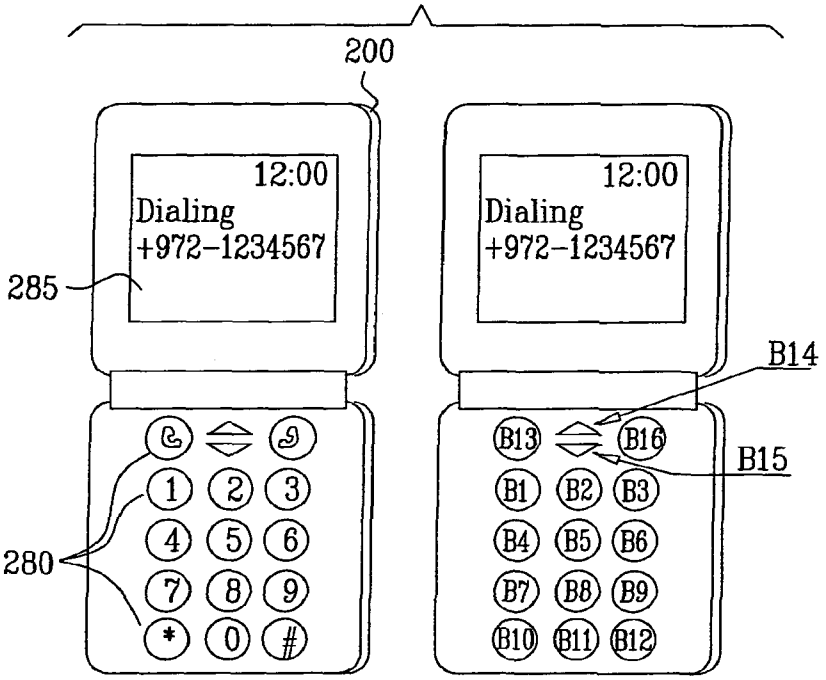

BUTTON ASSIGNMENT
TOUCH
B1
B1
B1
B
B2
B3
B4
B5
B6
B7
B8
B9
B10
B11
B12

FIG. 27A



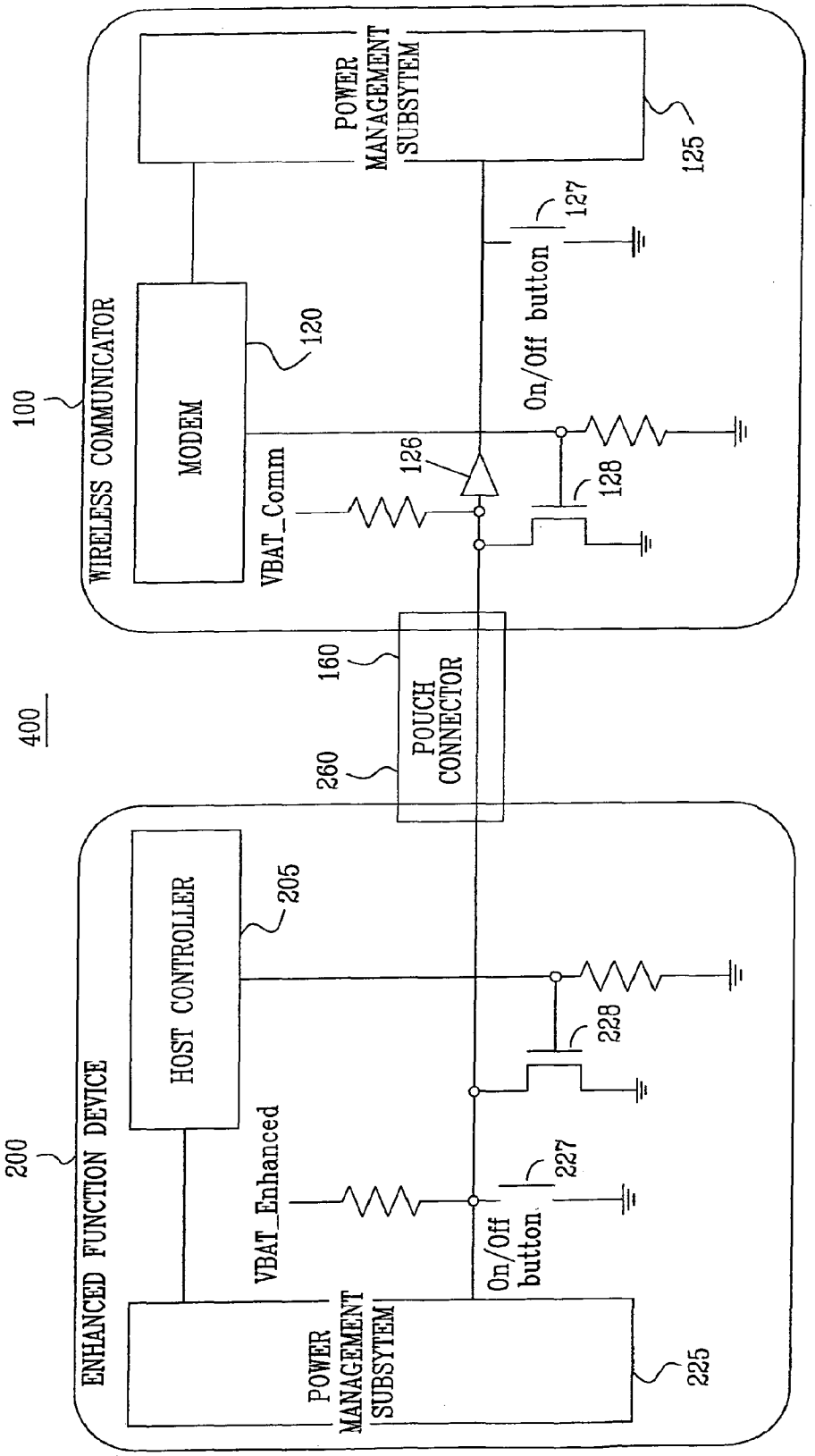

| BUTTON ASSIGNMENT | | | |
|---|---|---|---|
| FUNCTION | ASSIGNED KEY | FUNCTION | ASSIGNED KEY |
| 0 | B11 | # | B12 |
| 1 | B1 | * | B10 |
| 2 | B2 | LEFT | LONG B4 |
| 3 | B3 | RIGHT | LONG B6 |
| 4 | B4 | CALL | B13 |
| 5 | B5 | END | B14 |
| 6 | B6 | ERASE | LONG B14 |
| 7 | B7 | OPTION | LONG B13 |
| 8 | B8 | SPEAKER | B15 |
| 9 | B9 | HELP | TOUCH |

FIG. 27B




| BUTTON ASSIGNMENT | | | |
|---|---|---|---|
| FUNCTION | ASSIGNED KEY | FUNCTION | ASSIGNED KEY |
| 0 | B11 | # | B12 |
| 1 | B1 | * | B10 |
| 2 | B2 | UP | B14 |
| 3 | B3 | DOWN | B15 |
| 4 | B4 | CALL | B13 |
| 5 | B5 | END | B16 |
| 6 | B6 | | |
| 7 | B7 | | |
| 8 | B8 | | |
| 9 | B9 | | |

FIG. 28


400
100
WIRELESS COMMUNICATOR
MODEM
120
VBAT_Comm
126
128
On/Off button
127
POWER MANAGEMENT SUBSYTEM
125
160
POUCH CONNECTOR
260
200
ENHANCED FUNCTION DEVICE
HOST CONTROLLER
205
VBAT_Enhanced
228
227
On/Off button
POWER MANAGEMENT SUBSYTEM
225

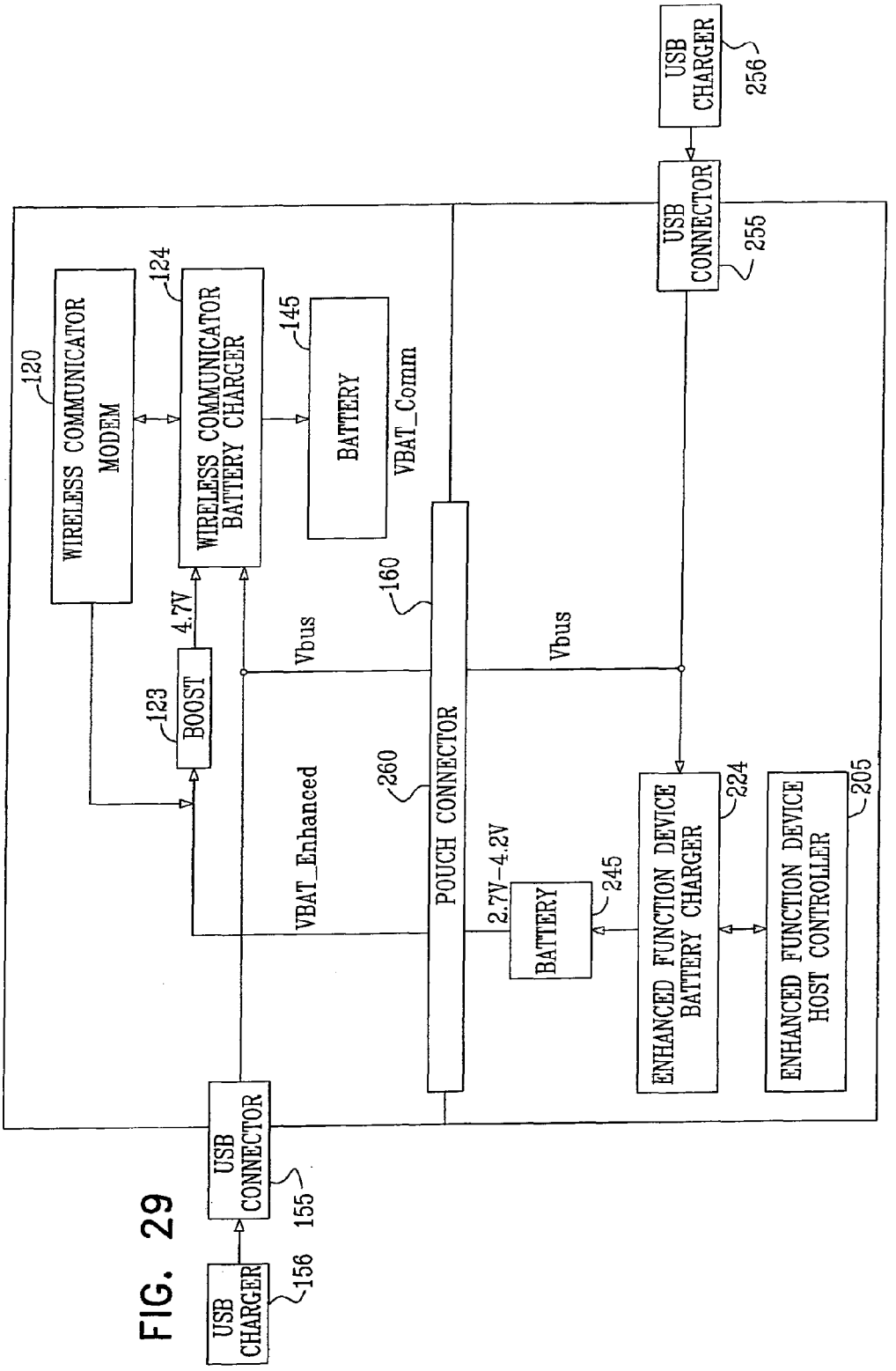

USB CHARGER
256
USB CONNECTOR
255
WIRELESS COMMUNICATOR MODEM
120
WIRELESS COMMUNICATOR BATTERY CHARGER
124
BATTERY
145
VBAT_Comm
4.7V
BOOST
123
Vbus
160
Vbus
VBAT_Enhanced
260
POUCH CONNECTOR
2.7V–4.2V
BATTERY
245
ENHANCED FUNCTION DEVICE BATTERY CHARGER
224
ENHANCED FUNCTION DEVICE HOST CONTROLLER
205
USB CONNECTOR
155
USB CHARGER
156

FIG. 29

FIG. 30

| SA Battery State | JKT Battery State | SA Mode | SA Charging Mode | SA Boost | SA Charger |
|---|---|---|---|---|---|
| SA>Vh | JKT>SA | Standby | Supply from JKT Battery | Disabled | Fixed voltage=SA |
| | | High | Supply from SA and JKT Battery | Disabled | Fixed current=STBC |
| | JKT<SA | All | No Charge | Disabled | No charge |
| V1<SA<Vh | JKT>SA+Vc | All | Charge from JKT Battery | Disabled | Fixed current=CC |
| | SA<JKT<SA+Vc | Standby | Supply from JKT Battery | Disabled | Fixed voltage=SA |
| | | High | Supply from SA and JKT Battery | Disabled | Fixed current=STBC |
| | JKT<SA | Standby | Supply from JKT Battery | Enabled | Fixed voltage=SA |
| | | High | Supply from SA and JKT Battery | Enabled | Fixed current=STBC |
| SA<V1 | JKT>SA+Vc | All | Charge from JKT Battery | Disabled | Fixed current=CC |
| | JKT<SA+Vc | All | Charge from JKT Battery | Enabled | Fixed current=CC |

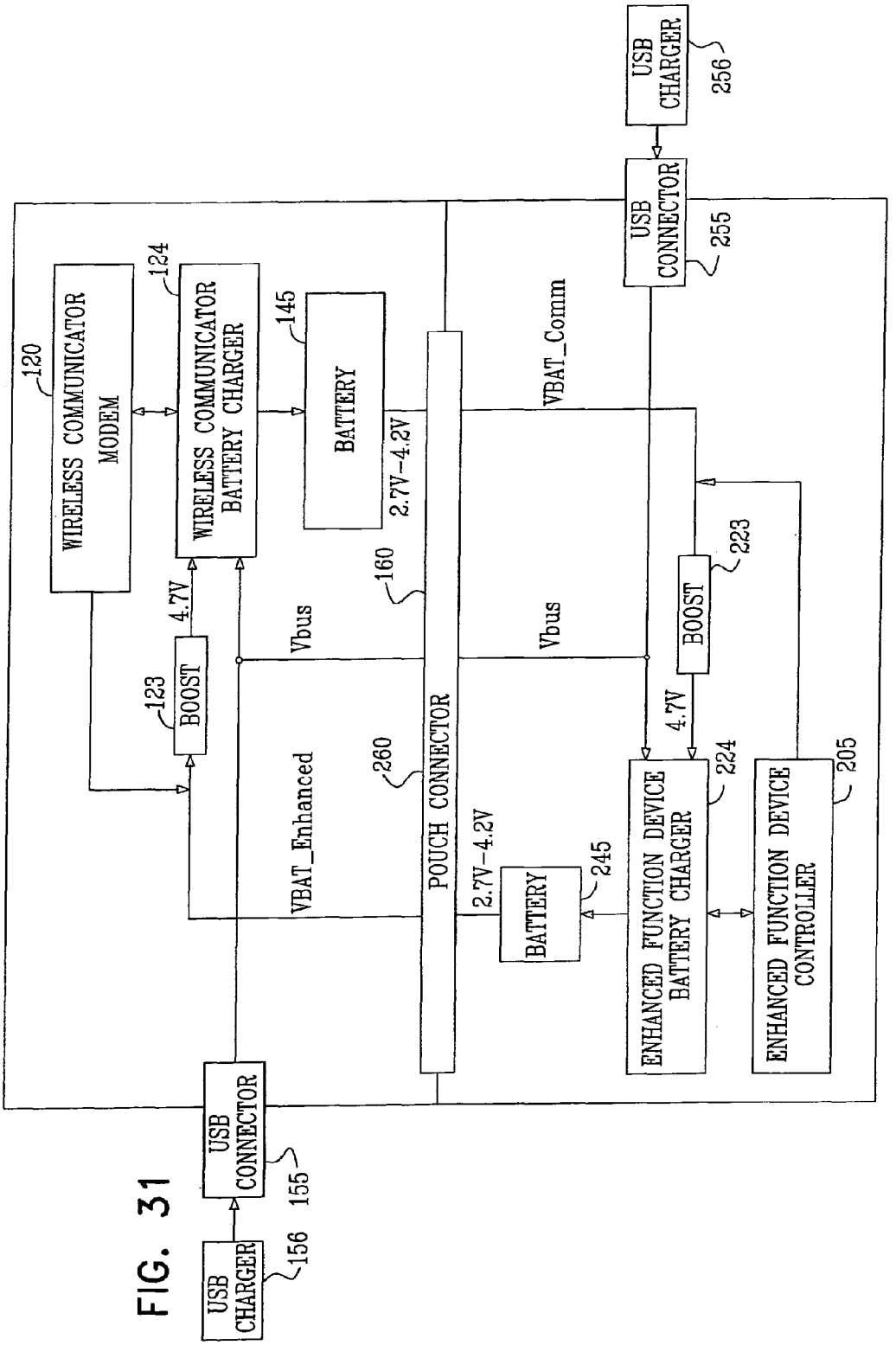

USB CHARGER
256
USB CONNECTOR
255
VBAT_Comm
WIRELESS COMMUNICATOR MODEM
120
WIRELESS COMMUNICATOR BATTERY CHARGER
124
BATTERY
145
2.7V-4.2V
160
4.7V
BOOST
123
Vbus
Vbus
BOOST
223
4.7V
VBAT_Enhanced
260
POUCH CONNECTOR
2.7V-4.2V
BATTERY
245
ENHANCED FUNCTION DEVICE BATTERY CHARGER
224
ENHANCED FUNCTION DEVICE CONTROLLER
205
USB CONNECTOR
155
USB CHARGER
156

FIG. 31

FIG. 32

| SA Battery State | HST Battery State | SA Mode | Charging Mode | SA Boost | SA Charger | HST Charger & Boost |
|---|---|---|---|---|---|---|
| SA>Vh | HST>SA | Standby | Supply from HST Battery | Disabled | Fixed voltage=SA | Disabled |
| | Vm<HST<SA | High | Supply from SA and HST Battery | Disabled | Fixed current=STBC | Disabled |
| | | All | No Charge | Disabled | No charge | Disabled |
| | HST<Vm | All | Charge from SA Battery | Disabled | No charge | Enabled |
| V1<SA<Vh | HST>SA+Vc | All | Supply from HST Battery | Disabled | Fixed current=CC | Disabled |
| | SA<HST<SA+Vc | Standby | Supply from SA and HST Battery | Disabled | Fixed voltage=SA | Disabled |
| | | High | Charge from SA Battery | Disabled | Fixed current=STBC | Disabled |
| | Vm<HST<SA | All | No Charge | Disabled | No charge | Disabled |
| | HST<Vm | All | Charge from SA Battery | Disabled | No charge | Enabled |
| SA<V1 | HST>SA+Vc | All | Charge from HST Battery | Disabled | Fixed current=CC | Disabled |
| | Vm<HST<SA+Vc | All | Charge from HST Battery | Enabled | Fixed current=CC | Disabled |
| | HST<Vm | All | No Charge | Disabled | No charge | Disabled |

FIG. 33A

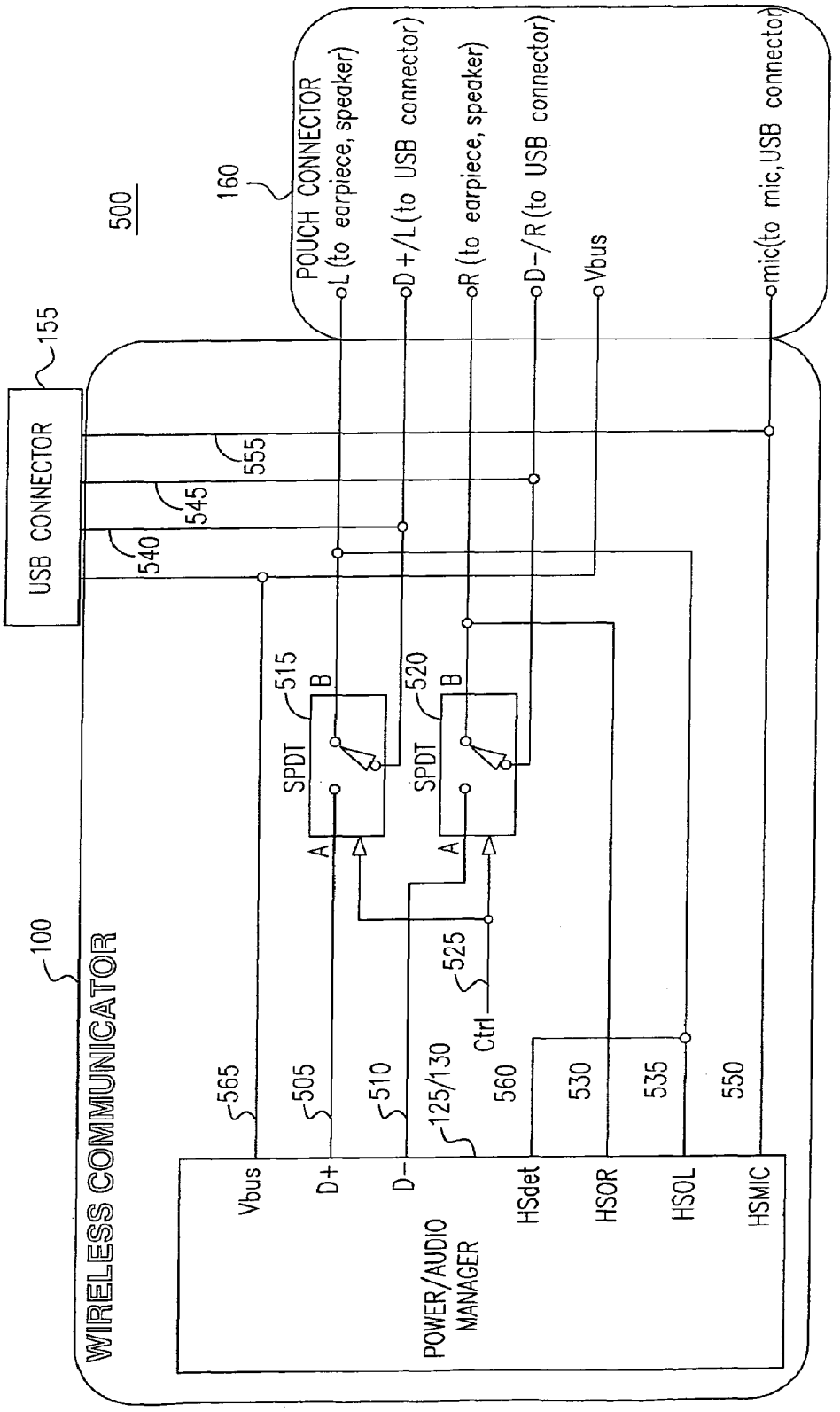
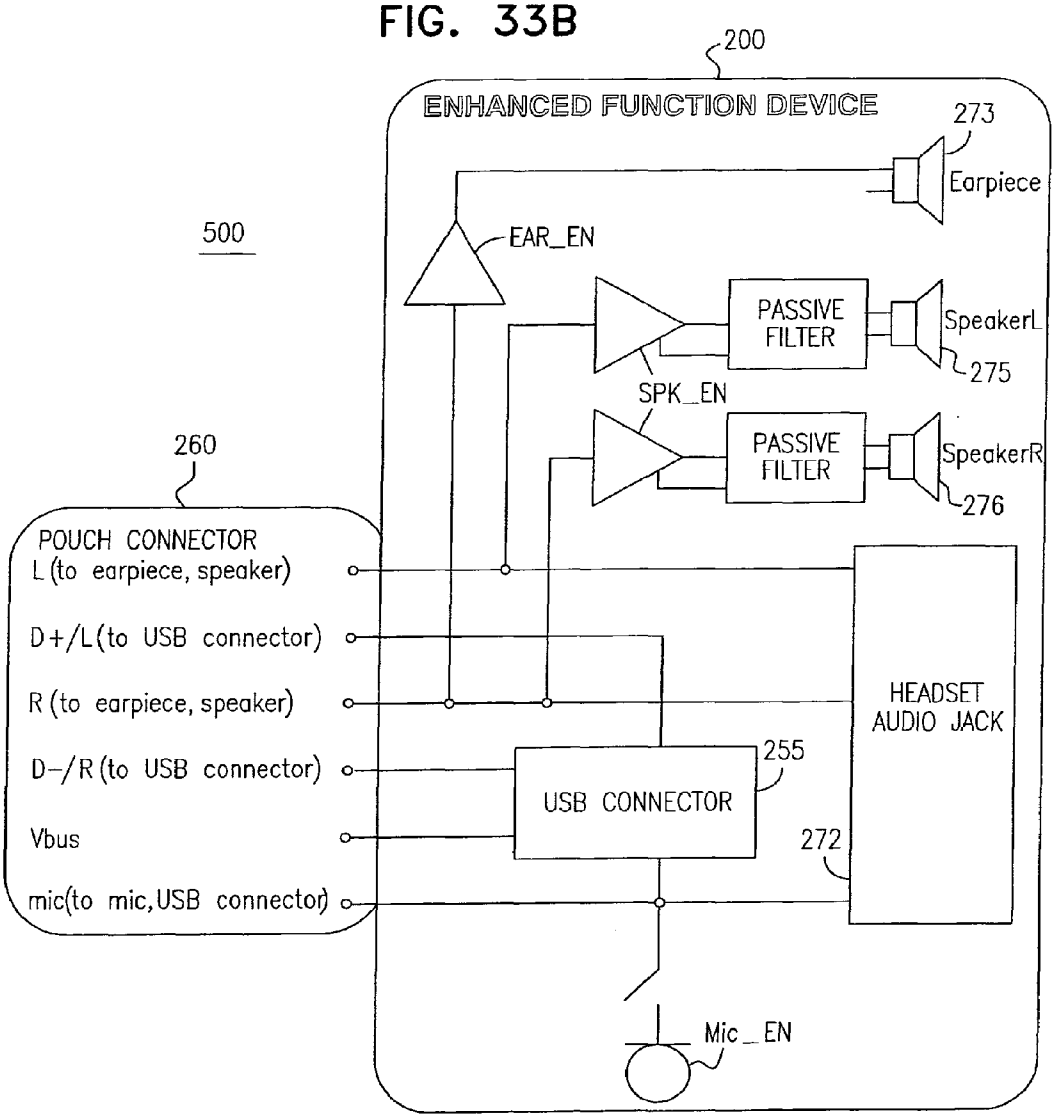

500
160
POUCH CONNECTOR
L (to earpiece, speaker)
D +/L (to USB connector)
R (to earpiece, speaker)
D −/R (to USB connector)
Vbus
mic(to mic,USB connector)
155
USB CONNECTOR
555
545
540
100
WIRELESS COMMUNICATOR
SPDT
515
520
A
B
565
505
510
125/130
525
560
530
535
550
Ctrl
Vbus
D+
D−
HSdet
HSOR
HSOL
HSMIC
POWER/AUDIO MANAGER

FIG. 33B


200
ENHANCED FUNCTION DEVICE
273
Earpiece
500
EAR_EN
PASSIVE FILTER
SpeakerL
275
SPK_EN
260
PASSIVE FILTER
SpeakerR
276
POUCH CONNECTOR
L (to earpiece, speaker)
D+/L (to USB connector)
R (to earpiece, speaker)
D−/R (to USB connector)
Vbus
mic(to mic, USB connector)
HEADSET AUDIO JACK
255
USB CONNECTOR
272
Mic_EN

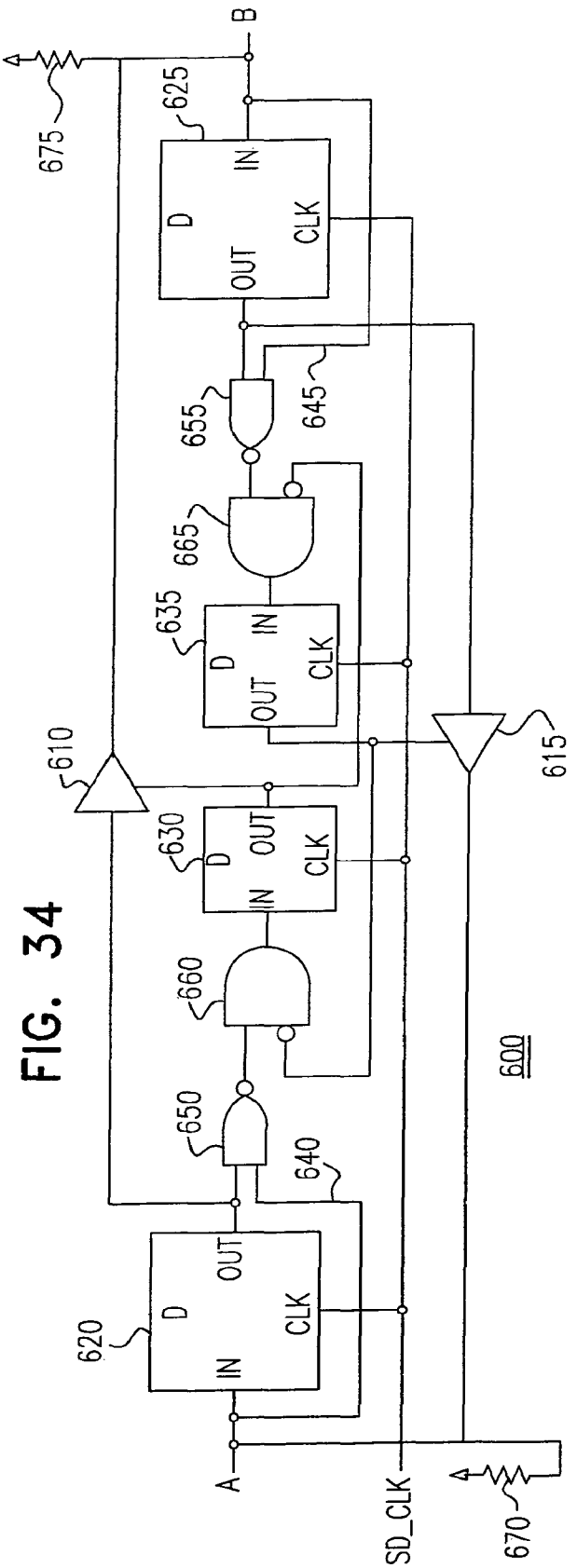

A
B
675
625
IN
D
OUT
CLK
645
655
665
635
610
615
630
660
650
640
620
600
SD_CLK
670

FIG. 34

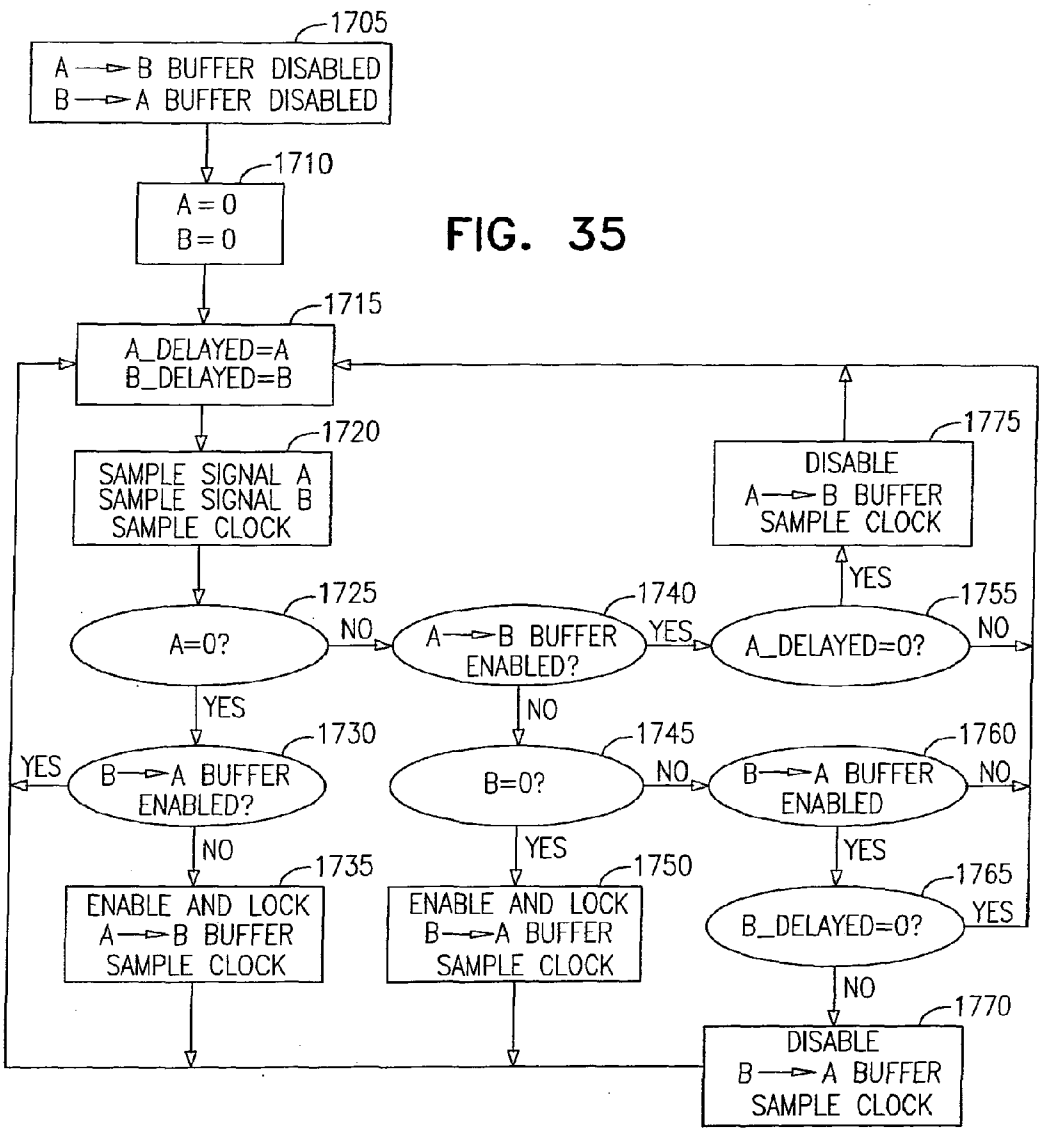

1705
A → B BUFFER DISABLED
B → A BUFFER DISABLED
1710
A = 0
B = 0
1715
A_DELAYED=A
B_DELAYED=B
1720
SAMPLE SIGNAL A
SAMPLE SIGNAL B
SAMPLE CLOCK
1725
A=0?
NO
YES
1730
B → A BUFFER ENABLED?
YES
NO
1735
ENABLE AND LOCK
A → B BUFFER
SAMPLE CLOCK
1740
A → B BUFFER ENABLED?
YES
NO
1745
B=0?
NO
YES
1750
ENABLE AND LOCK
B → A BUFFER
SAMPLE CLOCK
1755
A_DELAYED=0?
NO
YES
1760
B → A BUFFER ENABLED
NO
YES
1765
B_DELAYED=0?
YES
NO
1770
DISABLE
B → A BUFFER
SAMPLE CLOCK
1775
DISABLE
A → B BUFFER
SAMPLE CLOCK

FIG. 35

FIG. 36

SAMPLE A AND B SIGNALS FOR SSD/MMC BRIDGE LOGIC

| A | 1 | 1 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | x | x | x | x | x | x | x |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Logic A (DFF_EnAB.in) | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| DFF_EnAB.out | | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Out A (BufferAtoB.out) | | x | x | 0 | 0 | 1 | 0 | 1 | 0 | 1 | x | x | 0 | 1 | x | x | x | x | x | x | x | x |
| B | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | 0 | 0 | 1 | 0 | 1 | 1 | 1 |
| Logic B (DFF_EnBA.in) | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 |
| DFF_EnBA.out | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 |
| Out B (BufferBtoB.out) | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | 0 | 0 | 1 | 0 | 1 | x |

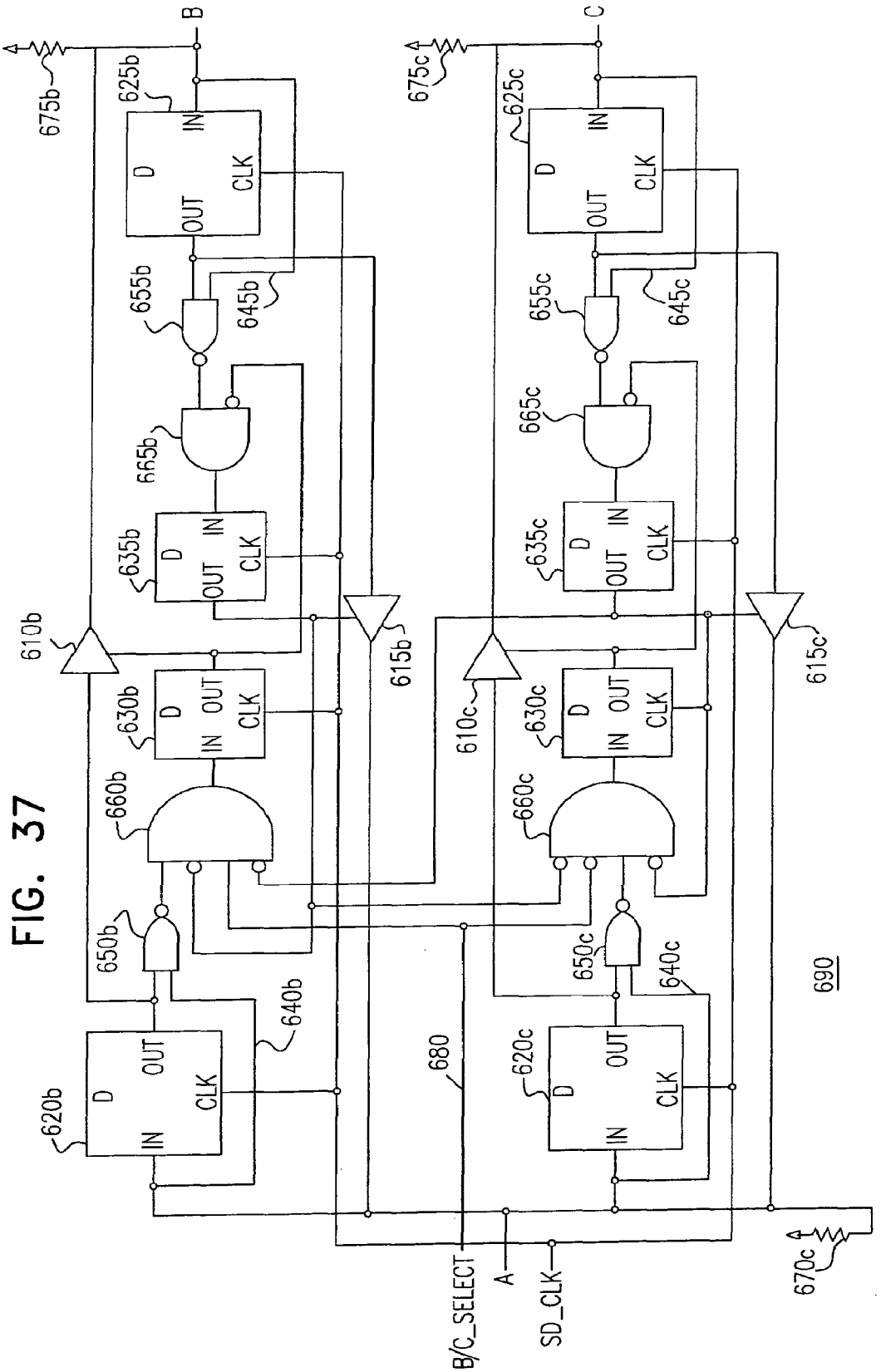

B
C
675b
675c
625b
625c
655b
655c
645b
645c
665b
665c
635b
635c
610b
610c
615b
615c
630b
630c
660b
660c
650b
650c
640b
640c
620b
620c
680
690
670c
B/C_SELECT
A
SD_CLK

FIG. 37

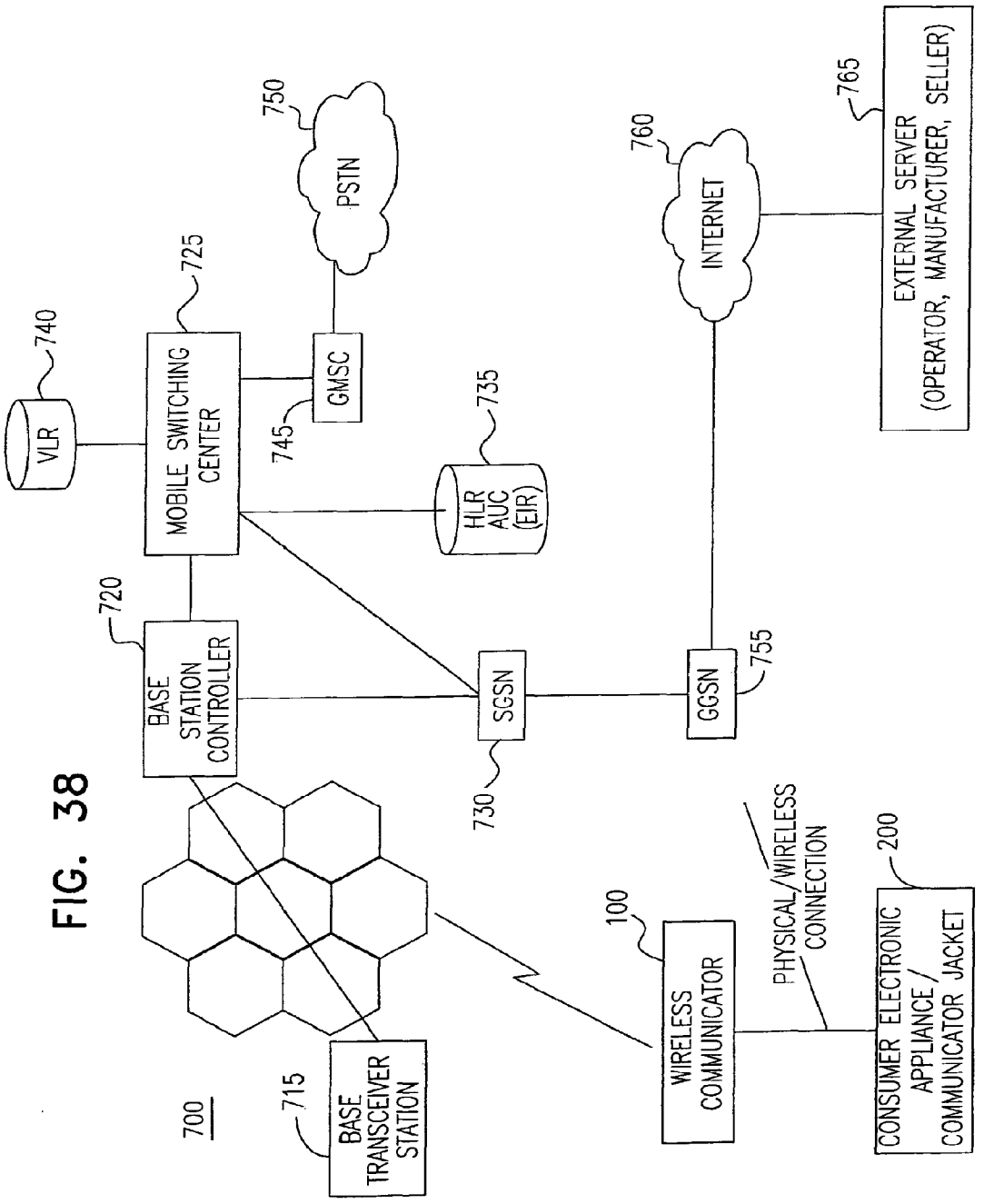

700
715
BASE TRANSCEIVER STATION
720
BASE STATION CONTROLLER
740
VLR
725
MOBILE SWITCHING CENTER
745
GMSC
750
PSTN
735
HLR AUC (EIR)
730
SGSN
755
GGSN
760
INTERNET
765
EXTERNAL SERVER (OPERATOR, MANUFACTURER, SELLER)
100
WIRELESS COMMUNICATOR
PHYSICAL/WIRELESS CONNECTION
200
CONSUMER ELECTRONIC APPLIANCE / COMMUNICATOR JACKET

FIG. 38

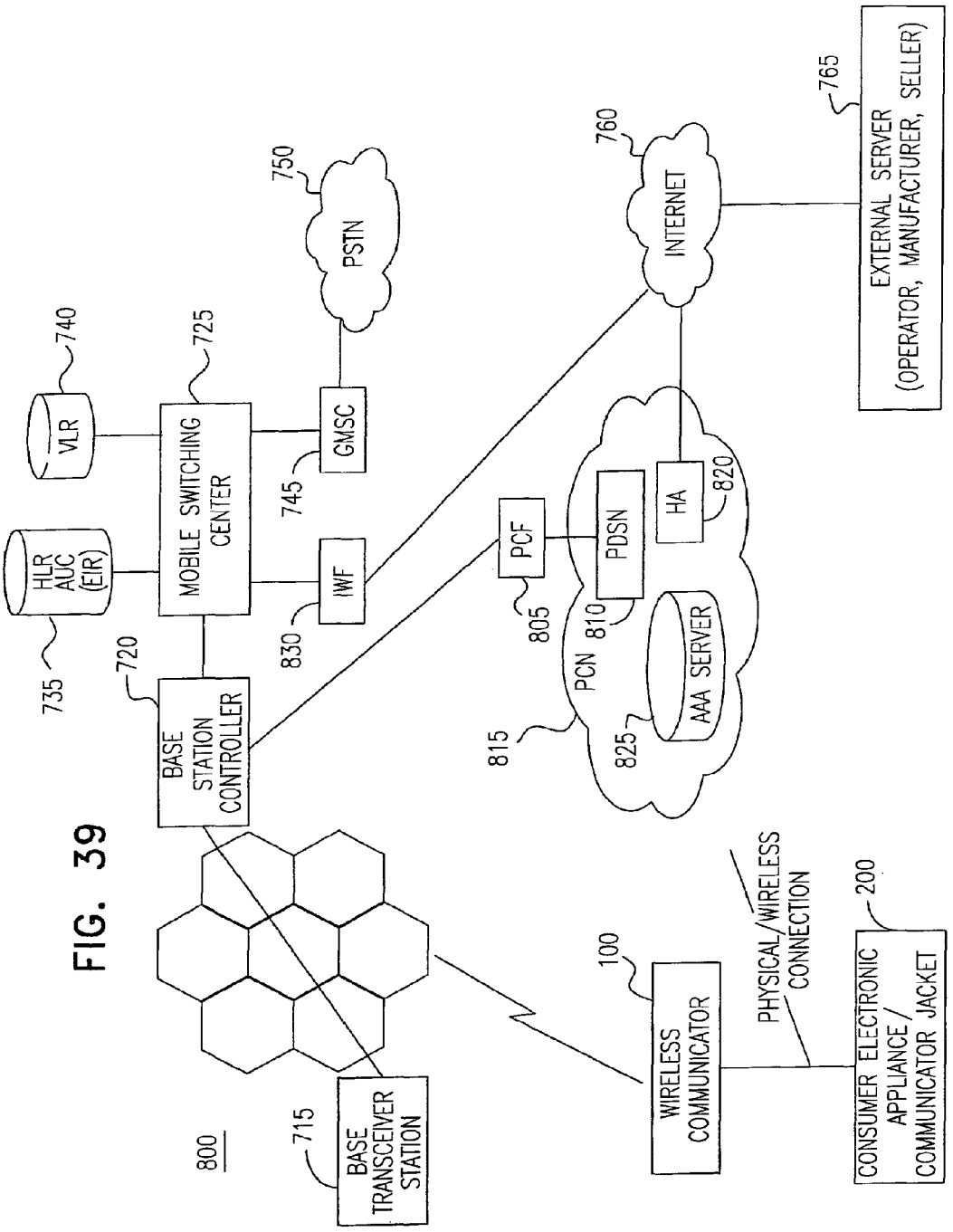

800
715
BASE TRANSCEIVER STATION
720
BASE STATION CONTROLLER
735
HLR AUC (EIR)
740
VLR
725
MOBILE SWITCHING CENTER
745
GMSC
750
PSTN
830
IWF
805
PCF
810
PDSN
820
HA
815
PCN
825
AAA SERVER
760
INTERNET
765
EXTERNAL SERVER (OPERATOR, MANUFACTURER, SELLER)
100
WIRELESS COMMUNICATOR
PHYSICAL/WIRELESS CONNECTION
200
CONSUMER ELECTRONIC APPLIANCE / COMMUNICATOR JACKET

FIG. 39

FIG. 40

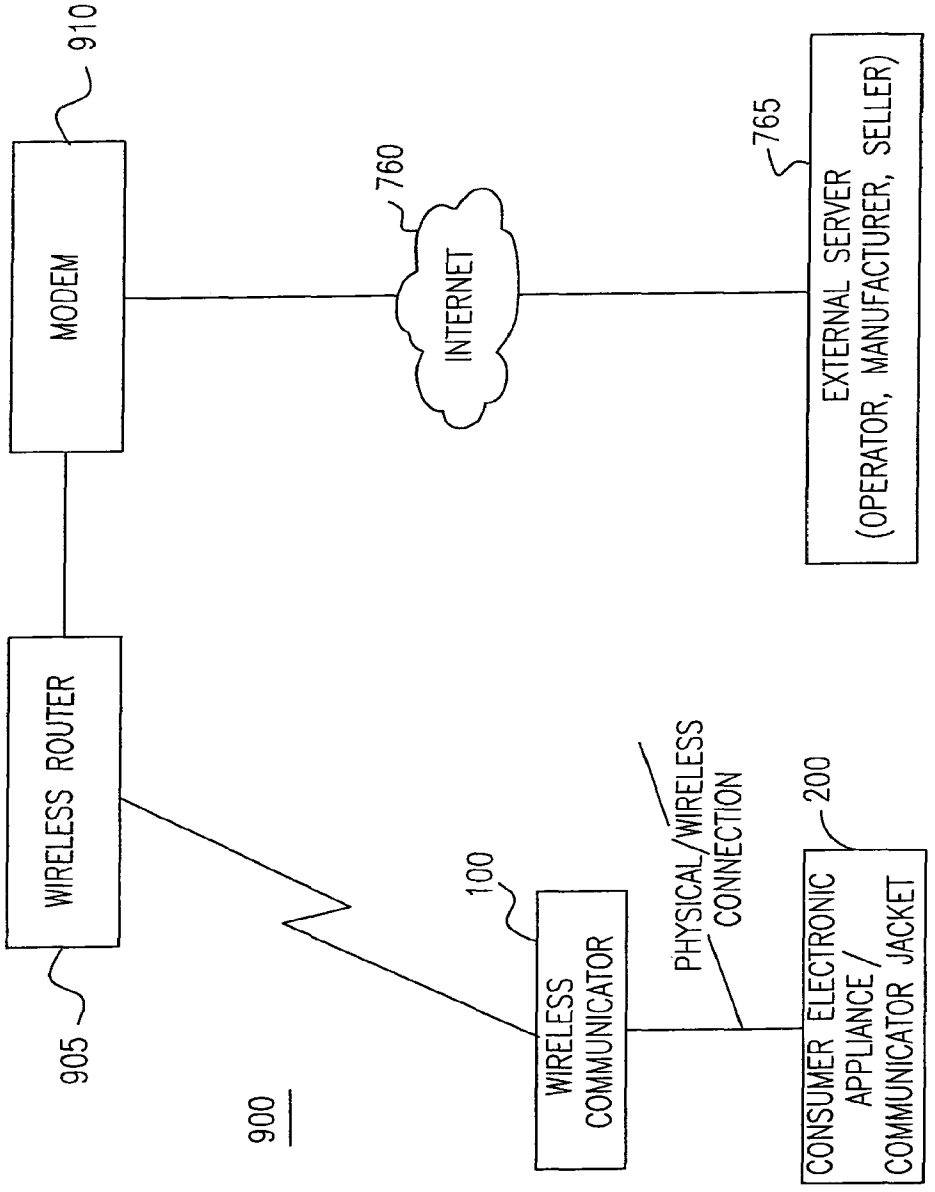

900
905
WIRELESS ROUTER
910
MODEM
760
INTERNET
765
EXTERNAL SERVER
(OPERATOR, MANUFACTURER, SELLER)
100
WIRELESS COMMUNICATOR
PHYSICAL/WIRELESS CONNECTION
200
CONSUMER ELECTRONIC APPLIANCE / COMMUNICATOR JACKET

FIG. 41

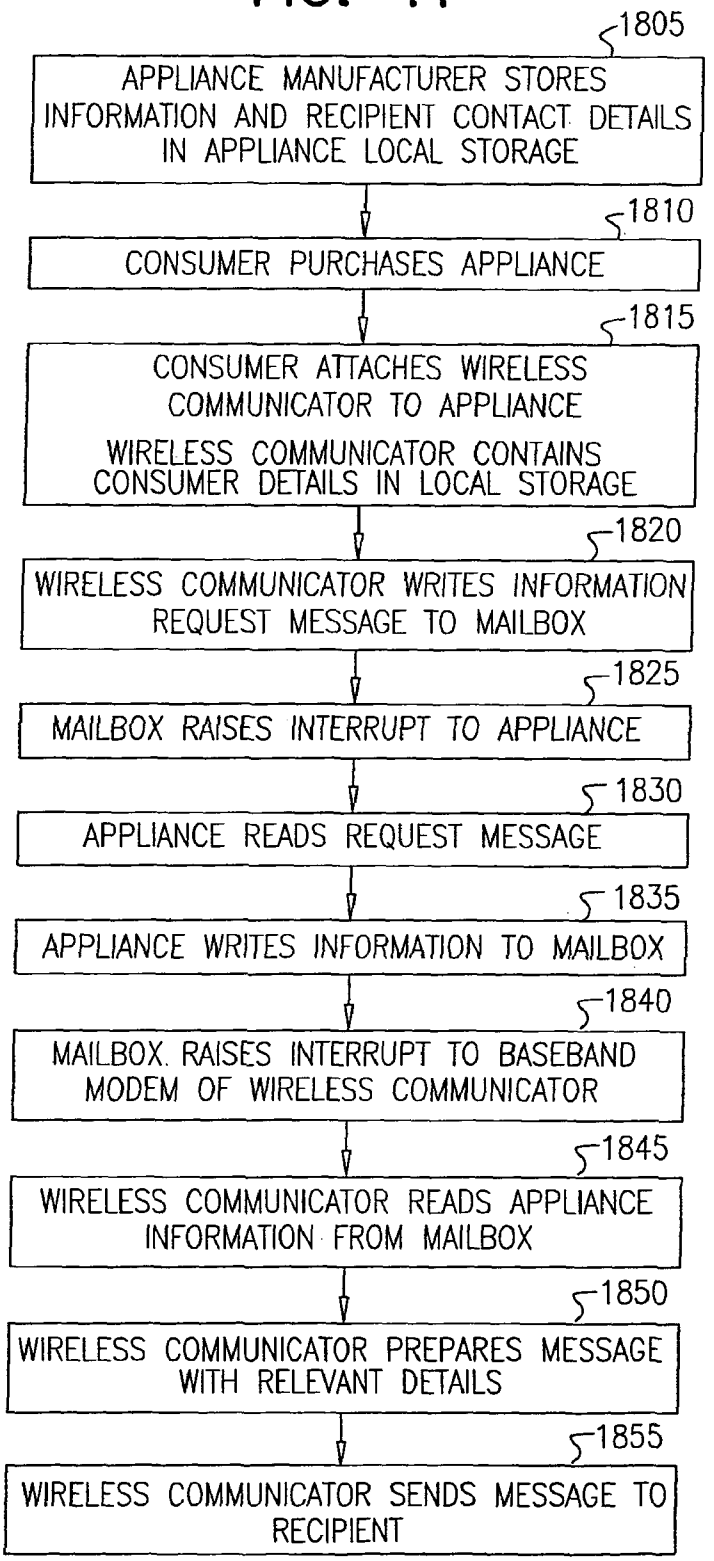
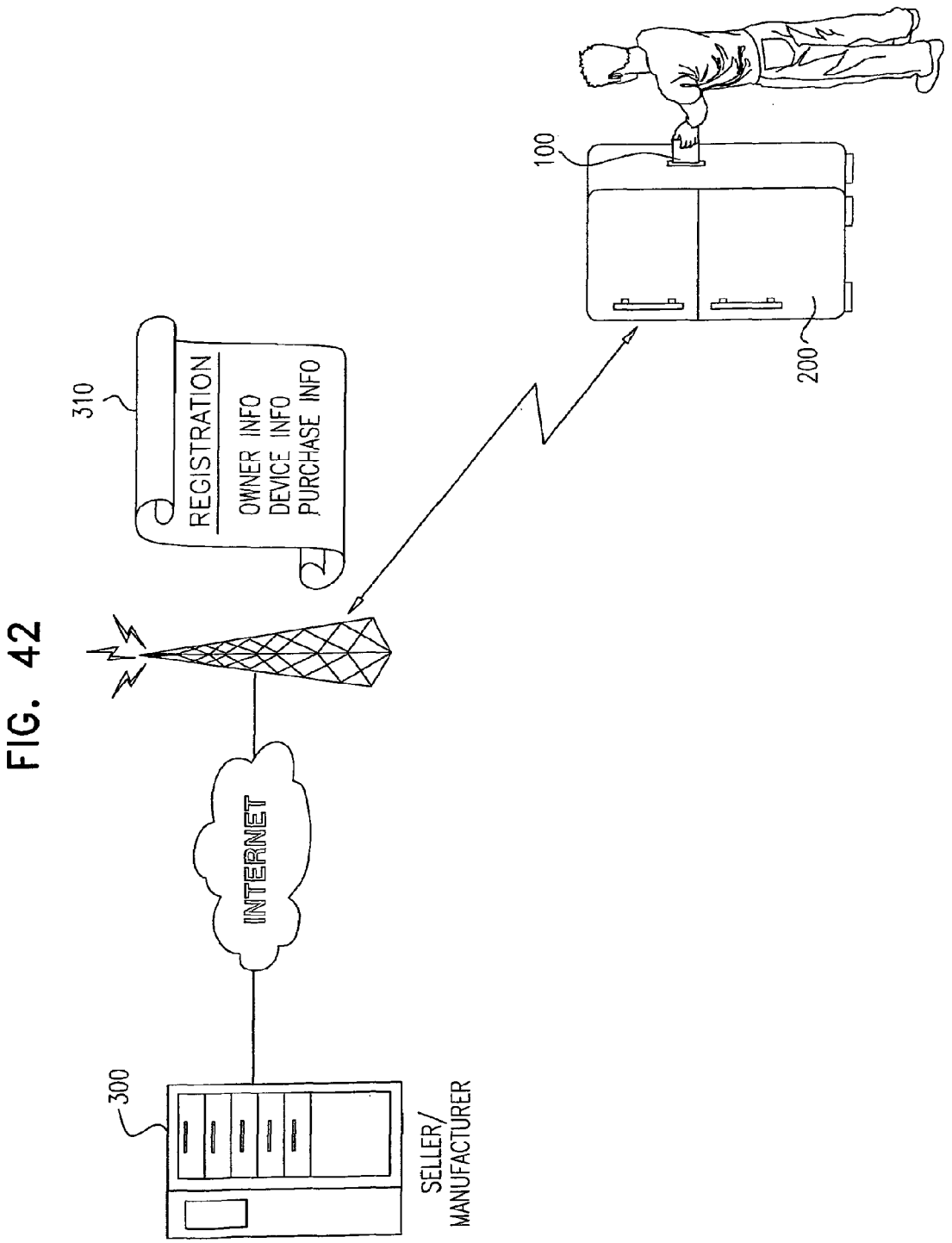

1805
APPLIANCE MANUFACTURER STORES INFORMATION AND RECIPIENT CONTACT DETAILS IN APPLIANCE LOCAL STORAGE
1810
CONSUMER PURCHASES APPLIANCE
1815
CONSUMER ATTACHES WIRELESS COMMUNICATOR TO APPLIANCE
WIRELESS COMMUNICATOR CONTAINS CONSUMER DETAILS IN LOCAL STORAGE
1820
WIRELESS COMMUNICATOR WRITES INFORMATION REQUEST MESSAGE TO MAILBOX
1825
MAILBOX RAISES INTERRUPT TO APPLIANCE
1830
APPLIANCE READS REQUEST MESSAGE
1835
APPLIANCE WRITES INFORMATION TO MAILBOX
1840
MAILBOX RAISES INTERRUPT TO BASEBAND MODEM OF WIRELESS COMMUNICATOR
1845
WIRELESS COMMUNICATOR READS APPLIANCE INFORMATION FROM MAILBOX
1850
WIRELESS COMMUNICATOR PREPARES MESSAGE WITH RELEVANT DETAILS
1855
WIRELESS COMMUNICATOR SENDS MESSAGE TO RECIPIENT

FIG. 42


100
200
310
REGISTRATION
OWNER INFO
DEVICE INFO
PURCHASE INFO
INTERNET
300
SELLER/
MANUFACTURER

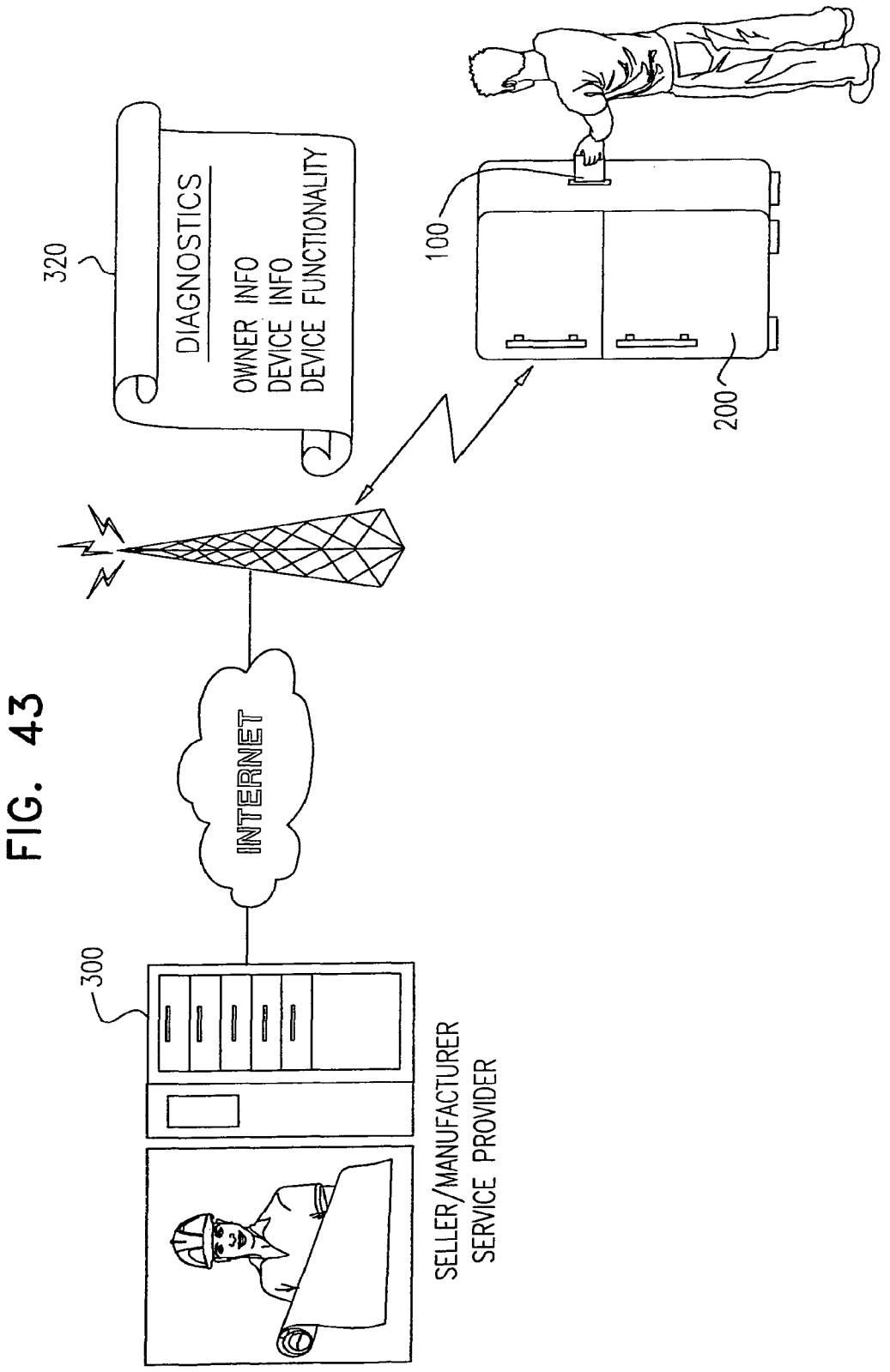

320
DIAGNOSTICS
OWNER INFO
DEVICE INFO
DEVICE FUNCTIONALITY
100
200
INTERNET
300
SELLER/MANUFACTURER
SERVICE PROVIDER

FIG. 43

FIG. 44

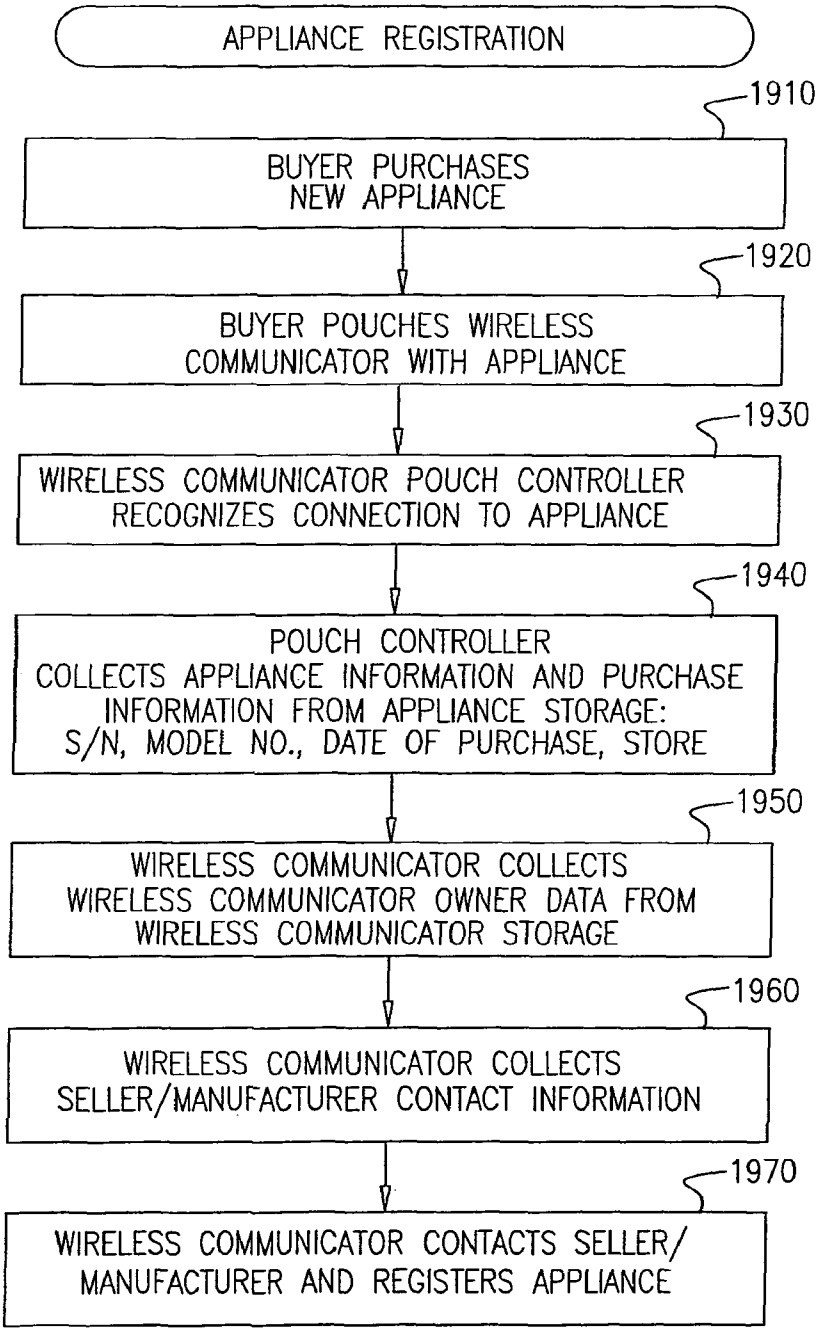

APPLIANCE REGISTRATION
1910
BUYER PURCHASES NEW APPLIANCE
1920
BUYER POUCHES WIRELESS COMMUNICATOR WITH APPLIANCE
1930
WIRELESS COMMUNICATOR POUCH CONTROLLER RECOGNIZES CONNECTION TO APPLIANCE
1940
POUCH CONTROLLER COLLECTS APPLIANCE INFORMATION AND PURCHASE INFORMATION FROM APPLIANCE STORAGE: S/N, MODEL NO., DATE OF PURCHASE, STORE
1950
WIRELESS COMMUNICATOR COLLECTS WIRELESS COMMUNICATOR OWNER DATA FROM WIRELESS COMMUNICATOR STORAGE
1960
WIRELESS COMMUNICATOR COLLECTS SELLER/MANUFACTURER CONTACT INFORMATION
1970
WIRELESS COMMUNICATOR CONTACTS SELLER/ MANUFACTURER AND REGISTERS APPLIANCE

FIG. 45

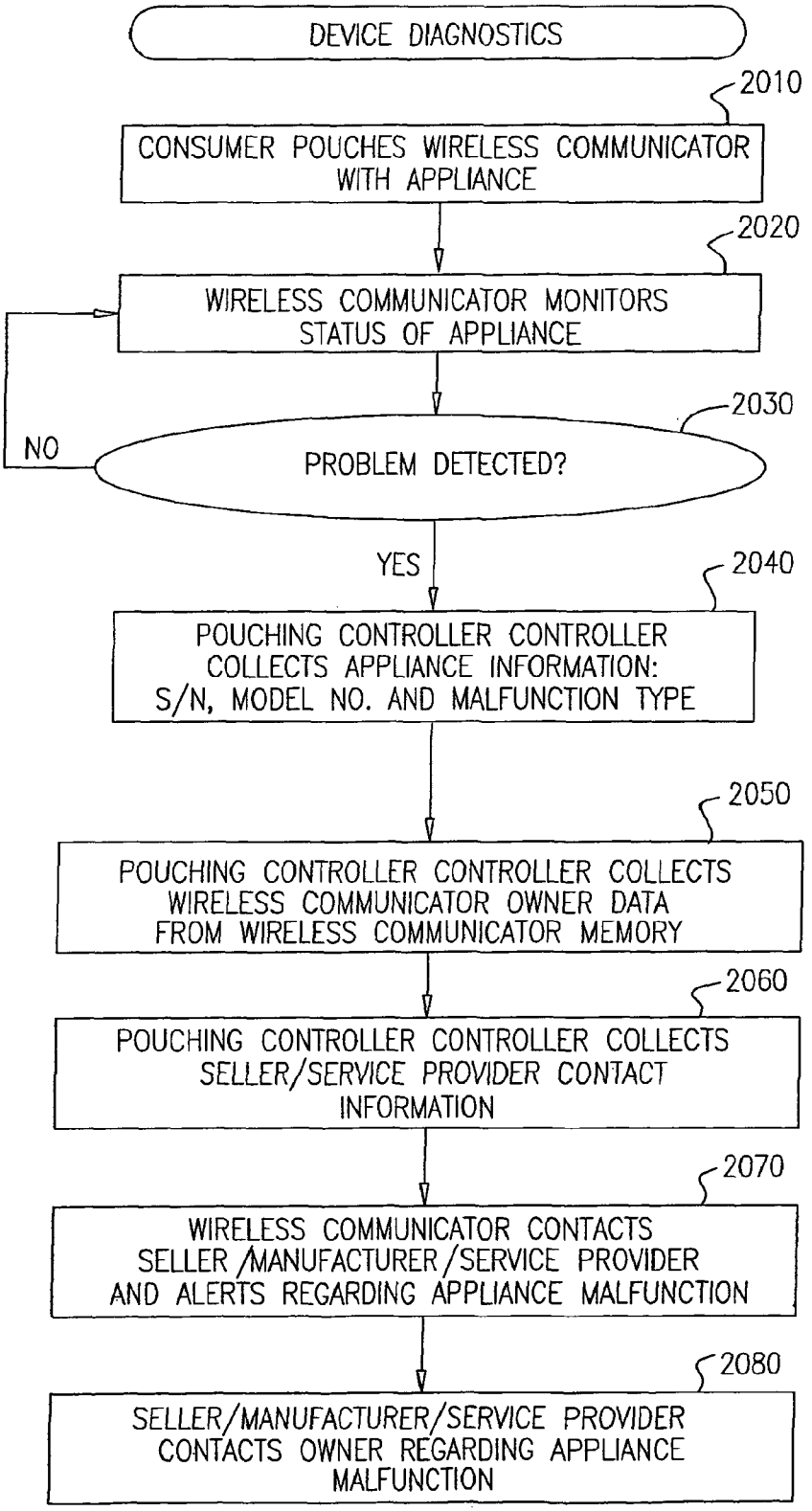

DEVICE DIAGNOSTICS
2010
CONSUMER POUCHES WIRELESS COMMUNICATOR WITH APPLIANCE
2020
WIRELESS COMMUNICATOR MONITORS STATUS OF APPLIANCE
2030
NO
PROBLEM DETECTED?
YES
2040
POUCHING CONTROLLER CONTROLLER COLLECTS APPLIANCE INFORMATION: S/N, MODEL NO. AND MALFUNCTION TYPE
2050
POUCHING CONTROLLER CONTROLLER COLLECTS WIRELESS COMMUNICATOR OWNER DATA FROM WIRELESS COMMUNICATOR MEMORY
2060
POUCHING CONTROLLER CONTROLLER COLLECTS SELLER/SERVICE PROVIDER CONTACT INFORMATION
2070
WIRELESS COMMUNICATOR CONTACTS SELLER /MANUFACTURER /SERVICE PROVIDER AND ALERTS REGARDING APPLIANCE MALFUNCTION
2080
SELLER/MANUFACTURER/SERVICE PROVIDER CONTACTS OWNER REGARDING APPLIANCE MALFUNCTION

FIG. 46

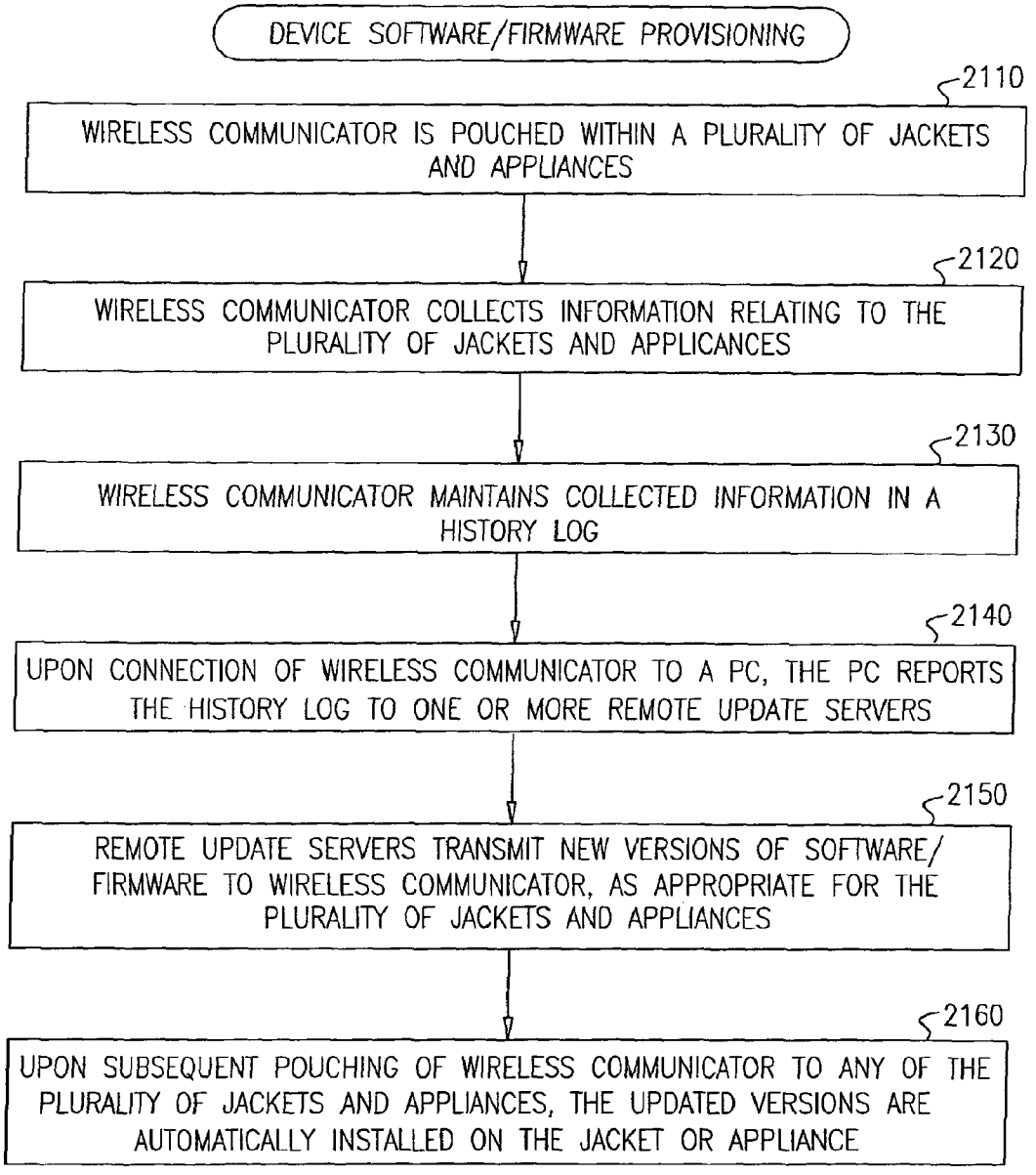

DEVICE SOFTWARE/FIRMWARE PROVISIONING
2110
WIRELESS COMMUNICATOR IS POUCHED WITHIN A PLURALITY OF JACKETS AND APPLIANCES
2120
WIRELESS COMMUNICATOR COLLECTS INFORMATION RELATING TO THE PLURALITY OF JACKETS AND APPLICANCES
2130
WIRELESS COMMUNICATOR MAINTAINS COLLECTED INFORMATION IN A HISTORY LOG
2140
UPON CONNECTION OF WIRELESS COMMUNICATOR TO A PC, THE PC REPORTS THE HISTORY LOG TO ONE OR MORE REMOTE UPDATE SERVERS
2150
REMOTE UPDATE SERVERS TRANSMIT NEW VERSIONS OF SOFTWARE/ FIRMWARE TO WIRELESS COMMUNICATOR, AS APPROPRIATE FOR THE PLURALITY OF JACKETS AND APPLIANCES
2160
UPON SUBSEQUENT POUCHING OF WIRELESS COMMUNICATOR TO ANY OF THE PLURALITY OF JACKETS AND APPLIANCES, THE UPDATED VERSIONS ARE AUTOMATICALLY INSTALLED ON THE JACKET OR APPLIANCE

FIG. 47

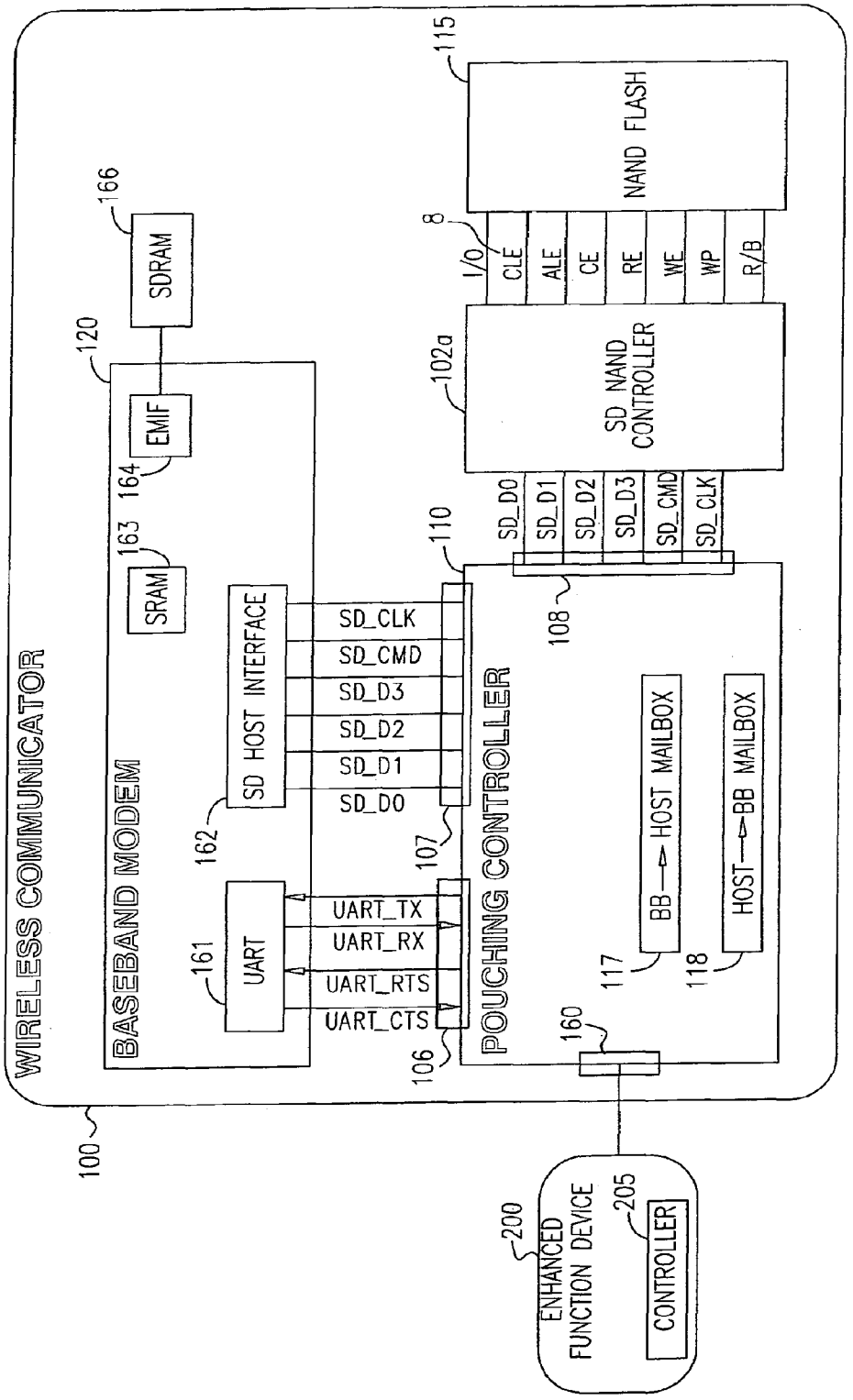

WIRELESS COMMUNICATOR
100
BASEBAND MODEM
120
SDRAM
166
EMIF
164
SRAM
163
SD HOST INTERFACE
162
SD_CLK
SD_CMD
SD_D3
SD_D2
SD_D1
SD_D0
UART
161
UART_TX
UART_RX
UART_RTS
UART_CTS
106
107
110
POUCHING CONTROLLER
108
SD_D0
SD_D1
SD_D2
SD_D3
SD_CMD
SD_CLK
SD NAND CONTROLLER
102a
8
I/O
CLE
ALE
CE
RE
WE
WP
R/B
NAND FLASH
115
BB → HOST MAILBOX
117
HOST → BB MAILBOX
118
160
ENHANCED FUNCTION DEVICE
200
CONTROLLER
205

FIG. 48

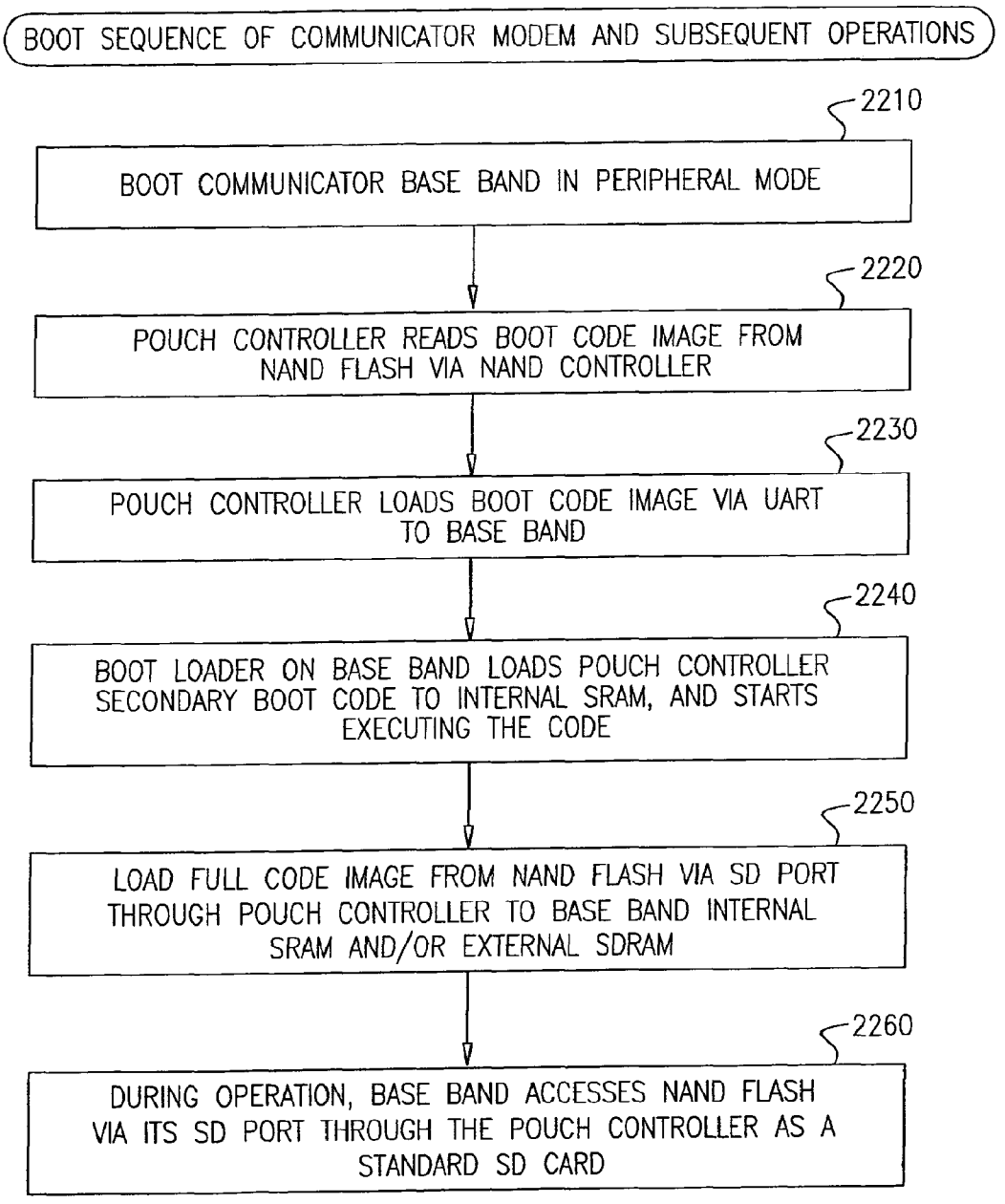

BOOT SEQUENCE OF COMMUNICATOR MODEM AND SUBSEQUENT OPERATIONS
2210
BOOT COMMUNICATOR BASE BAND IN PERIPHERAL MODE
2220
POUCH CONTROLLER READS BOOT CODE IMAGE FROM NAND FLASH VIA NAND CONTROLLER
2230
POUCH CONTROLLER LOADS BOOT CODE IMAGE VIA UART TO BASE BAND
2240
BOOT LOADER ON BASE BAND LOADS POUCH CONTROLLER SECONDARY BOOT CODE TO INTERNAL SRAM, AND STARTS EXECUTING THE CODE
2250
LOAD FULL CODE IMAGE FROM NAND FLASH VIA SD PORT THROUGH POUCH CONTROLLER TO BASE BAND INTERNAL SRAM AND/OR EXTERNAL SDRAM
2260
DURING OPERATION, BASE BAND ACCESSES NAND FLASH VIA ITS SD PORT THROUGH THE POUCH CONTROLLER AS A STANDARD SD CARD

FIG. 49

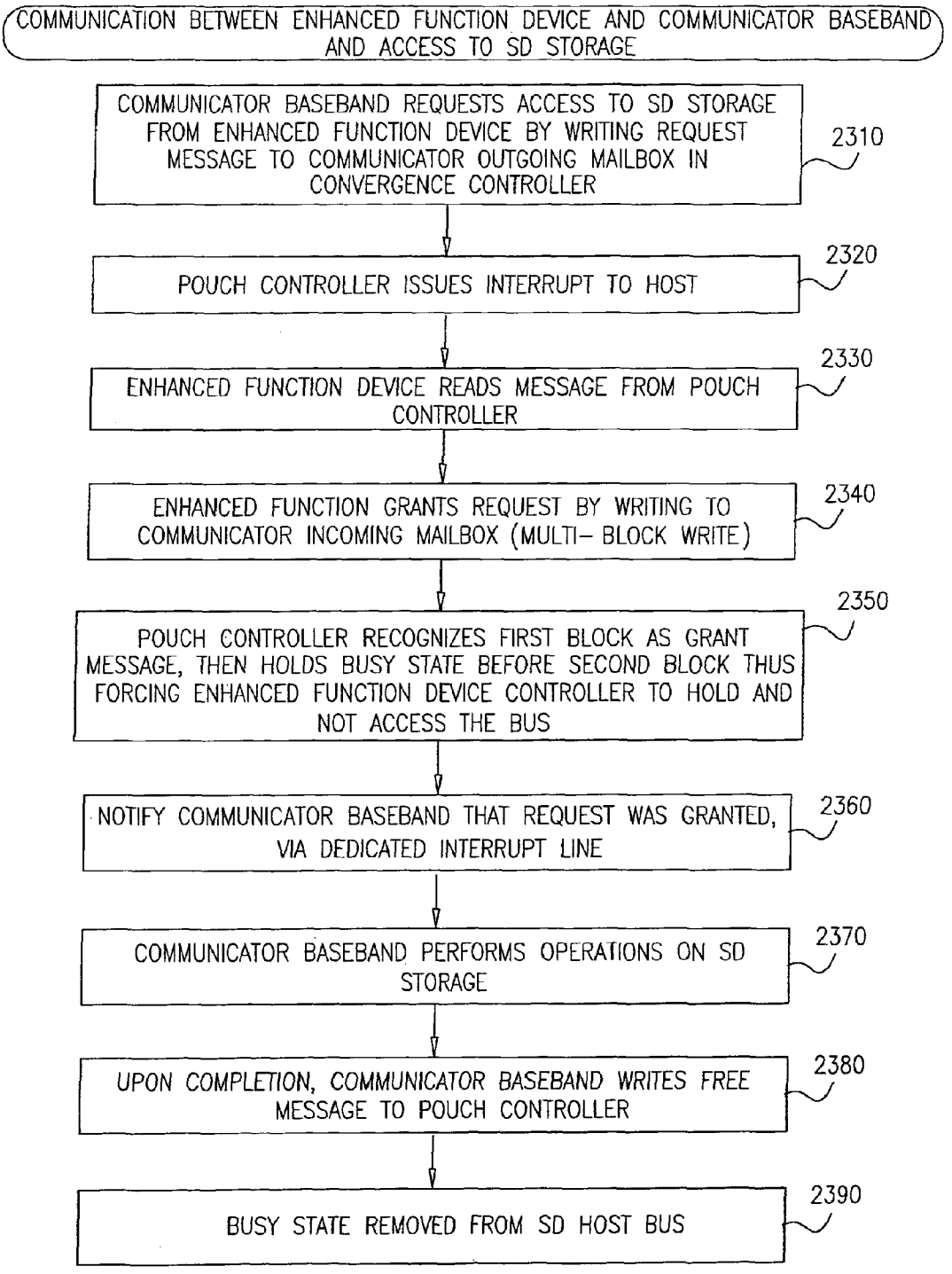

COMMUNICATION BETWEEN ENHANCED FUNCTION DEVICE AND COMMUNICATOR BASEBAND AND ACCESS TO SD STORAGE
COMMUNICATOR BASEBAND REQUESTS ACCESS TO SD STORAGE FROM ENHANCED FUNCTION DEVICE BY WRITING REQUEST MESSAGE TO COMMUNICATOR OUTGOING MAILBOX IN CONVERGENCE CONTROLLER
2310
POUCH CONTROLLER ISSUES INTERRUPT TO HOST
2320
ENHANCED FUNCTION DEVICE READS MESSAGE FROM POUCH CONTROLLER
2330
ENHANCED FUNCTION GRANTS REQUEST BY WRITING TO COMMUNICATOR INCOMING MAILBOX (MULTI– BLOCK WRITE)
2340
POUCH CONTROLLER RECOGNIZES FIRST BLOCK AS GRANT MESSAGE, THEN HOLDS BUSY STATE BEFORE SECOND BLOCK THUS FORCING ENHANCED FUNCTION DEVICE CONTROLLER TO HOLD AND NOT ACCESS THE BUS
2350
NOTIFY COMMUNICATOR BASEBAND THAT REQUEST WAS GRANTED, VIA DEDICATED INTERRUPT LINE
2360
COMMUNICATOR BASEBAND PERFORMS OPERATIONS ON SD STORAGE
2370
UPON COMPLETION, COMMUNICATOR BASEBAND WRITES FREE MESSAGE TO POUCH CONTROLLER
2380
BUSY STATE REMOVED FROM SD HOST BUS
2390

FIG. 50A/1

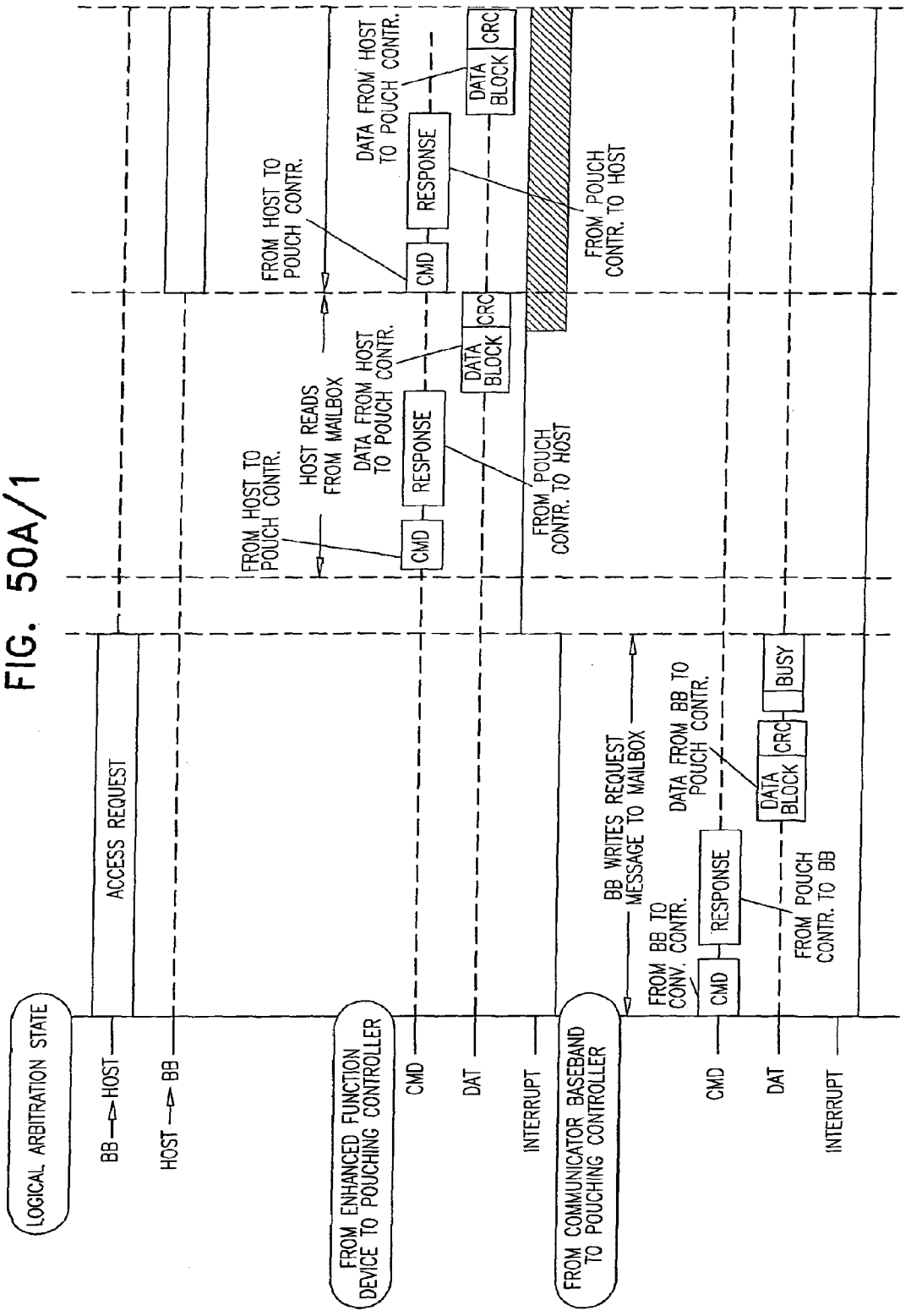

LOGICAL ARBITRATION STATE
BB → HOST
HOST → BB
ACCESS REQUEST
FROM ENHANCED FUNCTION DEVICE TO POUCHING CONTROLLER
CMD
DAT
INTERRUPT
FROM COMMUNICATOR BASEBAND TO POUCHING CONTROLLER
FROM HOST TO POUCH CONTR.
CMD
HOST READS FROM MAILBOX
RESPONSE
DATA FROM HOST TO POUCH CONTR.
DATA BLOCK
CRC
FROM POUCH CONTR. TO HOST
BB WRITES REQUEST MESSAGE TO MAILBOX
FROM BB TO CONV. CONTR.
CMD
RESPONSE
DATA FROM BB TO POUCH CONTR.
DATA BLOCK
CRC
BUSY
FROM POUCH CONTR. TO BB
CMD
DAT
INTERRUPT

FIG. 50A/2

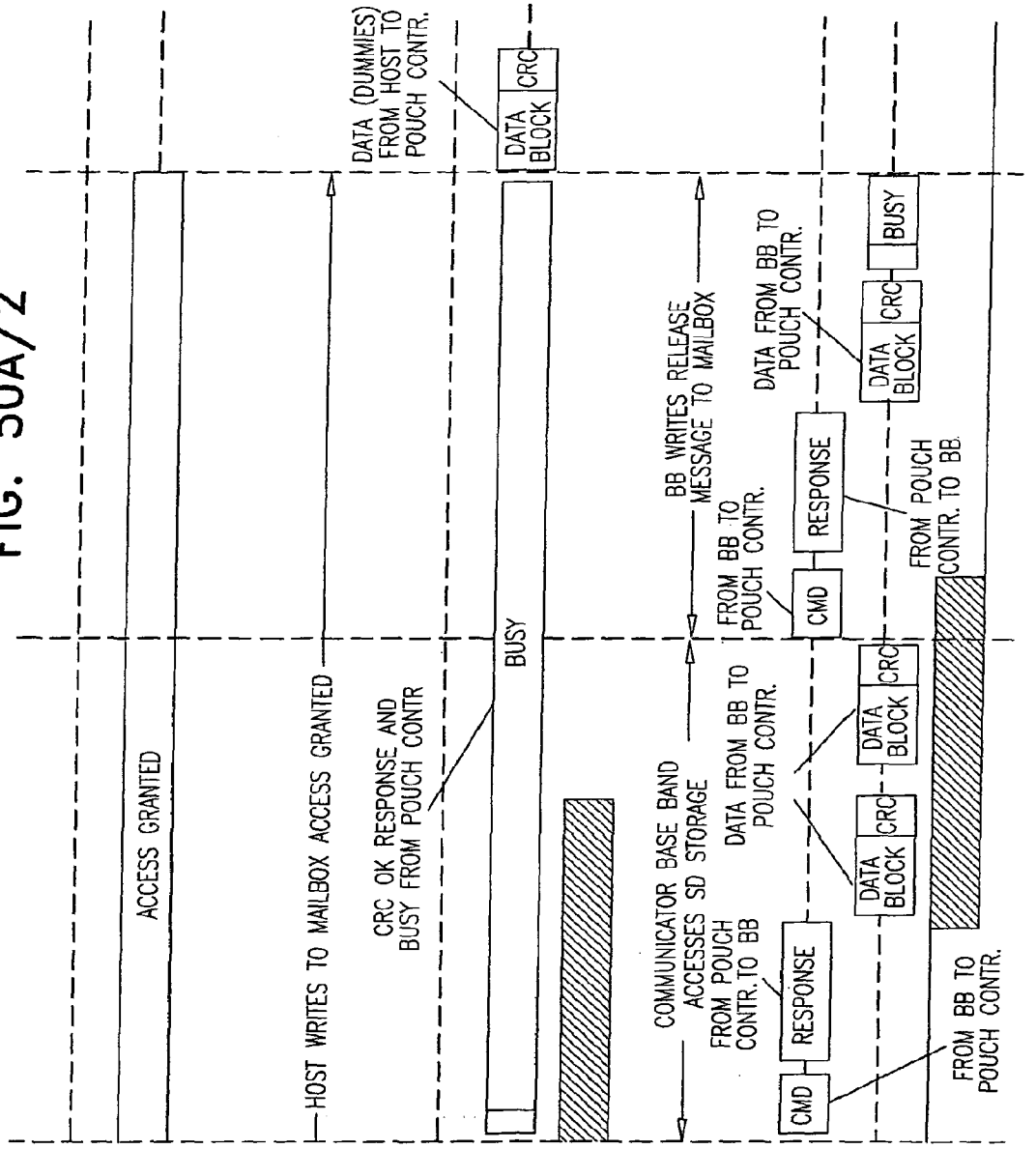

ACCESS GRANTED
HOST WRITES TO MAILBOX ACCESS GRANTED
CRC OK RESPONSE AND BUSY FROM POUCH CONTR
DATA (DUMMIES) FROM HOST TO POUCH CONTR.
DATA BLOCK
CRC
BUSY
COMMUNICATOR BASE BAND ACCESSES SD STORAGE
BB WRITES RELEASE MESSAGE TO MAILBOX
FROM POUCH CONTR. TO BB
CMD
RESPONSE
DATA FROM BB TO POUCH CONTR.
DATA BLOCK
CRC
FROM BB TO POUCH CONTR.
CMD
RESPONSE
DATA FROM BB TO POUCH CONTR.
DATA BLOCK
CRC
FROM POUCH CONTR. TO BB.
BUSY

FIG. 50B

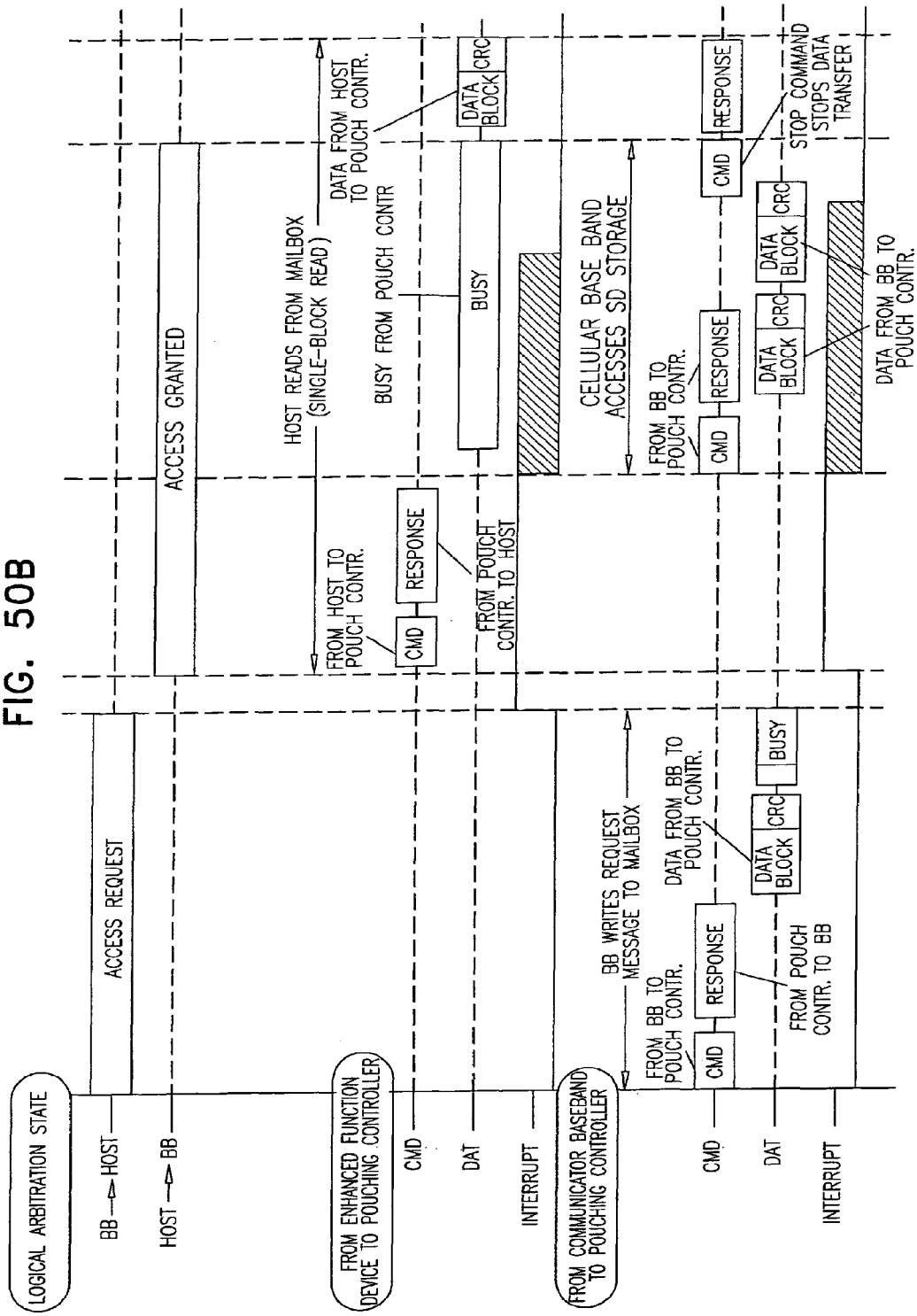

LOGICAL ARBITRATION STATE
BB → HOST
HOST → BB
ACCESS REQUEST
ACCESS GRANTED
FROM ENHANCED FUNCTION DEVICE TO POUCHING CONTROLLER
CMD
DAT
INTERRUPT
HOST READS FROM MAILBOX (SINGLE-BLOCK READ)
FROM HOST TO POUCH CONTR.
CMD
RESPONSE
BUSY FROM POUCH CONTR
DATA FROM HOST TO POUCH CONTR.
DATA BLOCK
CRC
BUSY
FROM POUCH CONTR. TO HOST
CELLULAR BASE BAND ACCESSES SD STORAGE
FROM COMMUNICATOR BASEBAND TO POUCHING CONTROLLER
BB WRITES REQUEST MESSAGE TO MAILBOX
FROM BB TO POUCH CONTR.
CMD
RESPONSE
DATA FROM BB TO POUCH CONTR.
DATA BLOCK
CRC
BUSY
FROM POUCH CONTR. TO BB
CMD
DAT
INTERRUPT
FROM BB TO POUCH CONTR.
CMD
RESPONSE
DATA BLOCK
CRC
DATA FROM BB TO POUCH CONTR.
CMD
RESPONSE
STOP COMMAND STOPS DATA TRANSFER

FIG. 51

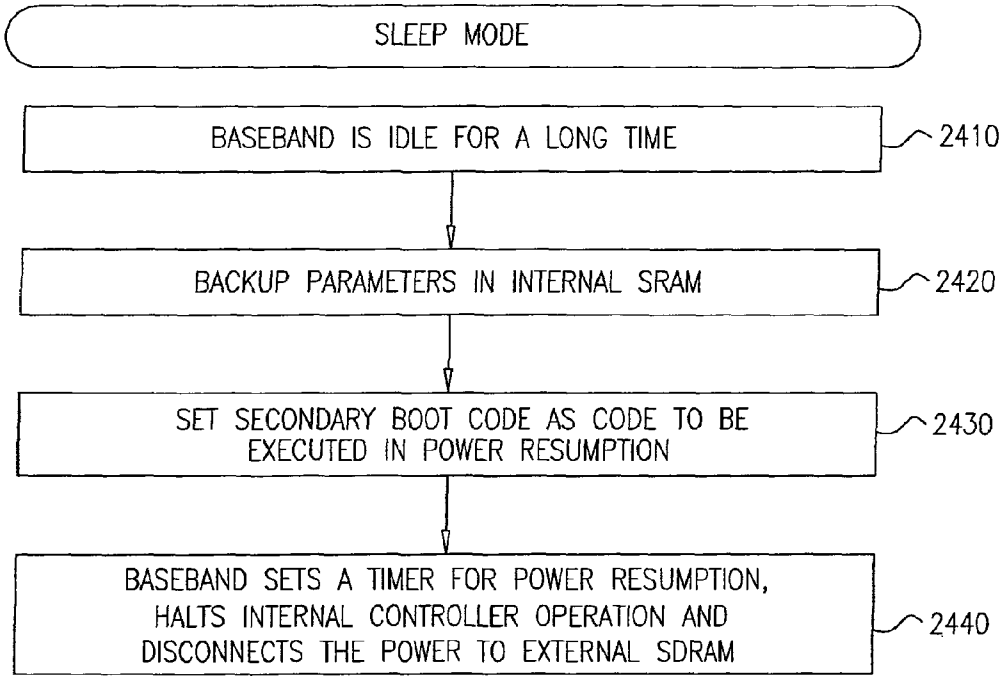

SLEEP MODE
BASEBAND IS IDLE FOR A LONG TIME
2410
BACKUP PARAMETERS IN INTERNAL SRAM
2420
SET SECONDARY BOOT CODE AS CODE TO BE EXECUTED IN POWER RESUMPTION
2430
BASEBAND SETS A TIMER FOR POWER RESUMPTION, HALTS INTERNAL CONTROLLER OPERATION AND DISCONNECTS THE POWER TO EXTERNAL SDRAM
2440

FIG. 52

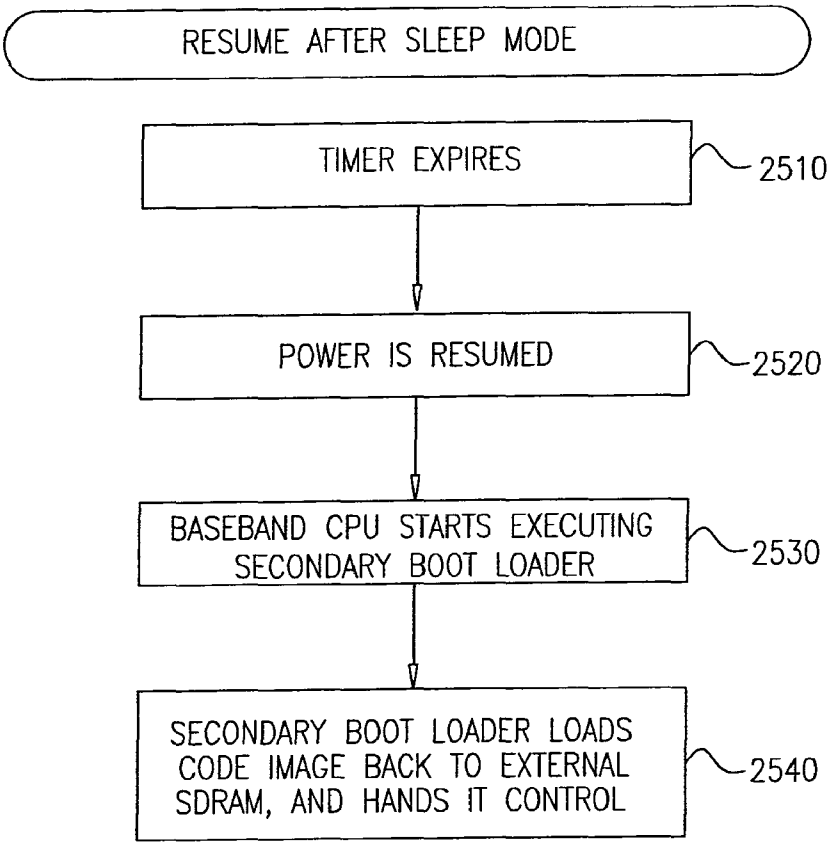
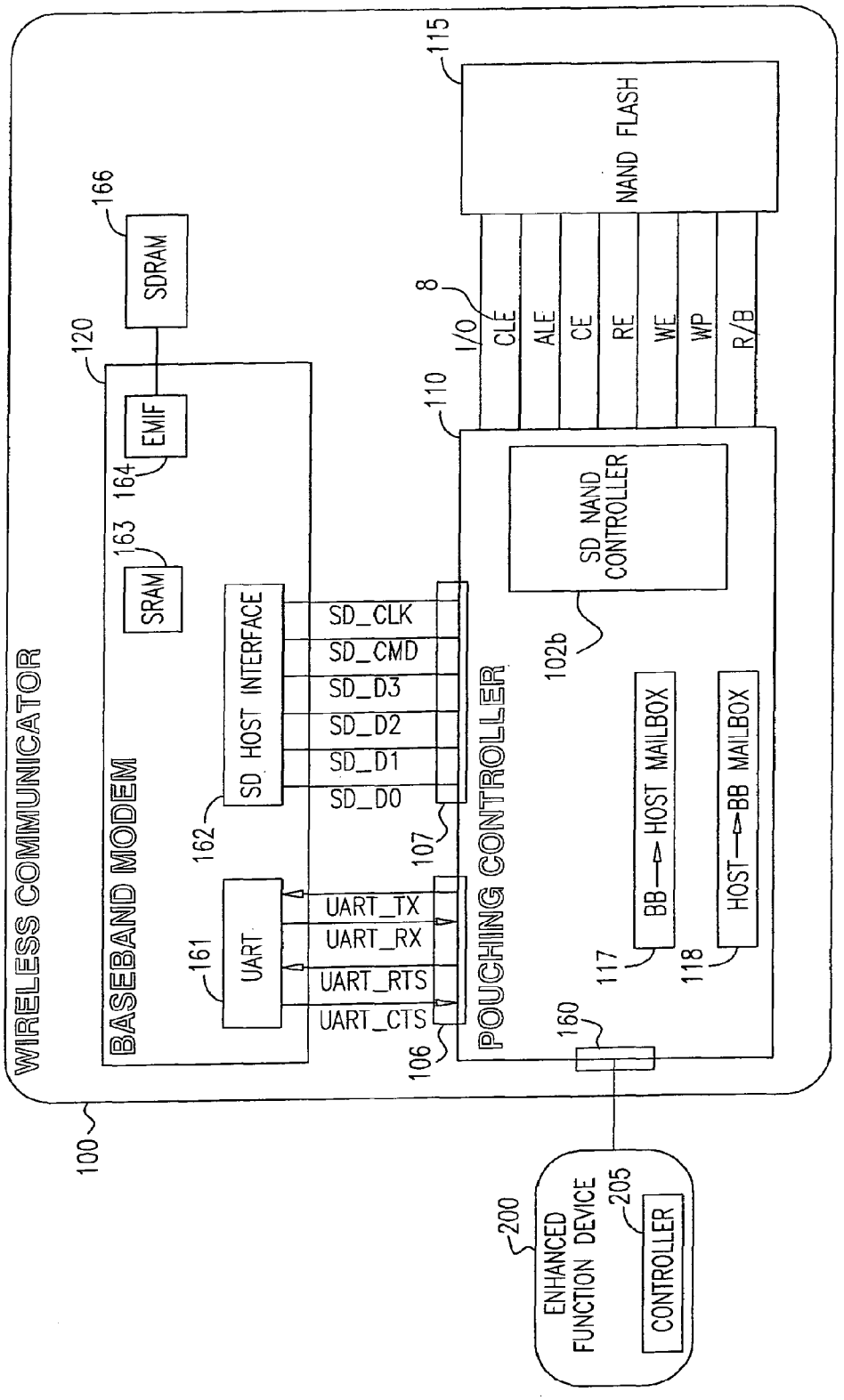

RESUME AFTER SLEEP MODE
TIMER EXPIRES
2510
POWER IS RESUMED
2520
BASEBAND CPU STARTS EXECUTING SECONDARY BOOT LOADER
2530
SECONDARY BOOT LOADER LOADS CODE IMAGE BACK TO EXTERNAL SDRAM, AND HANDS IT CONTROL
2540

FIG. 53


WIRELESS COMMUNICATOR
100
BASEBAND MODEM
120
SDRAM
166
EMIF
164
SRAM
163
SD HOST INTERFACE
162
SD_CLK
SD_CMD
SD_D3
SD_D2
SD_D1
SD_D0
107
UART
161
UART_TX
UART_RX
UART_RTS
UART_CTS
106
POUCHING CONTROLLER
110
SD NAND CONTROLLER
102b
NAND FLASH
115
8
I/O
CLE
ALE
CE
RE
WE
WP
R/B
BB→HOST MAILBOX
117
HOST→BB MAILBOX
118
160
ENHANCED FUNCTION DEVICE
200
CONTROLLER
205

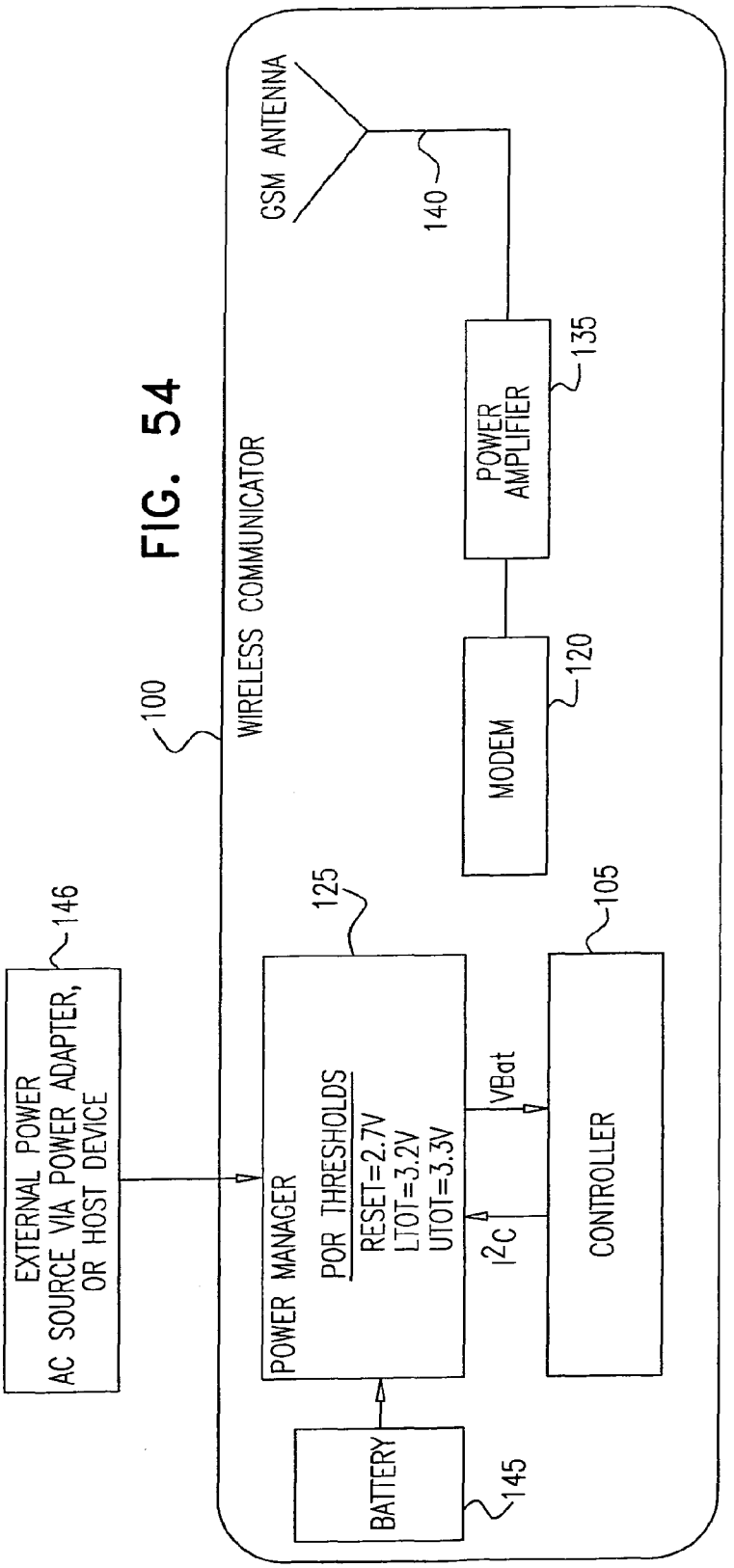

WIRELESS COMMUNICATOR
100
GSM ANTENNA
140
POWER AMPLIFIER
135
MODEM
120
125
POWER MANAGER
POR THRESHOLDS
RESET=2.7V
LTOT=3.2V
UTOT=3.3V
VBat
I2C
105
CONTROLLER
BATTERY
145
EXTERNAL POWER
AC SOURCE VIA POWER ADAPTER,
OR HOST DEVICE
146

FIG. 54

FIG. 55

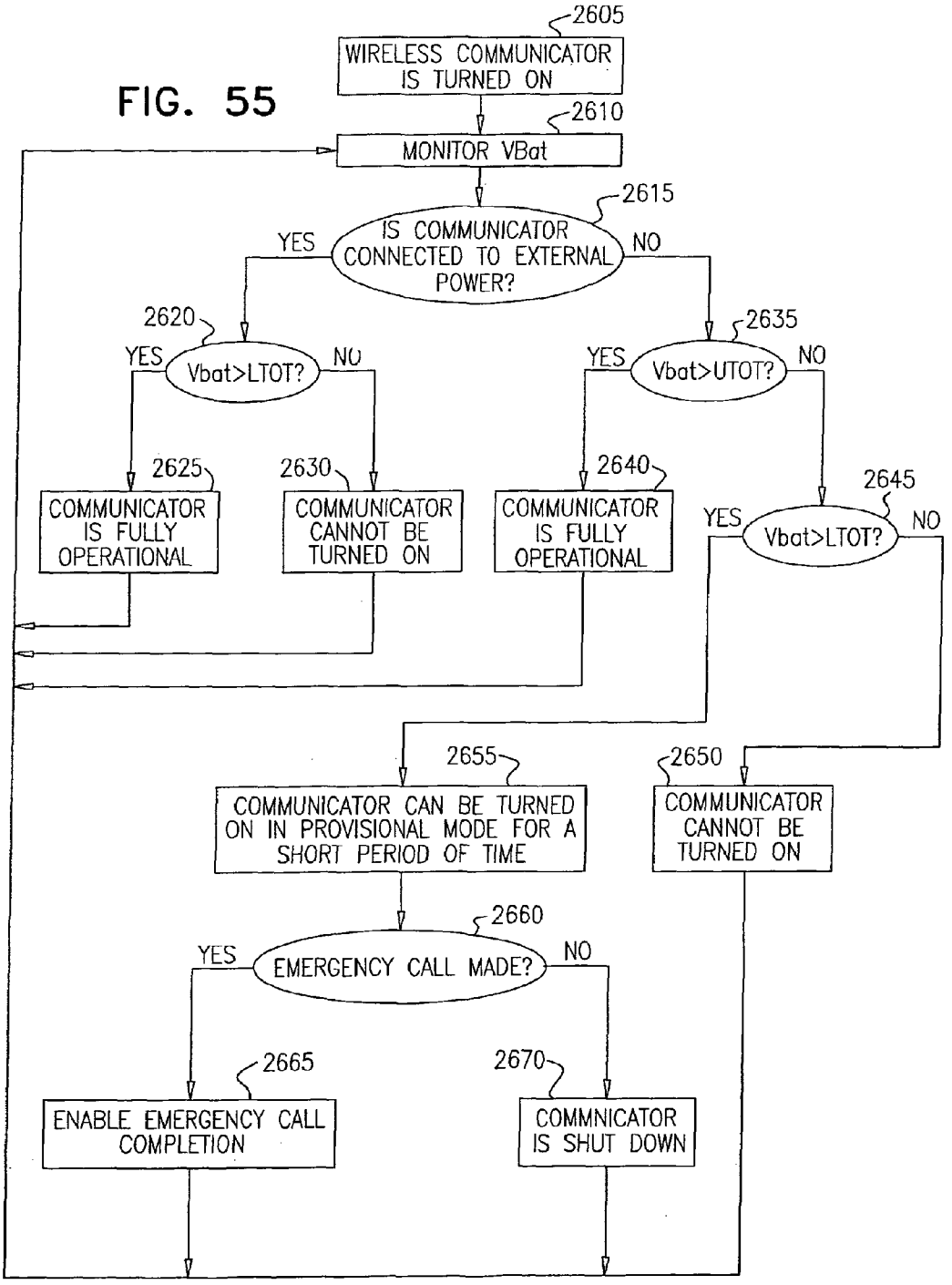

2605
WIRELESS COMMUNICATOR IS TURNED ON
2610
MONITOR VBat
2615
IS COMMUNICATOR CONNECTED TO EXTERNAL POWER?
YES
NO
2620
Vbat>LTOT?
YES
NO
2625
COMMUNICATOR IS FULLY OPERATIONAL
2630
COMMUNICATOR CANNOT BE TURNED ON
2635
Vbat>UTOT?
YES
NO
2640
COMMUNICATOR IS FULLY OPERATIONAL
2645
Vbat>LTOT?
YES
NO
2655
COMMUNICATOR CAN BE TURNED ON IN PROVISIONAL MODE FOR A SHORT PERIOD OF TIME
2650
COMMUNICATOR CANNOT BE TURNED ON
2660
EMERGENCY CALL MADE?
YES
NO
2665
ENABLE EMERGENCY CALL COMPLETION
2670
COMMNICATOR IS SHUT DOWN

FIG. 56

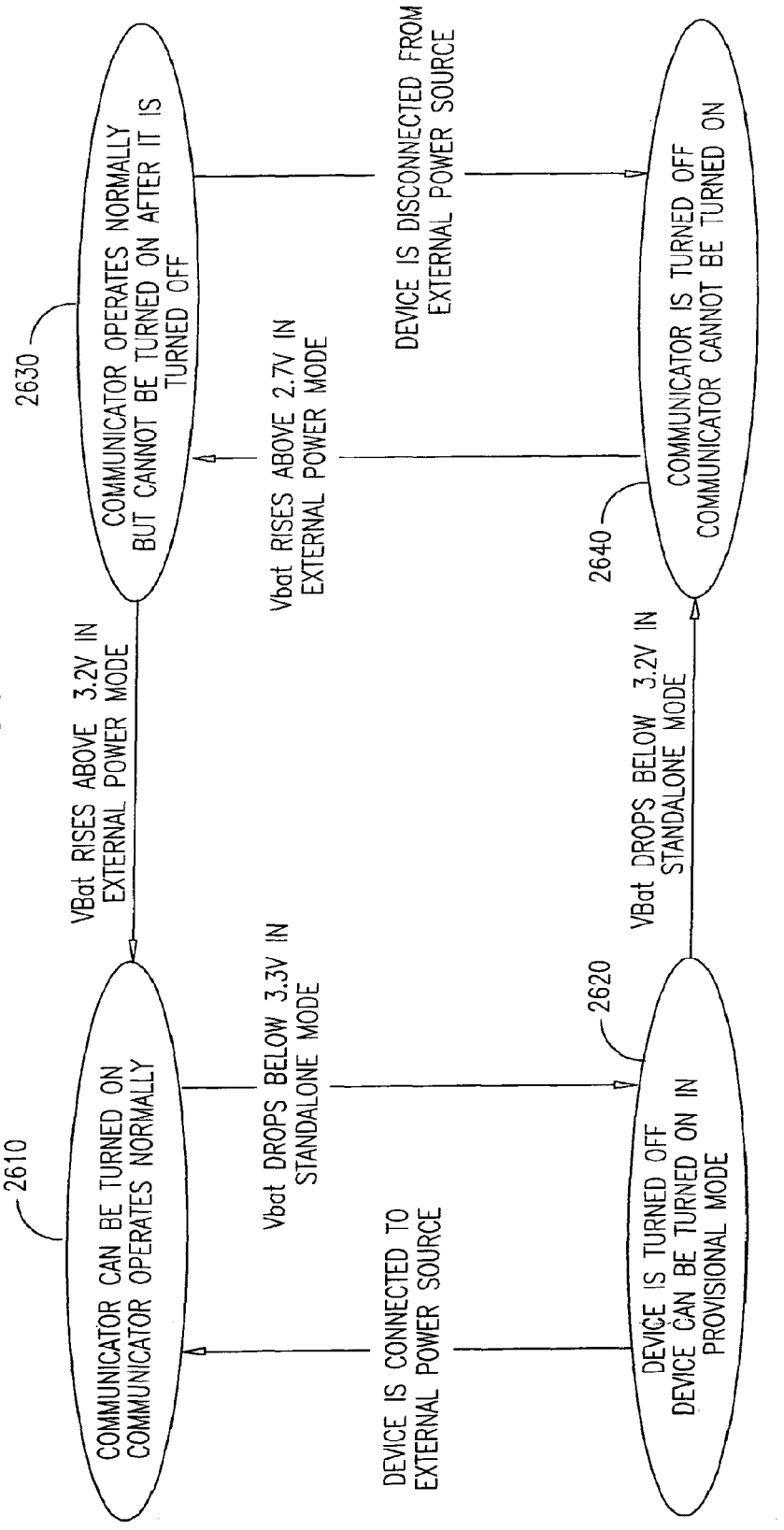

2610
COMMUNICATOR CAN BE TURNED ON
COMMUNICATOR OPERATES NORMALLY
2620
DEVICE IS TURNED OFF
DEVICE CAN BE TURNED ON IN
PROVISIONAL MODE
2630
COMMUNICATOR OPERATES NORMALLY
BUT CANNOT BE TURNED ON AFTER IT IS
TURNED OFF
2640
COMMUNICATOR IS TURNED OFF
COMMUNICATOR CANNOT BE TURNED ON
VBat RISES ABOVE 3.2V IN
EXTERNAL POWER MODE
Vbat DROPS BELOW 3.3V IN
STANDALONE MODE
DEVICE IS CONNECTED TO
EXTERNAL POWER SOURCE
Vbat RISES ABOVE 2.7V IN
EXTERNAL POWER MODE
VBat DROPS BELOW 3.2V IN
STANDALONE MODE
DEVICE IS DISCONNECTED FROM
EXTERNAL POWER SOURCE

FIG. 57A

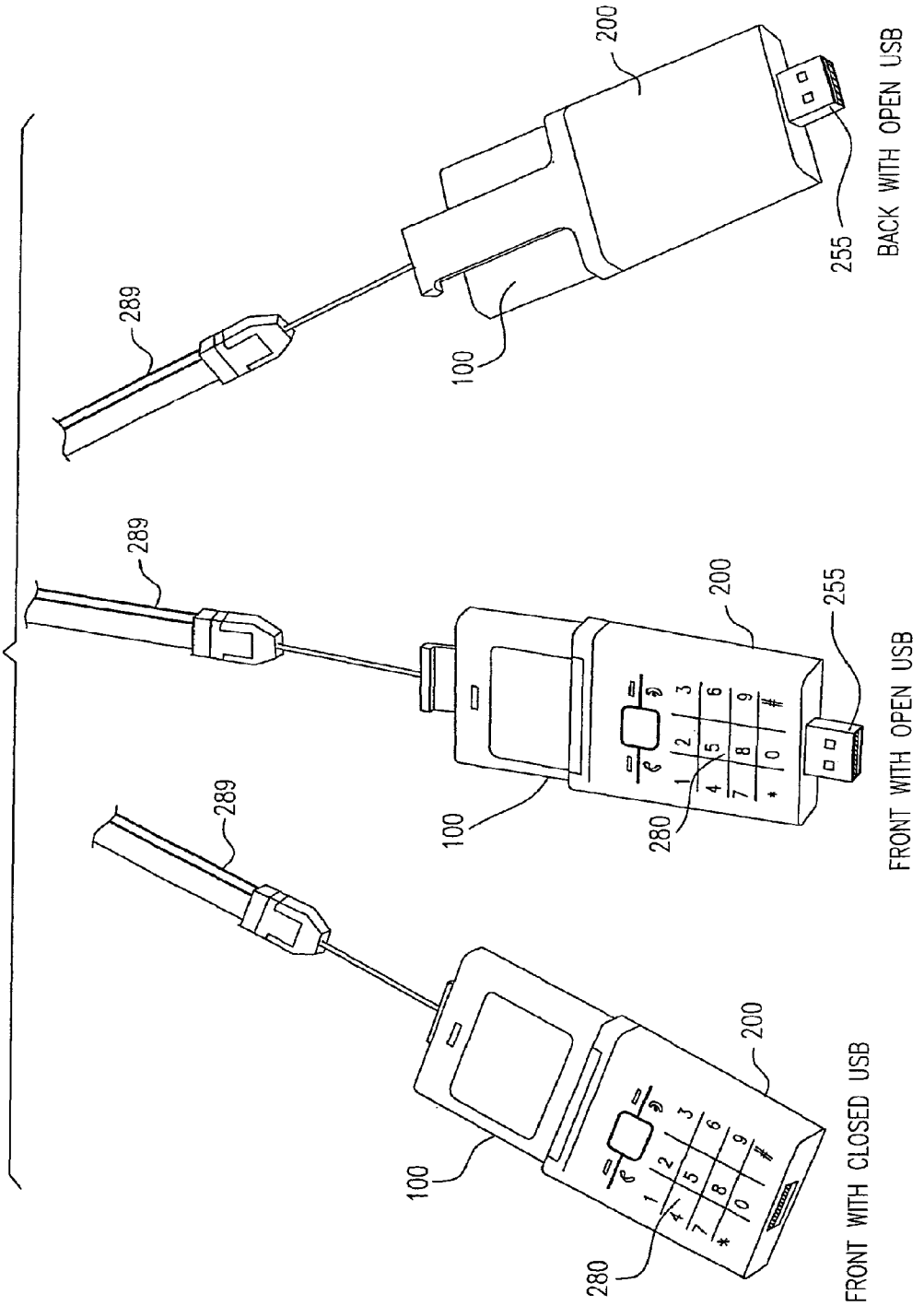

289
100
200
255
BACK WITH OPEN USB
289
100
200
255
280
FRONT WITH OPEN USB
289
100
200
280
FRONT WITH CLOSED USB

FIG. 57B

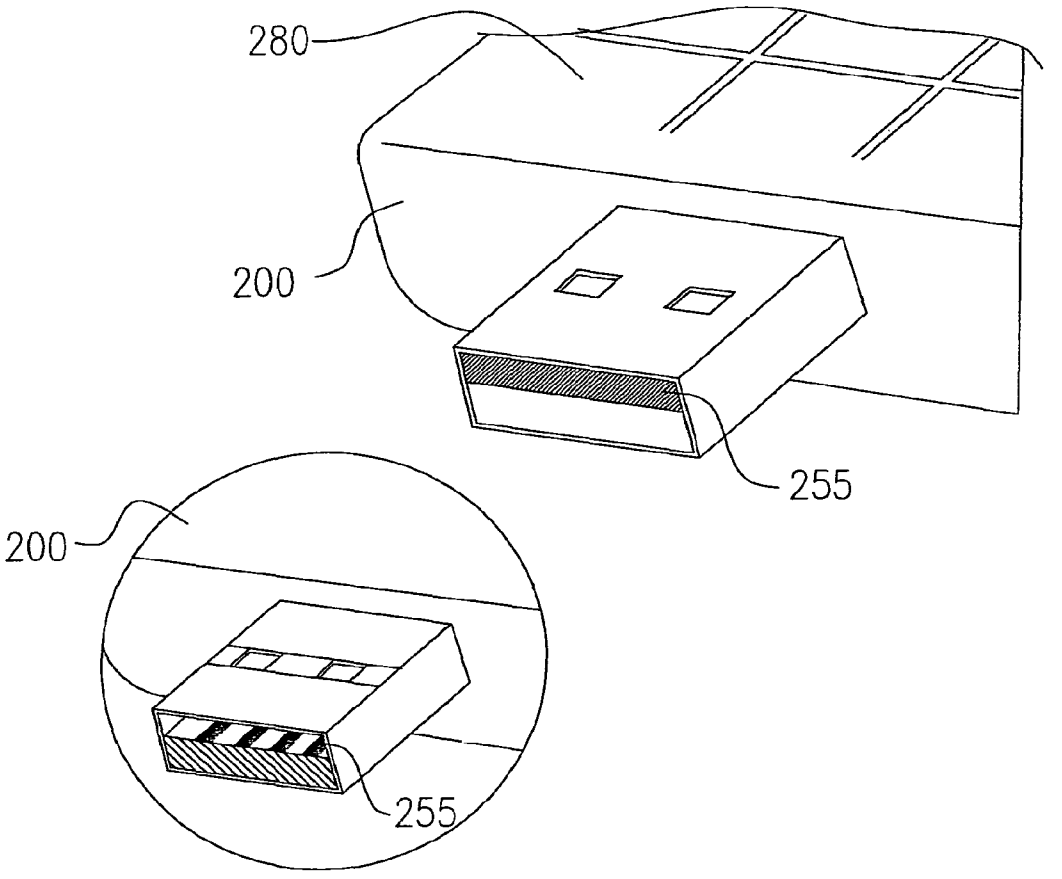


FIG. 58

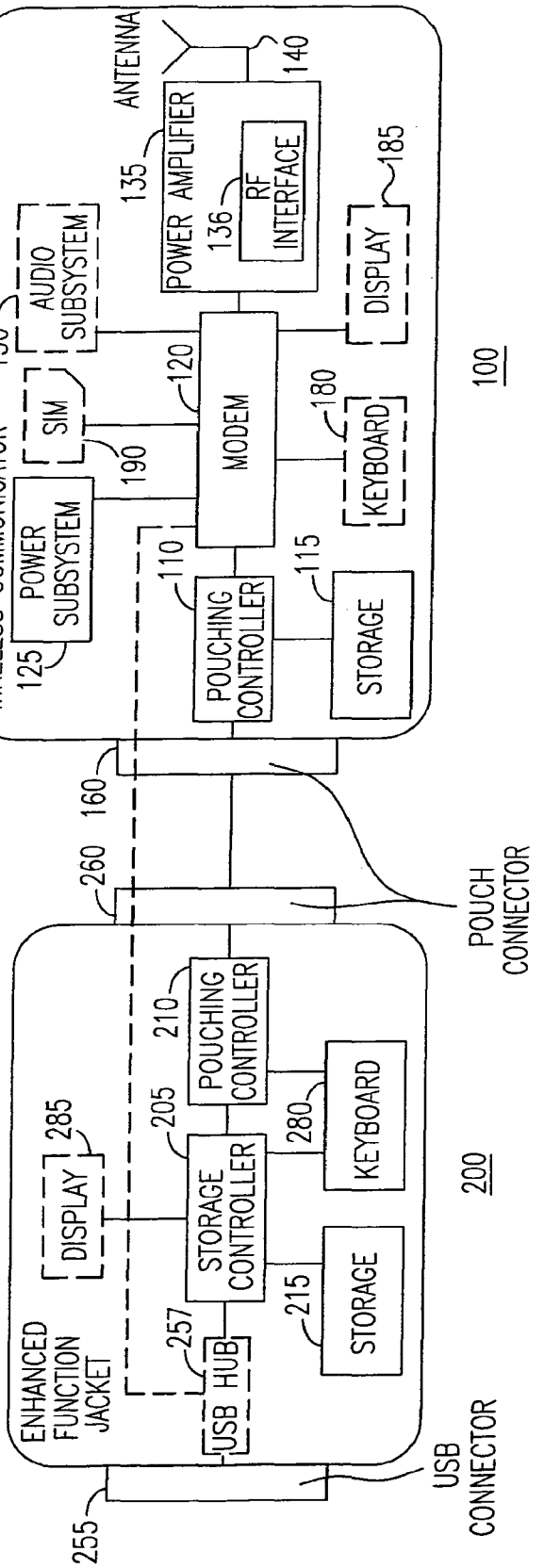

WIRELESS COMMUNICATOR
ANTENNA
140
POWER AMPLIFIER
135
RF INTERFACE
136
AUDIO SUBSYSTEM
130
DISPLAY
185
SIM
120
MODEM
180
KEYBOARD
190
POWER SUBSYSTEM
125
110
POUCHING CONTROLLER
115
STORAGE
100
160
260
POUCH CONNECTOR
ENHANCED FUNCTION JACKET
DISPLAY
285
210
POUCHING CONTROLLER
205
STORAGE CONTROLLER
280
KEYBOARD
257
USB HUB
215
STORAGE
200
255
USB CONNECTOR

FIG. 59

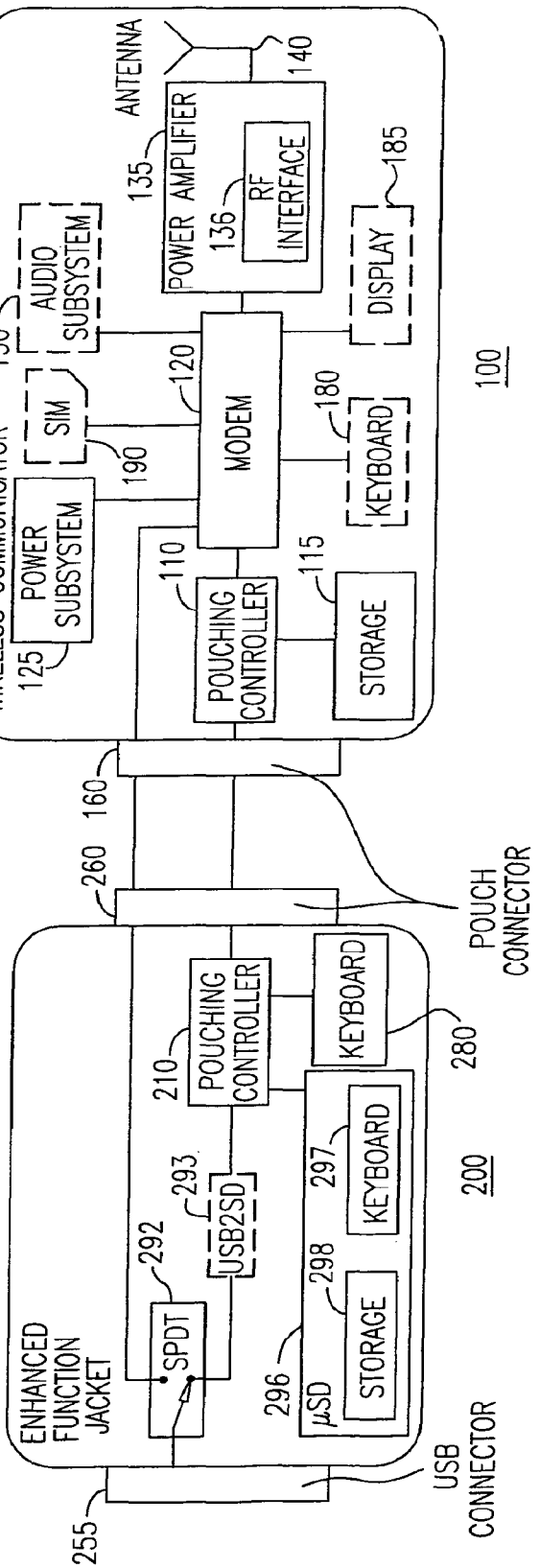

WIRELESS COMMUNICATOR
ANTENNA
140
135
POWER AMPLIFIER
136
RF INTERFACE
185
DISPLAY
130
AUDIO SUBSYSTEM
SIM
190
120
MODEM
180
KEYBOARD
125
POWER SUBSYSTEM
110
POUCHING CONTROLLER
115
STORAGE
100
160
260
POUCH CONNECTOR
ENHANCED FUNCTION JACKET
210
POUCHING CONTROLLER
KEYBOARD
280
293
USB2SD
297
KEYBOARD
292
SPDT
298
STORAGE
296
µSD
200
USB CONNECTOR
255

FIG. 60A

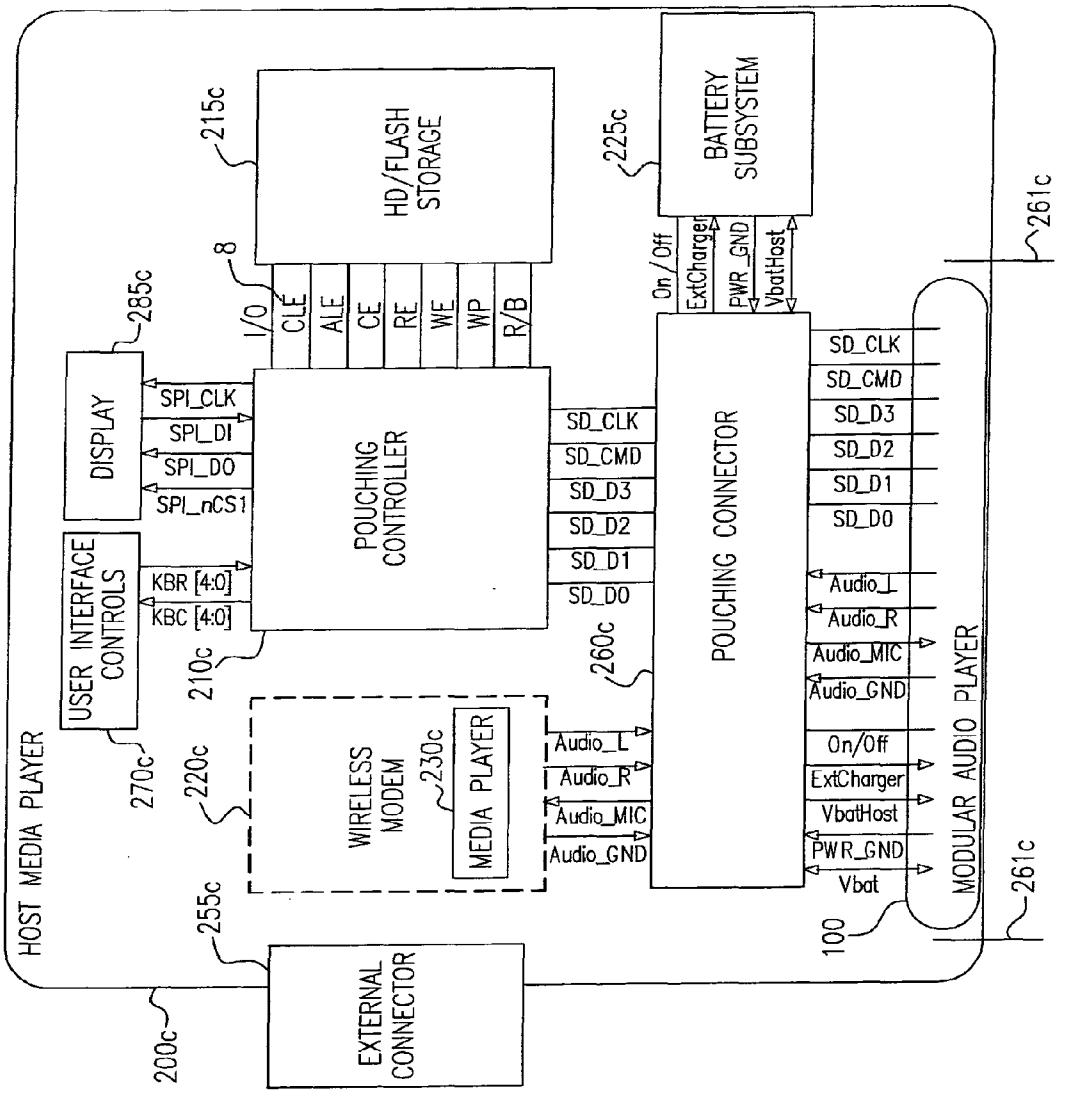
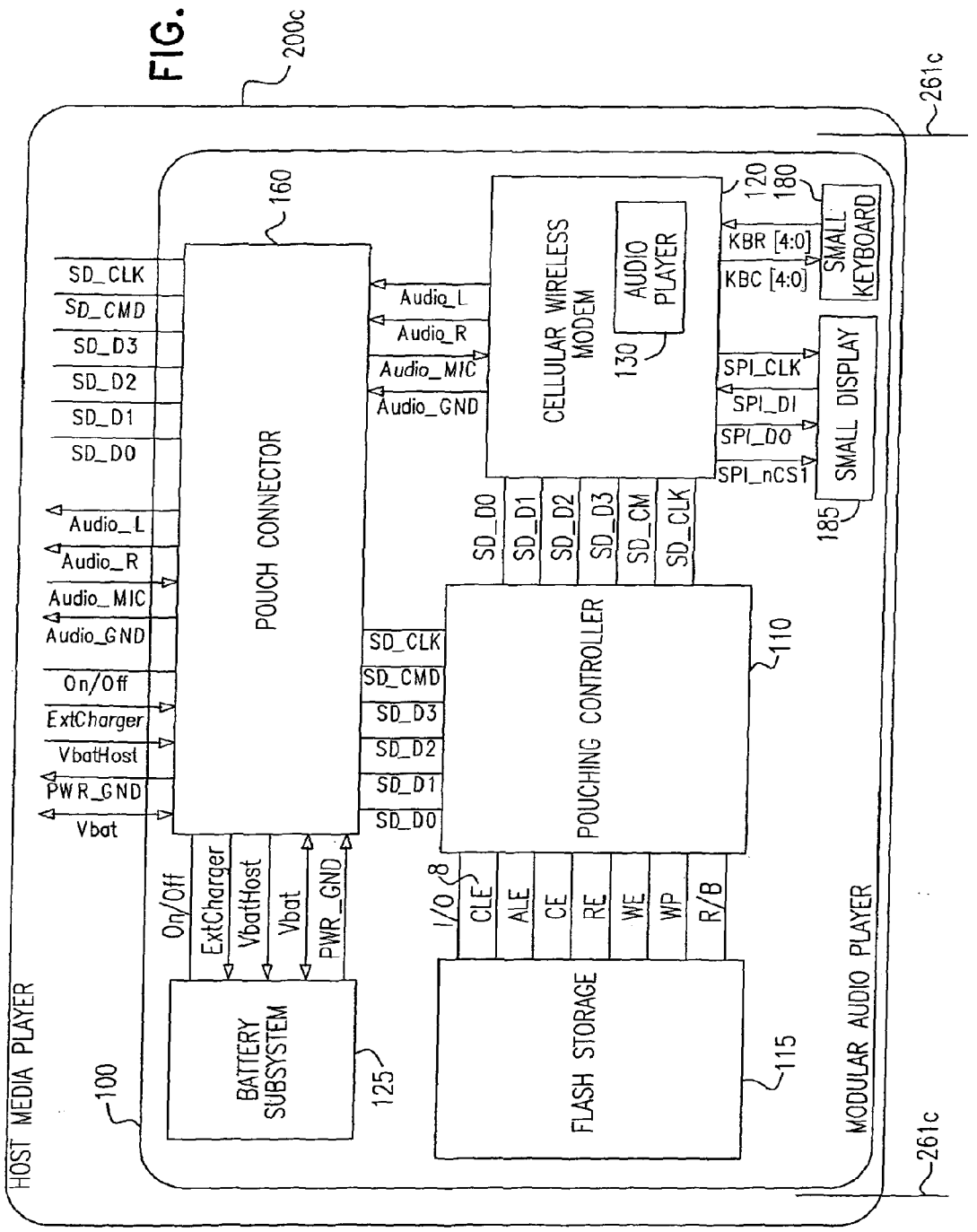

HOST MEDIA PLAYER
200c
EXTERNAL CONNECTOR
255c
WIRELESS MODEM
220c
MEDIA PLAYER
230c
270c
USER INTERFACE CONTROLS
KBR [4:0]
KBC [4:0]
DISPLAY
285c
SPI_CLK
SPI_DI
SPI_DO
SPI_nCS1
210c
POUCHING CONTROLLER
8
I/O
CLE
ALE
CE
RE
WE
WP
R/B
215c
HD/FLASH STORAGE
225c
BATTERY SUBSYSTEM
On/Off
ExtCharger
PWR_GND
VbatHost
260c
POUCHING CONNECTOR
SD_CLK
SD_CMD
SD_D3
SD_D2
SD_D1
SD_D0
Audio_L
Audio_R
Audio_MIC
Audio_GND
On/Off
ExtCharger
VbatHost
PWR_GND
Vbat
100
MODULAR AUDIO PLAYER
261c
261c

FIG. 60B


200c
261c
160
120
180
SD_CLK
SD_CMD
SD_D3
SD_D2
SD_D1
SD_D0
Audio_L
Audio_R
Audio_MIC
Audio_GND
On/Off
ExtCharger
VbatHost
PWR_GND
Vbat
POUCH CONNECTOR
Audio_L
Audio_R
Audio_MIC
Audio_GND
CELLULAR WIRELESS MODEM
AUDIO PLAYER
130
KBR [4:0]
KBC [4:0]
SMALL KEYBOARD
SPI_CLK
SPI_DI
SPI_DO
SPI_nCS1
SMALL DISPLAY
185
SD_D0
SD_D1
SD_D2
SD_D3
SD_CM
SD_CLK
SD_CLK
SD_CMD
SD_D3
SD_D2
SD_D1
SD_D0
POUCHING CONTROLLER
110
8
I/O
CLE
ALE
CE
RE
WE
WP
R/B
On/Off
ExtCharger
VbatHost
Vbat
PWR_GND
BATTERY SUBSYSTEM
125
FLASH STORAGE
115
100
HOST MEDIA PLAYER
MODULAR AUDIO PLAYER
261c

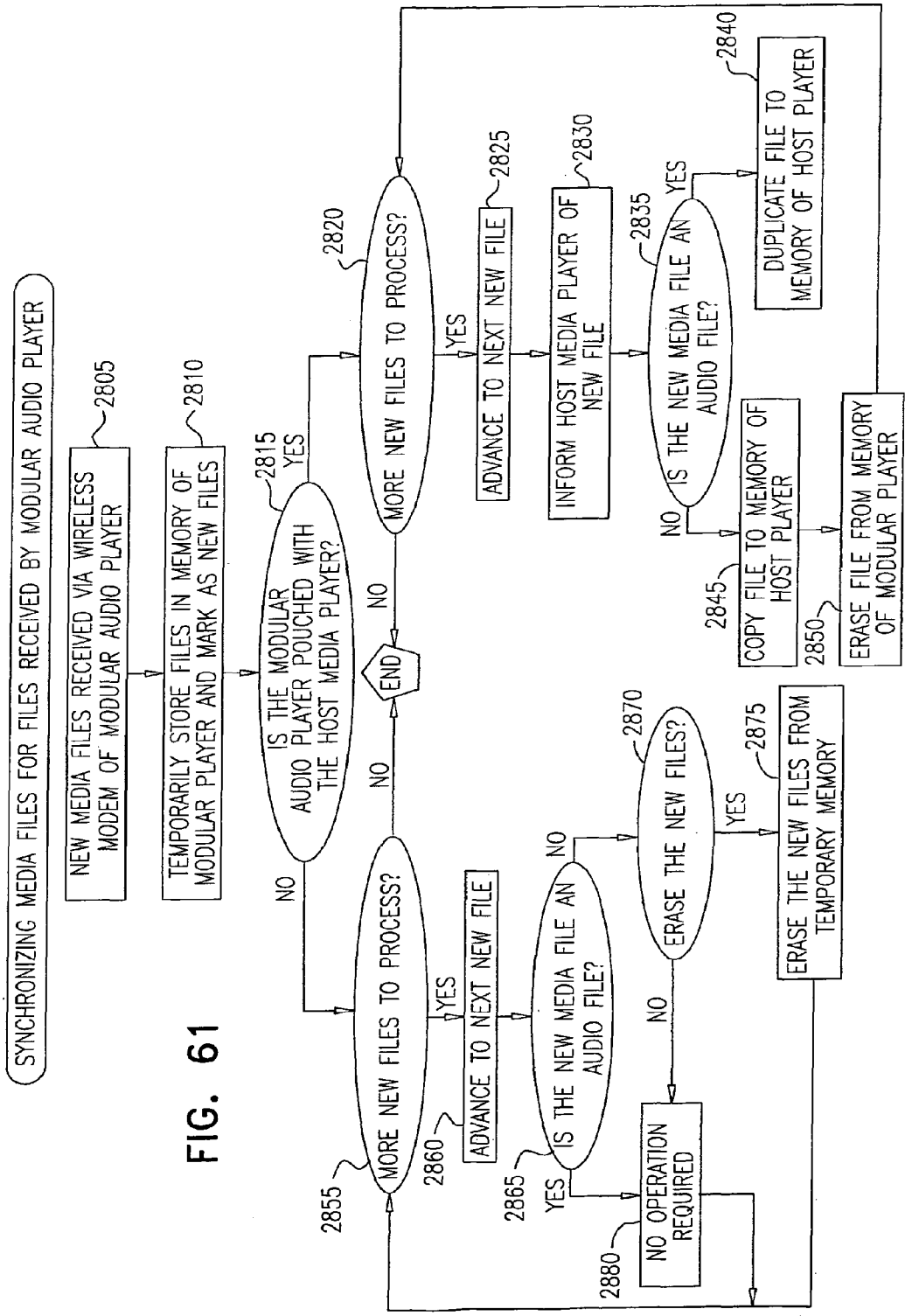

SYNCHRONIZING MEDIA FILES FOR FILES RECEIVED BY MODULAR AUDIO PLAYER
NEW MEDIA FILES RECEIVED VIA WIRELESS MODEM OF MODULAR AUDIO PLAYER
2805
TEMPORARILY STORE FILES IN MEMORY OF MODULAR PLAYER AND MARK AS NEW FILES
2810
IS THE MODULAR AUDIO PLAYER POUCHED WITH THE HOST MEDIA PLAYER?
2815
YES
NO
MORE NEW FILES TO PROCESS?
2820
YES
NO
END
ADVANCE TO NEXT NEW FILE
2825
INFORM HOST MEDIA PLAYER OF NEW FILE
2830
IS THE NEW MEDIA FILE AN AUDIO FILE?
2835
YES
NO
DUPLICATE FILE TO MEMORY OF HOST PLAYER
2840
COPY FILE TO MEMORY OF HOST PLAYER
2845
ERASE FILE FROM MEMORY OF MODULAR PLAYER
2850
MORE NEW FILES TO PROCESS?
2855
YES
NO
ADVANCE TO NEXT NEW FILE
2860
IS THE NEW MEDIA FILE AN AUDIO FILE?
2865
YES
NO
ERASE THE NEW FILES?
2870
YES
NO
ERASE THE NEW FILES FROM TEMPORARY MEMORY
2875
NO OPERATION REQUIRED
2880

FIG. 61

FIG. 62

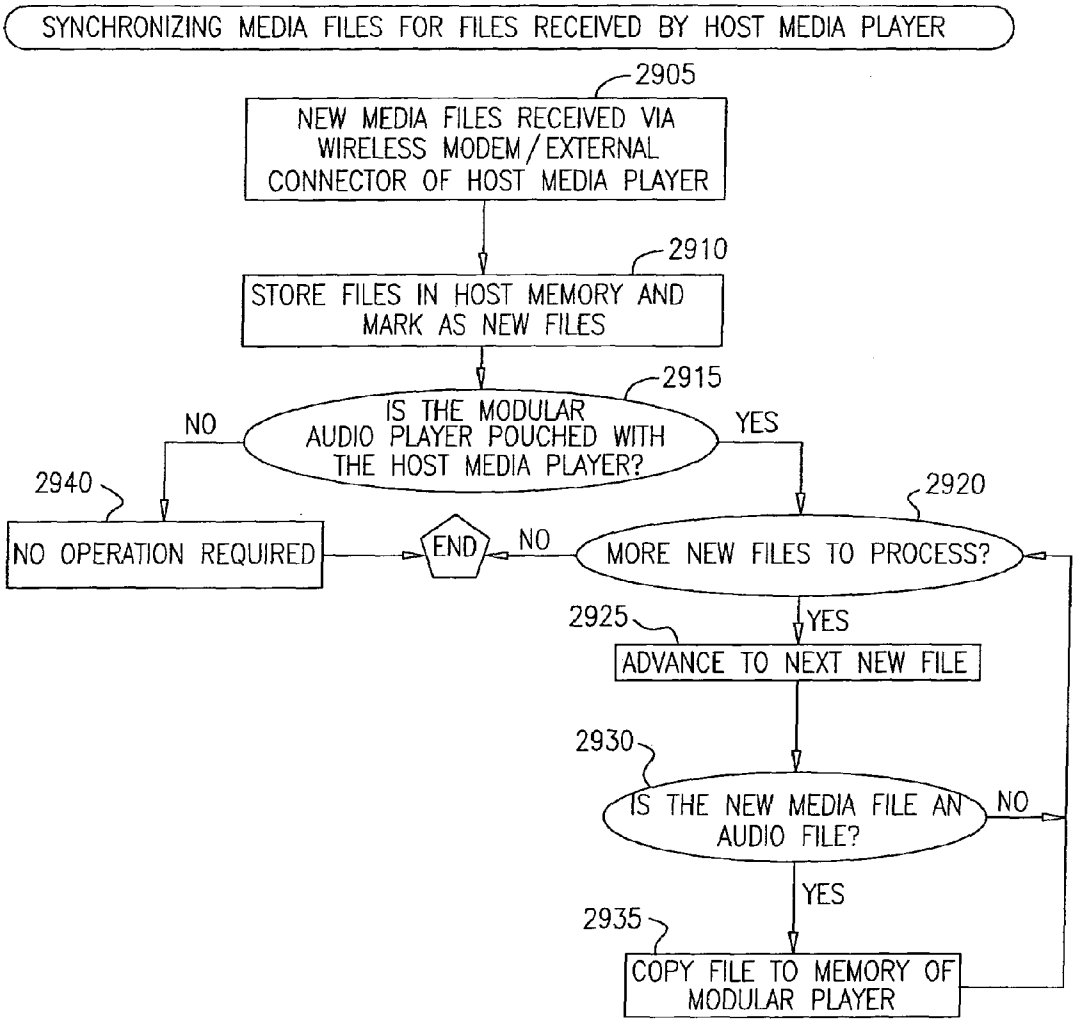
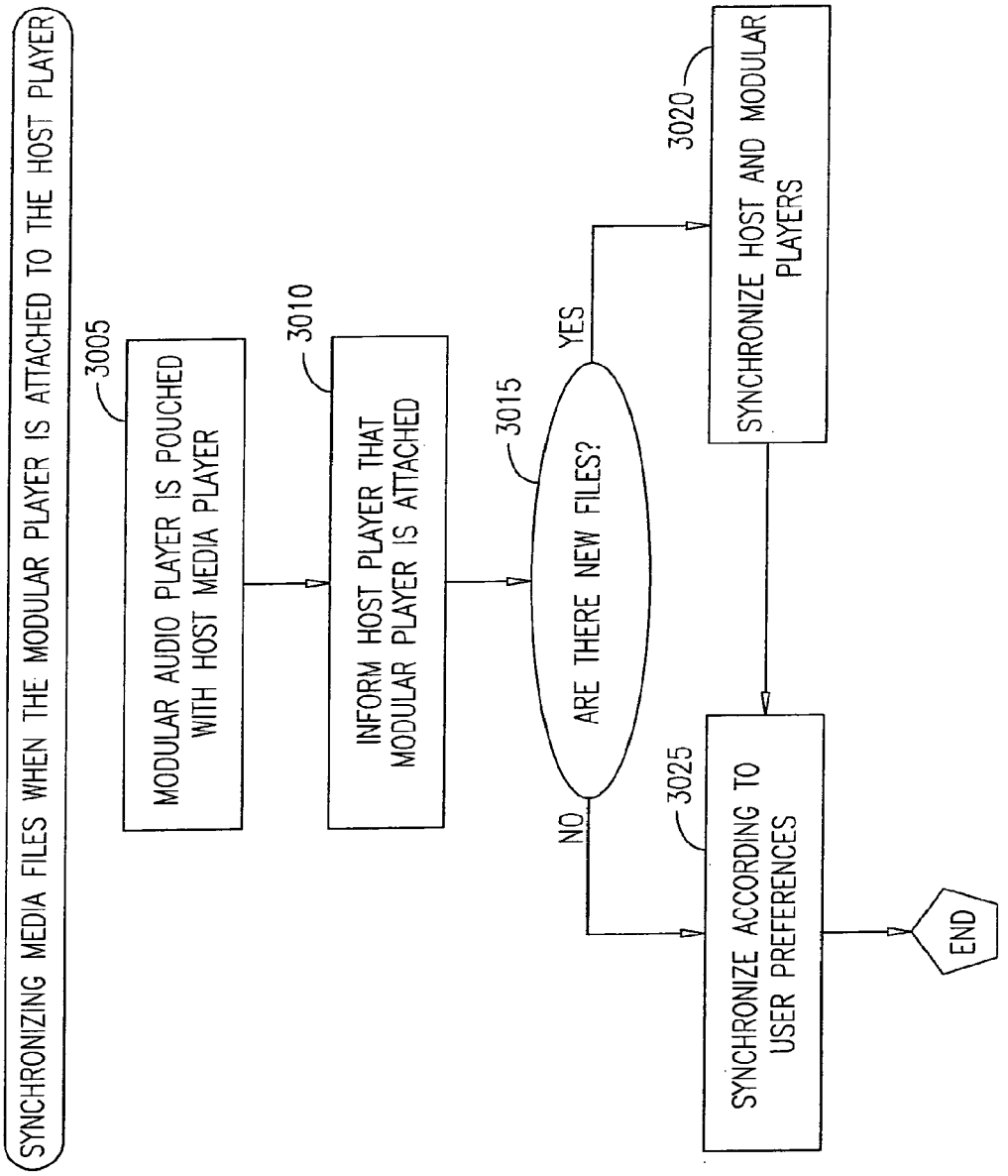

SYNCHRONIZING MEDIA FILES FOR FILES RECEIVED BY HOST MEDIA PLAYER
2905
NEW MEDIA FILES RECEIVED VIA WIRELESS MODEM / EXTERNAL CONNECTOR OF HOST MEDIA PLAYER
2910
STORE FILES IN HOST MEMORY AND MARK AS NEW FILES
2915
IS THE MODULAR AUDIO PLAYER POUCHED WITH THE HOST MEDIA PLAYER?
NO
YES
2940
NO OPERATION REQUIRED
END
NO
2920
MORE NEW FILES TO PROCESS?
YES
2925
ADVANCE TO NEXT NEW FILE
2930
IS THE NEW MEDIA FILE AN AUDIO FILE?
NO
YES
2935
COPY FILE TO MEMORY OF MODULAR PLAYER

FIG. 63


SYNCHRONIZING MEDIA FILES WHEN THE MODULAR PLAYER IS ATTACHED TO THE HOST PLAYER
3005
MODULAR AUDIO PLAYER IS POUCHED WITH HOST MEDIA PLAYER
3010
INFORM HOST PLAYER THAT MODULAR PLAYER IS ATTACHED
3015
ARE THERE NEW FILES?
YES
NO
3020
SYNCHRONIZE HOST AND MODULAR PLAYERS
3025
SYNCHRONIZE ACCORDING TO USER PREFERENCES
END

# MODULAR WIRELESS COMMUNICATOR

## PRIORITY REFERENCE TO RELATED APPLICATIONS

This application is a continuation of assignee's application U.S. Ser. No. 13/761,188 entitled MODULAR WIRELESS COMMUNICATOR, and filed on Feb. 7, 2013 by inventors Dov Moran, Itay Sherman, Eyal Bychkov, Itay Cohen, Yaron Segalov, Tamir Demri, Eran Miller, Uri Ron, Tal Engelstein, Hagay Katz and Hagit Perry. U.S. Ser. No. 13/761,188 is a continuation of assignee's application U.S. Ser. No. 13/471,751, now U.S. Pat. No. 8,391,921, entitled MODULAR WIRELESS COMMUNICATOR, and filed on May 15, 2012 by inventors Dov Moran, Itay Sherman, Eyal Bychkov, Itay Cohen, Yaron Segalov, Tamir Demri, Eran Miller, Uri Ron, Tal Engelstein, Hagay Katz and Hagit Perry. U.S. Ser. No. 13/471,751 is a continuation of assignee's application U.S. Ser. No. 12/525,820, now U.S. Pat. No. 8,180,395 entitled MODULAR WIRELESS COMMUNICATOR, and filed on Aug. 5, 2009 by inventors Dov Moran, Itay Sherman, Eyal Bychkov, Itay Cohen, Yaron Segalov, Tamir Demri, Eran Miller, Uri Ron, Tal Engelstein, Hagay Katz and Hagit Perry. U.S. Ser. No. 13/471,751 is a national phase entry of PCT/IL2008/000164 entitled MODULAR WIRELESS COMMUNICATOR, and filed on Feb. 6, 2008 by inventors Dov Moran, Itay Sherman, Eyal Bychkov, Itay Cohen, Yaron Segalov, Tamir Demri, Eran Miller, Uri Ron, Tal Engelstein, Hagay Katz and Hagit Perry.

This application claims benefit of the following U.S. patent applications, commonly owned by assignee:

U.S. Provisional Application No. 60/901,353, entitled CELLULAR MODEM ON SD CARD, filed on Feb. 13, 2007 by inventors Itay Sherman, Adar Azancot and Lior Storfer;

U.S. Provisional Application No. 60/901,368, entitled INTERFACE FOR EXTENDING FUNCTIONALITY OF MEMORY CARDS, filed on Feb. 13, 2007 by inventor Itay Sherman;

U.S. Provisional Application No. 60/918,943, entitled COMPACT KEY PAD, filed on Mar. 20, 2007 by inventors Adar Azancot, Yaron Segalov, Eran Miller and Itay Sherman;

U.S. Provisional Application No. 60/918,966, entitled REDUCING POWER DISSIPATION FOR SOLID STATE DISKS, filed on Mar. 20, 2007 by inventor Itay Sherman;

U.S. Provisional Application No. 60/918,967, entitled DEVICE REGISTRATION OVER A COMPUTER NETWORK, filed on Mar. 20, 2007 by inventor Itay Sherman;

U.S. Provisional Application No. 60/918,968, entitled INTEGRATED COMMUNICATION AND STORAGE SUBSYSTEM FOR EMBEDDED SYSTEMS, filed on Mar. 20, 2007 by inventor Itay Sherman;

U.S. Provisional Application No. 60/919,112 entitled PEER-TO-PEER FILE SHARING USING SHORT RANGE RF, filed on Mar. 20, 2007 by inventors Yaron Segalov and Eyal Bychkov;

U.S. Provisional Application No. 60/919,243, entitled INTEGRATED CELLULAR PHONE AND CORDLESS PHONE, filed on Mar. 21, 2007 by inventors Eyal Bychkov, Itay Sherman, Adar Azancot and Hagay Katz;

U.S. Provisional Application No. 60/920,037, entitled SYNCHRONIZED MEDIA PLAYERS WITHIN A SINGLE HOUSING, filed on Mar. 26, 2007 by inventor Itay Sherman;

U.S. Provisional Application No. 60/933,780, entitled ADAPTIVE USER INTERFACE FOR A MULTI-SOURCE SYSTEM, filed on Jun. 8, 2007 by inventors Itay Sherman, Eyal Bychkov and Yaron Segalov;



U.S. Provisional Application No. 60/933,792, entitled SD SWITCH BOX IN A CELLULAR HANDSET, filed on Jun. 8, 2007 by inventors Itay Sherman, Eyal Bychkov and Yaron Segalov;

U.S. Provisional Application No. 60/933,793, entitled COMMUNICATION CARD WITH THREE OPERATIONAL STATES, filed on Jun. 8, 2007 by inventors Itay Sherman, Itay Cohen and Yaron Segalov;

U.S. Provisional Application No. 60/964,233, entitled CALL SHUFFLING, filed on Aug. 9, 2007 by inventors Itay Sherman, Eyal Bychkov, Hagit Perry and Uri Ron;

U.S. Provisional Application No. 60/964,872, entitled COUNTER-TACTILE KEYPAD, filed on Aug. 14, 2007 by inventors Eyal Bychkov and Hagay Katz;

U.S. Provisional Application No. 60/995,575, entitled AUTOMATED CONSUMER ELECTRONICS DEVICE REPORTING, filed on Sep. 26, 2007, by inventors Itay Sherman, Eyal Bychkov, Uri Ron, Hagay Katz and Hagit Perry;

U.S. Provisional Application No. 61/009,523, entitled MULTI-TAPPING NUMPAD, filed on Dec. 28, 2007 by inventor Uri Ron;

U.S. Provisional Application No. [not yet assigned], entitled MODULAR WIRELESS COMMUNICATOR, filed on Jan. 23, 2008 by inventors Itay Sherman, Eyal Bychkov, Itay Cohen, Tamir Demri, Hagay Katz, Eran Miller, Hagit Perry, Uri Ron and Yaron Segalov;

U.S. Provisional Application No. [not yet assigned], entitled MODULAR WIRELESS COMMUNICATOR, filed on Feb. 5, 2008 by inventors Dov Moran, Itay Sherman, Eyal Bychkov, Itay Cohen, Yaron Segalov, Tamir Demri, Eran Miller, Uri Ron, Hagay Katz and Hagit Perry;

U.S. application Ser. No. 11/725,691, entitled INTERFACE FOR EXTENDING FUNCTIONALITY OF MEMORY CARDS, filed on Mar. 20, 2007 by inventors Itay Sherman and Yaron Segalov;

U.S. application Ser. No. 11/827,525, entitled SD SWITCH BOX IN A CELLULAR HANDSET, filed on Jul. 11, 2007 by inventors Itay Sherman, Eyal Bychkov and Yaron Segalov;

U.S. application Ser. No. 11/827,604, entitled COMMUNICATION CARD WITH THREE OPERATIONAL STATES, filed on Jul. 11, 2007 by inventors Itay Sherman, Itay Cohen and Yaron Segalov;

U.S. application Ser. No. 11/827,701, entitled SMALL REMOVABLE AUDIO PLAYER THAT ATTACHES TO A HOST MEDIA PLAYER, filed on Jul. 13, 2007 by inventor Itay Sherman;

U.S. application Ser. No. 11/891,777, entitled ADJUSTABLE CUT-OFF VOLTAGE FOR MOBILE DEVICE BATTERY, filed on Aug. 13, 2007 by inventors Itay Sherman, Eyal Bychkov, Eran Miller and Uri Ron;

U.S. application Ser. No. 11/893,837, entitled METHOD AND SYSTEM FOR REMOTE DIAGNOSTICS, filed on Aug. 16, 2007 by inventors Hagay Katz, Eyal Bychkov and Itay Sherman;

U.S. application Ser. No. 11/893,958, entitled COMMUNICATION LAYER SWITCHING DEVICE, filed on Aug. 16, 2007 by inventors Itay Sherman, Eyal Bychkov and Uri Ron;

U.S. application Ser. No. 11/975,489, entitled SYSTEM AND METHOD FOR PREDICTING TEXT, filed on Oct. 19, 2007 by inventors Hagit Perry and Uri Ron;

U.S. application Ser. No. 11/983,444, entitled UNSUCCESSFUL CALL ALERT, filed on Nov. 9, 2007 by inventors Eyal Bychkov and Uri Ron;

U.S. application Ser. No. 11/986,600, entitled SYSTEM AND METHOD FOR PREDICTING TEXT, filed on Nov. 21, 2007 by inventors Hagit Perry and Uri Ron;

U.S. application Ser. No. 11/986,242, entitled MULTIMEDIA ENHANCEMENT CHANNEL, filed on Nov. 19, 2007 by inventors Itay Sherman and Eyal Bychkov;

U.S. application Ser. No. 11/975,854, entitled REDUCING POWER DISSIPATION FOR SOLID STATE DISKS, filed on Oct. 22, 2007 by inventor Itay Sherman;

U.S. application Ser. No. 11/986,637, entitled UNIQUELY IDENTIFIABLE KEYS FOR ELECTRONIC KEYBOARDS, filed on Nov. 23, 2007 by inventors Uri Ron, Eyal Bychkov and Itay Sherman;

U.S. application Ser. No. 12/008,582, entitled AUDIO AND USB MULTIPLEXING, filed on Jan. 11, 2008 by inventors Itay Sherman and Eran Miller;

U.S. application Ser. No. 12/008,499, entitled BI-DIRECTIONAL BATTERY CHARGING FOR COUPLED ELECTRONIC DEVICES, filed on Jan. 11, 2008 by inventors Itay Sherman and Tamir Demri;

U.S. application Ser. No. 12/008,501, entitled BRIDGE DESIGN FOR SD AND MMC DATA BUSES, filed on Jan. 11, 2008 by inventor Itay Sherman;

U.S. application Ser. No. 12/008,582, entitled AUDIO AND USB MULTIPLEXING, filed on Jan. 11, 2008 by inventors Itay Sherman and Eran Miller; and

U.S. application Ser. No. [not yet assigned], entitled CONTENT DELIVERY DURING CALL IDLE TIME, filed on Jan. 16, 2008 by inventors Eyal Bychkov and Uri Ron.

## FIELD OF THE INVENTION

The field of the present invention is wireless communication.

## SUMMARY OF THE DESCRIPTION

Aspects of the present invention relate to a modular wireless communicator that may be coupled with an enhanced function device in a manner referred to herein as pouching. Pouching is defined herein to mean inserting the wireless communicator device inside of the enhanced function device so that the wireless communicator is at least partially obscured by the enhanced function device, and such that the enhanced function device mechanically supports the wireless communicator.

There is thus provided in accordance with an embodiment of the present invention a wireless communicator including a housing, wireless communication functionality located within the housing, native user interface functionality cooperating with the wireless communication functionality and including user interface surfaces located on at least one outer facing surface of the housing, and pouching responsive electrical interconnection functionality responsive to pouching orientation of the housing in a pouch of an enhanced function device for causing the wireless communication functionality to adapt to cooperating with parenting user interface functionality forming part of the enhanced function device at least partially instead of with the native user interface functionality.

Additionally in accordance with an embodiment of the present invention the wireless communication functionality includes a phone call dialing functionality.

Further in accordance with an embodiment of the present invention the wireless communication functionality includes a network access functionality.

Yet further in accordance with an embodiment of the present invention the pouching responsive electrical interconnection functionality automatically causes the wireless communication functionality to adapt to cooperating with the parenting user interface functionality when the housing is oriented in the pouch of the enhanced function device.

Moreover in accordance with an embodiment of the present invention the pouching responsive electrical interconnection functionality causes the wireless communication functionality to adapt to cooperating with the parenting user interface functionality, when manually prompted to do so and when the housing is oriented in the pouch of the enhanced function device.

Additionally in accordance with an embodiment of the present invention the pouching responsive electrical interconnection functionality includes alien rejection functionality operative to prevent cooperation of the wireless communication functionality with user interface functionality of an alien enhanced function device notwithstanding existence of pouching orientation of the housing in a pouch of the alien enhanced function device.

Further in accordance with an embodiment of the present invention the adaptation to interoperation includes transmission from the enhanced function device to the wireless communicator of information relating to parenting user interface functionality forming part of the enhanced function device, and configuration of the wireless communication functionality to be controlled by the parenting user interface functionality forming part of the enhanced function device at least partially instead of by the native user interface functionality.

Yet further in accordance with an embodiment of the present invention the pouching responsive electrical interconnection functionality causes the wireless communicator to transmit user interface data from the wireless communicator to the enhanced function device in conformance with the information relating to parenting user interface functionality.

Moreover in accordance with an embodiment of the present invention the pouching responsive electrical interconnection functionality expands the functionality of the wireless communicator, in addition to causing the wireless communication functionality to adapt to cooperating with the parenting user interface functionality.

Additionally in accordance with an embodiment of the present invention the enhanced function device expands the functionality of the wireless communicator by enabling access to functionality of the wireless communicator that is inaccessible when the wireless communicator is not pouched with the enhanced function device.

Further in accordance with an embodiment of the present invention the enhanced function device provisions software to the wireless communicator when the wireless communicator is pouched with the enhanced function device.

Yet further in accordance with an embodiment of the present invention the enhanced function device includes a subscriber identifier, which enables wireless network connectivity that is inaccessible to the wireless communicator when the wireless communicator is not pouched with the enhanced function device.

Moreover in accordance with an embodiment of the present invention the subscriber identifier is a SIM card.

Additionally in accordance with an embodiment of the present invention the housing includes an at least partially transparent portion in an outer facing surface, the wireless communicator further includes at least one light source fastened inside of the housing, the light source indicates when the wireless communicator is sufficiently pouched with the enhanced function device so as to activate the pouching responsive electrical interconnection functionality, and the light of the at least one light source shines through the at least partially transparent portion of the housing.

Moreover in according to an embodiment of the present invention said portion is a hole in the housing.

Further in accordance with an embodiment of the present invention the light source is an LED light.

Yet further in accordance with an embodiment of the present invention the light source indicates a state of the wireless communicator.

Moreover in accordance with an embodiment of the present invention the light source indicates a battery status of the wireless communicator.

Additionally in accordance with an embodiment of the present invention the light source indicates a reception strength of the wireless communicator.

Further in accordance with an embodiment of the present invention the light source indicates an operational mode of the wireless communication functionality.

Yet further in accordance with an embodiment of the present invention the light source indicates when the wireless communication functionality is in audio conversation operational mode.

Moreover in accordance with an embodiment of the present invention the light source indicates when the wireless communication functionality is in video operational conversation mode.

Additionally in accordance with an embodiment of the present invention the light source indicates when a new message has been received.

Further in accordance with an embodiment of the present invention the light source indicates when a new message has been sent.

Yet further in accordance with an embodiment of the present invention said message is a text message.

Moreover in accordance with an embodiment of the present invention said message is a multimedia message.

Additionally in accordance with an embodiment of the present invention said message is an email message.

Further in accordance with an embodiment of the present invention the light source indicates when the wireless communicator has an incoming phone call.

Moreover in accordance with an embodiment of the present invention the light source indicates a status of the enhanced function device when the wireless communicator is pouched therewith.

Additionally in accordance with an embodiment of the present invention the light source indicates an operational mode of the enhanced function device when the wireless communicator is pouched therewith.

Further in accordance with an embodiment of the present invention the housing includes an at least partially transparent portion in an outer facing surface, the wireless communication functionality includes an antenna fastened inside of the housing, for receiving and transmitting radio signals, the antenna includes an antenna hole in an outer facing surface, the antenna hole is aligned with the at least partially transparent portion of the housing, the wireless communicator further includes a light source fastened inside of the housing, the light source indicates when the wireless communicator is sufficiently pouched with the enhanced function device so as to activate the pouching responsive electrical interconnection functionality, and the light of the light source shines through the antenna hole and through the at least partially transparent portion in the housing.

Yet further n accordance with an embodiment of the present invention the native user interface functionality includes at least one of a keyboard, a display, a microphone, an earpiece, a headset port, a speaker and a vibrator.

Moreover in accordance with an embodiment of the present invention the pouching responsive electrical interconnection functionality responsive to pouching orientation of the housing in the pouch of the enhanced function device restricts the wireless communication functionality from using at least a portion of the native user interface functionality.

Additionally in accordance with an embodiment of the present invention the wireless communication functionality includes a phone call dialing functionality, and the pouching responsive electrical interconnection functionality responsive to pouching orientation of the housing in the pouch of the enhanced function device restricts the dialing functionality.

Further in accordance with an embodiment of the present invention the wireless communication functionality includes a network access functionality, and the pouching responsive electrical interconnection functionality responsive to pouching orientation of the housing in said pouch of the enhanced function device restricts the network access functionality.

There is yet further provided in accordance with an embodiment of the present invention an enhanced function device for use with a wireless communicator including a housing, wireless communication functionality located within the housing and native user interface functionality cooperating with the wireless communication functionality, the enhanced function device including a pouch, parenting user interface functionality, and pouching responsive electrical interconnection functionality responsive to pouching orientation of the housing of the wireless communicator in the pouch for causing the wireless communication functionality to adapt to cooperating with the parenting user interface functionality at least partially instead of with the native user interface functionality.

Moreover in accordance with an embodiment of the present invention the pouching responsive electrical interconnection functionality automatically causes the wireless communication functionality to adapt to cooperating with the parenting user interface functionality when the housing is oriented in the pouch of the enhanced function device.

Additionally in accordance with an embodiment of the present invention the pouching responsive electrical interconnection functionality causes the wireless communication functionality to adapt to cooperating with the parenting user interface functionality, when manually prompted to do so and when the housing is oriented in the pouch of the enhanced function device.

Further in accordance with an embodiment of the present invention the pouching responsive electrical interconnection functionality includes alien rejection functionality operative to prevent cooperation of an alien wireless communicator with the parenting user interface functionality of the enhanced function device notwithstanding existence of pouching orientation of the alien wireless communicator in the pouch of the enhanced function device.

Yet further in accordance with an embodiment of the present invention the enhanced function device is able to operate when the wireless communicator is not pouched therewith.

Moreover in accordance with an embodiment of the present invention the enhanced function device is not able to operate unless the wireless communicator is pouched therewith.

Additionally in accordance with an embodiment of the present invention the enhanced function device includes a non-volatile storage positioned within the housing, for storing information relating to parenting user interface functionality, and a controller positioned within the housing for trans-

mitting from the enhanced function device to the wireless communicator the information relating to parenting user interface functionality, when the wireless communicator is pouched with the enhanced function device.

Further in accordance with an embodiment of the present invention the parenting user interface functionality includes at least one of a keyboard, a display, a microphone, a speaker, a headset port and an earpiece.

There is yet further provided in accordance with an embodiment of the present invention a wireless communication system including a wireless communicator, including a housing, wireless communication functionality located within the housing, native user interface functionality cooperating with the wireless communication functionality and including user interface surfaces located on at least one outer facing surface of the housing, and pouching responsive electrical interconnection functionality responsive to pouching orientation of the housing in a pouch of an enhanced function device for automatically causing the wireless communication functionality to adapt to cooperating with parenting user interface functionality forming part of the enhanced function device at least partially instead of with the native user interface functionality, and an enhanced function device, including a pouch, parenting user interface functionality, and pouching responsive electrical interconnection functionality responsive to pouching orientation of the housing of the wireless communicator in the pouch for automatically causing the wireless communication functionality to adapt to cooperating with the parenting user interface functionality at least partially instead of with the native user interface functionality.

Moreover in accordance with an embodiment of the present invention the wireless communication functionality includes a phone call dialing functionality.

Additionally in accordance with an embodiment of the present invention the wireless communication functionality includes a network access functionality.

Further in accordance with an embodiment of the present invention the system includes-alien rejection functionality operative to prevent cooperation between mutually alien wireless communication functionality and enhanced user interface functionality of a wireless communicator and an enhanced function device which are mutually alien notwithstanding existence of pouching orientation of said housing in a pouch of said enhanced function device.

Yet further in accordance with an embodiment of the present invention the wireless communication system includes connector circuitry connecting the wireless communicator with the enhanced function device when the wireless communicator is pouched with the enhanced function device, wherein the connector circuitry enables the wireless communicator to detect whether or not the wireless communicator is pouched with the enhanced function device.

Alternatively in accordance with an embodiment of the present invention the wireless communication system includes connector circuitry connecting the wireless communicator with the enhanced function device when the wireless communicator is pouched with the enhanced function device, wherein the connector circuitry enables the wireless communicator to determine whether the enhanced function device is able to operate when the wireless communicator is not pouched therewith, or else is unable to operate unless the wireless communicator is pouched therewith.

Additionally in accordance with an embodiment of the present invention the wireless communicator functions as a master when pouched with the enhanced function device if the wireless communicator determines that the enhanced function device is unable to operate unless the wireless communicator is pouched therewith.

Further in accordance with an embodiment of the present invention the wireless communicator functions as a slave when pouched with the enhanced function device if the wireless communicator determines that the enhanced function device is able to operate when the wireless communicator is not pouched therewith.

Yet further in accordance with an embodiment of the present invention the wireless communication system includes connector circuitry connecting the wireless communicator with the enhanced function device when the wireless communicator is pouched with the enhanced function device, where the connector circuitry enables the enhanced function device to power the wireless communicator on and off when the enhanced function device is respectively powered on and off.

Moreover in accordance with an embodiment of the present invention the wireless communicator and the enhanced function device each includes a rechargeable battery, the wireless communicator system including connector circuitry connecting the wireless communicator with the enhanced function device when the wireless communicator is pouched with the enhanced function device, wherein the connector circuitry enables each of the rechargeable batteries to supply power to both the wireless communicator and the enhanced function device.

Additionally in accordance with an embodiment of the present invention the wireless communicator and the enhanced function device each includes a rechargeable battery, the wireless communicator system including connector circuitry connecting the wireless communicator with the enhanced function device when the wireless communicator is pouched with the enhanced function device, wherein the connector circuitry enables each of the rechargeable batteries to charge the other rechargeable battery.

Further in accordance with an embodiment of the present invention the wireless communicator includes a mailbox for receiving data from the enhanced function device and for transmitting data to the enhanced function device, when the wireless communicator is pouched with the enhanced function device.

Yet further in accordance with an embodiment of the present invention the wireless communicator pouching responsive electrical interconnection functionality is operative to wirelessly transmit a report about the enhanced function device to a remote recipient.

Moreover in accordance with an embodiment of the present invention the enhanced function device is an electronic appliance.

Additionally in accordance with an embodiment of the present invention the report is an appliance registration report.

Further in accordance with an embodiment of the present invention the report is an appliance diagnostic report.

Yet further in accordance with an embodiment of the present invention the enhanced function device includes a media playing module for playing digital media files, and a storage unit for storing digital media files, and wherein the parenting user interface functionality includes functionality for navigating and playing digital media files stored in the storage unit, and wherein the wireless communicator further includes a storage unit for storing digital media files, and a controller for storing incoming media files in the storage unit and for selectively copying media files from the storage unit

to the enhanced function device storage unit when the wireless communicator is pouched in the enhanced function device.

Moreover in accordance with an embodiment of the present invention the wireless communicator includes an audio playing module for playing digital audio files, and the enhanced function device includes a controller for selectively copying media files from the enhanced function device storage unit to the wireless communicator storage unit when the wireless communicator is pouched in the enhanced function device.

Additionally in accordance with an embodiment of the present invention the parenting user interface functionality includes functionality for navigating and playing digital media files stored in the wireless communicator storage unit.

There is further provided in accordance with an embodiment of the present invention a method for a pouchable wireless communicator, the wireless communicator having a native user interface, including in response to orienting the wireless communicator in a pouch of an enhanced function device, adapting the wireless communicator to conform with a parent user interface forming part of the enhanced function device at least partially instead of with the native user interface.

Yet further in accordance with an embodiment of the present invention the method includes preventing the wireless communicator from adapting to conform with an alien enhanced function device, notwithstanding the wireless communicator being oriented in a pouched of the alien enhanced function device.

Moreover in accordance with an embodiment of the present invention the method includes mutually transmitting from the enhanced function device to the wireless communicator information relating to the parent user interface of the enhanced function device, and configuring the wireless communicator to conform with the parent user interface forming part of the enhanced function device at least partially instead of with the native user interface.

Additionally in accordance with an embodiment of the present invention the method includes transmitting user interface data from the wireless communicator to the enhanced function device in conformance with the information relating to the parent user interface.

Further in accordance with an embodiment of the present invention the native user interface functionality includes at least one of a keyboard, a display, a microphone, an earpiece, a headset port, a speaker and a vibrator.

Yet further in accordance with an embodiment of the present invention adapting the wireless communicator to conform with a parent user interface includes restricting the wireless communicator from using at least a portion of its native user interface.

There is moreover provided in accordance with an embodiment of the present invention a method for using a wireless communicator, the wireless communicator having a native user interface, including in response to orienting the wireless communicator in a pouch of an enhanced function device, causing the wireless communicator to adapt to conform with a parent user interface of the enhanced function device at least partially instead of with the native user interface.

Additionally in accordance with an embodiment of the present invention the enhanced function device is able to operate when the wireless communicator is not pouched therewith.

Further in accordance with an embodiment of the present invention the enhanced function device is not able to operate unless the wireless communicator is pouched therewith.

Yet further in accordance with an embodiment of the present invention the parenting user interface functionality includes at least one of a keyboard, a display, a microphone, a speaker, a headset port and an earpiece.

There is moreover provided in accordance with an embodiment of the present invention a method for wireless communication including in response to orienting a wireless communicator having a native user interface in a pouch of an enhanced function device, adapting the wireless communicator to conform with a parent user interface forming part of the enhanced function device at least partially instead of with the native user interface, and in response to orienting the wireless communicator in the pouch of the enhanced function device, causing the wireless communicator to adapt to conform with the parent user interface of the enhanced function device at least partially instead of with the native user interface.

Additionally in accordance with an embodiment of the present invention the method includes detecting whether or not the wireless communicator is pouched with the enhanced function device.

Alternatively in accordance with an embodiment of the present invention the method includes determining whether the enhanced function device is able to operate when the wireless communicator is not pouched therewith, or else is unable to operate unless the wireless communicator is pouched therewith.

Yet further in accordance with an embodiment of the present invention the method includes controlling the wireless communicator to function as a master when pouched with the enhanced function device if the determining determines that the enhanced function device is unable to operate unless the wireless communicator is pouched therewith.

Moreover in accordance with an embodiment of the present invention the method includes controlling the wireless communicator to function as a slave when pouched with the enhanced function device if the determining determines that the enhanced function device is able to operate when the wireless communicator is not pouched therewith.

Additionally in accordance with an embodiment of the present invention the method includes powering the wireless communicator on and off, by the enhanced function device, when the enhanced function device is respectively powered on and off.

Further in accordance with an embodiment of the present invention the method includes supplying power to both the wireless communicator and the enhanced function device by a rechargeable battery in the wireless communicator.

Yet further in accordance with an embodiment of the present invention the method includes supplying power to both the wireless communicator and the enhanced function device by a rechargeable battery in the enhanced function device.

Moreover in accordance with an embodiment of the present invention the method includes charging a rechargeable battery in the wireless communicator by a rechargeable battery in the enhanced function device.

Additionally in accordance with an embodiment of the present invention the method includes charging a rechargeable battery in the enhanced function device by a rechargeable battery in the wireless communicator.

Further in accordance with an embodiment of the present invention the method includes wirelessly transmitting, by the wireless communicator, a report about the enhanced function device to a remote recipient.

Yet further in accordance with an embodiment of the present invention the enhanced function device is an electronic appliance.

Moreover in accordance with an embodiment of the present invention the report is an appliance registration report.

Additionally in accordance with an embodiment of the present invention the report is an appliance diagnostic report.

Further in accordance with an embodiment of the present invention the wireless communicator and the enhanced function device each have storage units, and the parent user interface includes an interface for navigating and playing digital media files stored in the enhanced function device storage unit, the method including storing, by the wireless communicator, incoming media files in the wireless communicator storage unit, and selectively copying media files from the wireless communicator storage unit to the enhanced function device storage unit when the wireless communicator is pouched in the enhanced function device.

Yet further in accordance with an embodiment of the present invention the native user interface includes an interface for playing digital audio files stored in the wireless communicator storage unit, the method including selectively copying, by the enhanced function device, media files from the enhanced function device storage unit to the wireless communicator storage unit when the wireless communicator is pouched in the enhanced function device.

There is moreover provided in accordance with an embodiment of the present invention a wireless communication system including a plurality of wireless communicators, each wireless communicator including a housing, wireless communication functionality located within the housing, native user interface functionality cooperating with the wireless communication functionality and including user interface surfaces located on at least one outer facing surface of the housing, and pouching responsive electrical interconnection functionality responsive to pouching orientation of the housing in a pouch of an enhanced function device for automatically causing the wireless communication functionality to adapt to interoperation with parenting user interface functionality forming part of the enhanced function device at least partially instead of with the native user interface functionality, and a plurality of distinguishable enhanced function devices, each enhanced function device including a pouch, parenting user interface functionality, and pouching responsive electrical interconnection functionality responsive to pouching orientation of the housing of the wireless communicator in the pouch for automatically causing the wireless communication functionality to adapt to interoperation with the parenting user interface functionality at least partially instead of with the native user interface functionality, wherein the plurality of wireless communicator pouching responsive electrical interconnection functionalities and the plurality of enhanced function device pouching responsive electrical interconnection functionalities enable each wireless communicator to identify which of the plurality of distinguishable enhanced function devices it is pouched in.

Additionally in accordance with an embodiment of the present invention the wireless communication functionality wirelessly transmits to a remote recipient a report about an enhanced function device, when the wireless communicator identifies the enhanced function device as being pouched therewith.

Further in accordance with an embodiment of the present invention the plurality of wireless communicators includes GSM wireless communicators and CDMA wireless communicators.

There is yet further provided in accordance with an embodiment of the present invention a method for wireless communication including in response to orienting each of a plurality of wireless communicators having native user interfaces in a pouch of one of a plurality of distinguishable enhanced function devices adapting the wireless communicator to conform with a parent user interface forming part of the one enhanced function device at least partially instead of with the native user interface, and identifying which one of the plurality of distinguishable enhanced function devices the wireless communicator is pouched in, and in response to orienting each of the plurality of wireless communicators in the pouch of one of the plurality of enhanced function devices, causing the wireless communicator to adapt to conform with the parent user interface of the one enhanced function device at least partially instead of with the native user interface.

Moreover in accordance with an embodiment of the present invention the method includes wirelessly transmitting to a remote recipient, by the wireless communicator, a report about an enhanced function device, when the wireless communicator identifies the enhanced function device as being pouched therewith.

Additionally in accordance with an embodiment of the present invention the plurality of wireless communicators includes GSM wireless communicators and CDMA wireless communicators.

There is further provided in accordance with an embodiment of the present invention an enhanced function device for use with a plurality of wireless communicators, each wireless communicator including a housing, wireless communication functionality located within the housing, and native user interface functionality cooperating with the wireless communication functionality, the enhanced function device including parenting user interface functionality, a plurality of pouches, and pouching responsive electrical interconnection functionality responsive to pouching orientation of the housing of any specific one of the plurality of wireless communicator in a corresponding one of the plurality of pouches, for causing the wireless communication functionality of the specific wireless communicator to adapt to cooperating with the parenting user interface functionality at least partially instead of with the specific wireless communicator native user interface functionality.

Yet further in accordance with an embodiment of the present invention the pouching responsive electrical interconnection functionality causes the wireless communication functionality of at least two wireless communicators to simultaneously adapt to cooperating with the parenting user interface functionality at least partially instead of with the respective native user interface functionalities of the at least two wireless communicators, in response to pouching orientation of the housings of the at least two wireless communicators in corresponding at least two pouches.

## BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will be more fully understood and appreciated from the following detailed description, taken in conjunction with the drawings in which:

FIG. **1** is a simplified illustration of a multifunctional multi-parent, pouchable communication system constructed and operative in accordance with an embodiment of the present invention;

FIG. **2**A is a simplified illustrations of various stages of pouching of a wireless communicator with a first enhanced function device in accordance with an embodiment of the present invention;

FIG. **2**B is a simplified illustrations of various stages of pouching of a wireless communicator with a second enhanced function device in accordance with an embodiment of the present invention;

FIGS. **3**A and **3**B are pictorial illustrations of an embodiment of a wireless communicator in accordance with an embodiment of the present invention;

FIGS. **4**A and **4**B are pictorial illustrations of an embodiment of an enhanced function device in accordance with an embodiment of the present invention;

FIG. **5** is a pictorial illustration of an embodiment of an internal antenna of the wireless communicator in accordance with an embodiment of the present invention;

FIG. **6** is a simplified block diagram illustration of the wireless communicator in accordance with an embodiment of the present invention;

FIG. **7**A is a simplified block diagram illustration of a first enhanced function device in accordance with an embodiment of the present invention;

FIG. **7**B is a simplified block diagram illustration of a second enhanced function device in accordance with an embodiment of the present invention;

FIG. **8**A is a simplified flow chart illustration of operation of the wireless communicator when pouched within the enhanced function device in accordance with an embodiment of the present invention;

FIG. **8**B is a simplified diagram of logic for alien rejection for a wireless communicator and an enhanced function device in accordance with an embodiment of the present invention;

FIG. **9** is a simplified block diagram of a pouching interface between the wireless communicator and the enhanced function device in accordance with an embodiment of the present invention;

FIG. **10** is a simplified block diagram of the wireless communicator with three operational states in accordance with an embodiment of the present invention;

FIG. **11** is a simplified flowchart of a method for the wireless communicator to detect the type of enhanced function device it is pouched with in accordance with an embodiment of the present invention;

FIG. **12**, which is a simplified diagram of an SD card interface that provides extended functionality in accordance with the present invention;

FIG. **13** is a simplified illustration of an arrangement of clusters in an SD card file system in accordance with an embodiment of the present invention;

FIG. **14** is a simplified flowchart of a method for downloading a file from a remote server to the wireless communicator in accordance with an embodiment of the present invention;

FIGS. **15**A-**15**D are snapshots of a user interface and a file system for a simple example use case, during various stages of file download during operation of the method of FIG. **14** in accordance with an embodiment of the present invention;

FIG. **16** is a simplified flowchart of a method for playing a streamed file from an SD card in accordance with an embodiment of the present invention;

FIG. **17** is a simplified flowchart of a method for playing a streamed file from the wireless communicator in accordance with an embodiment of the present invention;

FIG. **18** is an illustration of file streaming using a circular cluster cycle in the FAT in accordance with an embodiment of the present invention;

FIG. **19**, which is a simplified flowchart of a method for uploading a file from the wireless communicator to a remote server in accordance with an embodiment of the present invention;

FIGS. **20**A and **20**B, which are snapshots of a user interface and a file system for a simple example use case, during various stages of file upload during operation of the method of FIG. **19** in accordance with an embodiment of the present invention;

FIGS. **21**A and **21**B, are displays of configuration screens for the enhanced function device and the wireless communicator, pouched together, controlled so as to have the same look & feel, in accordance with an embodiment of the present invention;

FIGS. **22**A and **22**B, are displays of different configuration screens for the enhanced function device and the wireless communicator, pouched together, controlled so as to have the same look & feel, in accordance with an embodiment of the present invention;

FIGS. **23**A and **23**B, are displays of yet different configuration screens for the enhanced function device and the wireless communicator, pouched together, controlled so as to have the same look & feel, in accordance with an embodiment of the present invention;

FIG. **24** is a simplified block diagram of a system with a uniform interface for configuring the wireless communicator and the enhanced function device in accordance with an embodiment of the present invention;

FIG. **25**A is a simplified flowchart of a first embodiment of a method for controlling a configuration interface for the wireless communicator so as to conform to the look & feel of the parent user interface; in accordance with an embodiment of the present invention;

FIG. **25**B, which is a simplified flowchart of a second embodiment of a method for controlling a configuration interface for the wireless communicator so as to conform to the look & feel of the parent user interface in accordance with an embodiment of the present invention;

FIG. **25**C is a simplified flowchart of a third embodiment of a method for controlling a configuration interface for the wireless communicator so as to conform to the look & feel of the parent user interface in accordance with an embodiment of the present invention;

FIG. **26** is an illustration of button keys that have different key assignments for parent mode and native mode, but a common look & feel user interface for setting wireless communicator and enhanced function device configuration parameters in accordance with an embodiment of the present invention;

FIGS. **27**A and **27**B are illustrations of handset body dressed up in jackets with two different parent user interface packages in accordance with an embodiment of the present invention;

FIG. **28** is a simplified diagram of a circuit that provides bi-directional power control, in accordance with an embodiment of the present invention;

FIG. **29**, which is a simplified block diagram of bi-directional battery charging for a simple enhanced function device in accordance with an embodiment of the present invention;

FIG. **30** is a summary of bi-directional battery charging logic for the hardware of FIG. **29** in accordance with an embodiment of the present invention;

FIG. **31** is a simplified block diagram of bi-directional battery charging for a complex enhanced function device in accordance with an embodiment of the present invention;

FIG. **32** is a summary of bi-directional battery charging logic for the hardware of FIG. **31** in accordance with an embodiment of the present invention;

FIGS. **33**A and **33**B are simplified diagrams of a switching circuit that distinguishes between twelve audio/USB configurations of in accordance with an embodiment of the present invention;

FIG. **34** is a simplified diagram of an electrical circuit that determines bus direction in bi-directional SD and MMC signal lines in accordance with an embodiment of the present invention;

FIG. **35** is a simplified flowchart of a method for determining bus direction in bi-directional SD and MMC signal lines in accordance with an embodiment of the present invention;

FIG. **36** is a sample simulation for A and B signals 110010101110111 and 0010111, respectively in accordance with an embodiment of the present invention;

FIG. **37** is a simplified diagram of an electrical circuit that determines bus direction in multiplexed directional SD and MMC signal lines in accordance with an embodiment of the present invention;

FIG. **38** is a simplified illustration of an exemplary GSM communication network, within which the wireless communicator transmits information about a consumer electronic (CE) device to remote sites in accordance with an embodiment of the present invention;

FIG. **39** is a simplified illustration of an exemplary Code Division Multiple Access (CDMA) communication network, within which the wireless communicator transmits information about a consumer electronic (CE) device to remote sites in accordance with an embodiment of the present invention;

FIG. **40** is a simplified illustration of an exemplary IEEE 802.11b WiFi communication network, within which the wireless communicator transmits information about a consumer electronic (CE) device to remote sites in accordance with an embodiment of the present invention;

FIG. **41** is a simplified flowchart of a method for automated consumer electronic device reporting, using the wireless communicator in accordance with an embodiment of the present invention;

FIG. **42** is a simplified illustration of a communications network with the wireless communicator that wirelessly transmits registration information about an appliance to one or both of a remote manufacturer and a remote seller in accordance with an embodiment of the present invention;

FIG. **43** is a simplified illustration of a communications network with the wireless communicator that wirelessly transmits diagnostic information about an appliance to one or more of a remote seller, a remote manufacturer and a remote service provider in accordance with an embodiment of the present invention;

FIG. **44** is a simplified flowchart of a method for registering electrical appliances using the wireless communicator in accordance with an embodiment of the present invention;

FIG. **45** is a simplified flowchart of a method for reporting diagnostics for electrical appliances using the wireless communicator in accordance with an embodiment of the present invention;

FIG. **46** is a simplified flow chart of a method for provisioning software and firmware updates to a plurality of jackets and appliances using the wireless communicator in accordance with an embodiment of the present invention.

FIG. **47** is a simplified block diagram of the wireless communicator with a pouching controller in accordance with a first embodiment of the present invention;

FIG. **48** is a simplified flowchart of a method for booting the wireless communicator's baseband modem, and for performing subsequent operations in accordance with an embodiment of the present invention;

FIG. **49** is a simplified flowchart of a method for communicating between the enhanced function host device and the wireless communicator's baseband modem, and accessing the SD storage, in accordance with an embodiment of the present invention;

FIGS. **50**A/**1** and **50**A/**2** together are a simplified diagram illustrating a process of enabling a baseband modem to access SD storage, where a pouching controller coordinates between the baseband modem and enhanced function host device in accordance with a first embodiment of the present invention;

FIG. **50**B is a simplified diagram illustrating a process of enabling a baseband modem to access SD storage, where a pouching controller coordinates between the baseband modem and enhanced function host device in accordance with a second embodiment of the present invention;

FIG. **51** is a simplified flowchart of a method for a sleep mode in accordance with an embodiment of the present invention;

FIG. **52** is a simplified flowchart of a method for resuming operation after a sleep mode, in accordance with an embodiment of the present invention;

FIG. **53** is a simplified block diagram of a cellular handset, in accordance with a second embodiment of the present invention;

FIG. **54** is a simplified block diagram of a power management system, for preserving life of the battery in the wireless communicator in accordance with an embodiment of the present invention;

FIG. **55** is a simplified flowchart of a method for preserving life of a battery in the wireless communicator in accordance with an embodiment of the present invention;

FIG. **56** is a simplified state transition diagram for power modes of the wireless communicator in accordance with an embodiment of the present invention;

FIGS. **57**A and **57**B are illustrations of the wireless communicator pouched with a USB jacket in accordance with an embodiment of the present invention;

FIG. **58** is a simplified block diagram of the wireless communicator and a USB jacket in accordance with an embodiment of the present invention;

FIG. **59** is a simplified block diagram of the wireless communicator and a USB jacket, in accordance with a second embodiment of the present invention;

FIGS. **60**A and **60**B are simplified block diagrams of a modular audio player pouched with a digital media player in accordance with an embodiment of the present invention;

FIG. **61** is a simplified flowchart of a method for synchronizing media files between the host media player and the modular audio player, when the media files are received by the modular player in accordance with an embodiment of the present invention;

FIG. **62** is a simplified flowchart of a method for synchronizing media files between the host media player and the modular audio player, when the media files are received by the host player in accordance with an embodiment of the present invention; and

FIG. **63** is a simplified flowchart of operations carried out when the modular audio player is pouched with the host media player in accordance with an embodiment of the present invention.

For reference to the figures, the following index of elements and their numerals is provided. Elements numbered in the 100's generally relate to the wireless communicator, elements numbered in the 200's generally relate to the enhanced function device, elements numbered in the 400's-600's generally relate to pouch connection circuitry, elements num-

bered in the 300's and 700's-900's generally relate to wireless networks. Elements numbered in the 1000's-3000's are steps of flow charts.

| Element | Description |
|---|---|
| | Elements generally related to the wireless communicator |
| 100 | Wireless communicator |
| 101 | Transparent portion of housing |
| 102 | SD NAND controller |
| 106 | UART port of pouching controller |
| 107 | SD host port of pouching controller |
| 108 | SD port of pouching controller |
| 109 | SD host of modem |
| 110 | Pouching controller |
| 111 | SD host of pouching controller |
| 112 | SD slave of pouching controller |
| 113 | Management data channel |
| 114 | Data channel bridge |
| 115 | Storage |
| 117 | Outgoing mailbox |
| 118 | Incoming mailbox |
| 120 | Modem |
| 123 | Voltage boost |
| 124 | Battery charger |
| 125 | Power management subsystem |
| 126 | Voltage level shifter |
| 127 | On/off button |
| 128 | On/off switch |
| 130 | Audio/video subsystem |
| 135 | Power amplifier |
| 136 | RF interface |
| 140 | Internal antenna |
| 145 | Battery |
| 146 | External power source |
| 150 | Connector |
| 155 | USB connector |
| 156 | USB charger |
| 160 | Pouch connector |
| 161 | UART interface modem |
| 162 | SD interface of modem |
| 163 | Internal SRAM memory |
| 164 | External memory interface |
| 166 | External SDRAM memory |
| 170 | Native user interface |
| 171 | Microphone |
| 173 | Earpiece |
| 175 | Speaker |
| 177 | Vibrator |
| 180 | Keyboard |
| 185 | Display |
| 190 | SIM card |
| | Elements generally related to the enhanced function device |
| 200 | Enhanced function device |
| 200a | Jacket |
| 200b | Host |
| 200c | Media player |
| 205 | Host controller |
| 205a | Auxiliary processor for jacket |
| 205b | Host controller for host |
| 207 | SD driver |
| 208 | SD application |
| 209 | SD host of host controller |
| 210 | Pouching controller |
| 210a | Pouching controller for jacket |
| 210b | Pouching controller for host |
| 210c | Pouching controller for media player |
| 211 | SD host of pouching controller |
| 212 | SD slave of pouching controller |
| 213 | Management data channel |
| 214 | Data channel bridge |
| 215 | Storage |
| 215a | Storage for jacket |
| 215c | Storage for media player |
| 220c | Modem |
| 223 | Voltage boost |
| 224 | Battery charger |
| 225 | Power manager |

-continued

| Element | Description |
|---|---|
| 225a | Power manager for jacket |
| 225b | Power manager for host |
| 225c | Power manager for media player |
| 227 | On/off button |
| 228 | On/off switch |
| 230c | Media player |
| 245 | Battery |
| 245a | Battery for jacket |
| 255 | USB connector |
| 255c | External connector for media player |
| 256 | USB charger |
| 257 | USB hub |
| 260 | Pouch connector |
| 260a | Pouch connector of jacket |
| 260b | Pouch connector of host |
| 260c | Pouch connector of media player |
| 261c | Tracks for sliding wireless communicator |
| 270a | Parent user interface of jacket |
| 270b | Parent user interface of host |
| 270c | Parent user interface of media player |
| 271a | Microphone of jacket |
| 271b | Microphone of host |
| 272 | Headset audio jack |
| 273 | Earpiece |
| 273a | Earpiece of jacket |
| 273b | Earpiece of host |
| 275 | Left speaker |
| 275a | Speaker(s) of jacket |
| 275b | Speaker(s) of host |
| 276 | Right speaker |
| 277a | Vibrator of jacket |
| 277b | Vibrator of host |
| 280 | Keyboard |
| 280a | Keyboard of jacket |
| 280b | Keyboard of host |
| 281 | Soft key |
| 282 | Soft key |
| 283 | Display bar |
| 285 | Peripheral display/camera |
| 285a | Display of jacket |
| 285b | Display of host |
| 285c | Display of media player |
| 286 | Left display panel |
| 287 | Right display panel |
| 288 | Display control element |
| 289 | Strap for USB jacket |
| 290a | SIM card for jacket |
| 290b | SIM card for host |
| 292 | SPDT switch of USB jacket |
| 293 | USB2SD bridge of USB jacket |
| 295 | Web browser |
| 296 | Micro-SD card of USB jacket |
| 297 | Controller of micro-SD card |
| 298 | Storage of micro-SD card |
| | Elements generally related to the pouching connection/Network elements |
| 300 | Manufacturer/seller/service provider |
| 310 | Appliance registration report |
| 320 | Appliance diagnostic report |
| 395 | Web server |
| 400 | Bi-directional power control circuit |
| 500 | Audio and USB multiplexing circuit |
| 505 | D+ signal line |
| 510 | D− signal line |
| 515 | Analog/digital switch |
| 520 | Analog/digital switch |
| 525 | Control signal line |
| 530 | Headset left signal line |
| 535 | Headset right signal line |
| 540 | USB signal line |
| 545 | USB signal line |
| 550 | Headset microphone signal line |
| 555 | USB signal line |
| 560 | Headset detection line |
| 565 | USB detection line |
| 600 | SD/MMC bi-directional bridge |

-continued

| Element | Description |
|---|---|
| 610 | Level shifter buffer |
| 610b | Level shifter buffer |
| 610c | Level shifter buffer |
| 615 | Level shifter buffer |
| 615b | Level shifter buffer |
| 615c | Level shifter buffer |
| 620 | Data flip-flop module |
| 620b | Data flip-flop module |
| 620c | Data flip-flop module |
| 625 | Data flip-flop module |
| 625b | Data flip-flop module |
| 625c | Data flip-flop module |
| 630 | Data flip-flop module |
| 630b | Data flip-flop module |
| 630c | Data flip-flop module |
| 635 | Data flip-flop module |
| 635b | Data flip-flop module |
| 635c | Data flip-flop module |
| 640 | Data by-pass line |
| 640b | Data by-pass line |
| 640c | Data by-pass line |
| 645 | Data by-pass line |
| 645b | Data by-pass line |
| 645c | Data by-pass line |
| 650 | Logical processing unit |
| 650b | Logical processing unit |
| 650c | Logical processing unit |
| 655 | Logical processing unit |
| 655b | Logical processing unit |
| 655c | Logical processing unit |
| 660 | Logical processing unit |
| 660b | Logical processing unit |
| 660c | Logical processing unit |
| 665 | Logical processing unit |
| 665b | Logical processing unit |
| 665c | Logical processing unit |
| 670 | Pull-up resistor |
| 670c | Pull-up resistor |
| 675 | Pull-up resistor |
| 675b | Pull-up resistor |
| 675c | Pull-up resistor |
| 680 | Control signal line |
| 690 | SD/MMC bi-directional bridge |
| 700 | GSM communication network |
| 715 | Base transceiver station |
| 720 | Base station controller |
| 725 | Mobile switching center |
| 730 | Serving GPRS support node |
| 735 | GPRS HLR/AUC/EIR |
| 740 | GPRS visitor location registry |
| 745 | Gateway mobile switching center |
| 750 | Public-switched telephone network |
| 755 | Gateway GPRS support node |
| 760 | Internet |
| 765 | Remote server |
| 800 | CDMA communication network |
| 805 | Packet control function |
| 810 | Packet data serving node |
| 815 | Packet core network |
| 820 | CDMA home agent |
| 825 | CDMA AAA server |
| 830 | CDMA interworking function |
| 900 | WiFi communication network |
| 905 | Wireless router |
| 910 | Modem |

## DETAILED DESCRIPTION

Aspects of the present invention relate to a wireless communicator that attaches to an enhanced function device in a manner referred to herein as pouching. Pouching is defined herein to mean inserting the wireless communicator device inside of the enhanced function device so that the wireless communicator is at least partially obscured by the enhanced function device, and such that the enhanced function device mechanically supports the wireless communicator.

There are two general types of enhanced function devices into which the wireless communicator may be pouched; namely, jackets and hosts. A jacket is a device that provides a user interface for the wireless communicator, enriches the capabilities of the wireless communicator, and is not able to operate independently when the wireless communicator is not pouched therewith. Conversely, a host is a device that is able to operate independently when the wireless communicator is not pouched therewith, and whose capabilities are enriched by the wireless communicator when the wireless communicator is pouched therewith. Generally a host does not have communication functionality independent of the wireless communicator.

Reference is now made to FIG. **1**, which is a simplified illustration of a multifunctional multi-parent, pouchable communication system constructed and operative in accordance with an embodiment of the present invention. Shown in FIG. **1** are a variety of wireless communicators, including 2.5G communicators for a GSM network, 3G communicators for GSM network, and CDMA communicators for a CDMA network. Such wireless communicators are described hereinbelow with reference to FIGS. **38** and **39**. It will be appreciated by those skilled in the art that the networks illustrated in FIG. **1** are exemplary of a wide variety of networks and communication protocols that are supported by the wireless communicators of the present invention, such networks and communication protocols including inter alia WiFi, Bluetooth and WiMax.

Also shown in FIG. **1** are a variety of enhanced function devices. In accordance with an embodiment of the present invention, each wireless communicator may be pouched with each enhanced function device, and is compatible therewith. The wireless communicators are substantially of the same form factor and, as such, are able to be pouched with the various enhanced function devices.

Reference is now made to FIG. **2**A, which is a simplified illustration of various stages of pouching of a wireless communicator **100** with a first enhanced function device **200***a* in accordance with an embodiment of the present invention. First enhanced device **200***a* is a jacket for wireless communicator **100**. The housing of wireless communicator **100** has an at least partially transparent portion **101** for a light source, such as an LED display, to show through. When wireless communicator **100** is fully inserted into jacket **200***a* so that electrical connection is made via a pouch connector, the light source is lit underneath portion **101**, indicating that the connection has been made.

It will be appreciated by those skilled in the art that the light source may be used to indicate a status of wireless communicator **100**. Thus the light source may indicate inter alia a battery status of wireless communicator, or a reception strength thereof. The light source may indicate an operational mode of wireless communicator **100**. Thus the light source may indicate inter alia an audio conversation mode or a video conversation mode. The light source may indicate when a new message has been received by wireless communicator **100**, or when a new message has been sent by wireless communicator **100**. The light source may indicate that wireless communicator **100** has an incoming call. Similarly, the light source may indicate a status or operational mode of enhanced function device **200** when wireless communicator **100** is pouched therewith.

Reference is now made to FIG. **2**B, which is a simplified illustration of various stages of pouching of wireless communicator **100** with a second enhanced function device **200***b* in

accordance with an embodiment of the present invention. Second enhanced function device **200***b* is a host for wireless communicator **100**. When wireless communicator **100** is fully inserted into jacket **200***b* so that electrical connection is made via a pouch connector, a light source is lit underneath portion **101**, confirming that the connection has been made.

Reference is now made to FIGS. **3**A and **3**B, which are pictorial illustrations of an embodiment of wireless communicator **100** in accordance with an embodiment of the present invention. Wireless communicator **100** is small; in one embodiment, its dimensions are approximately 72.09 mm×37.59 mm×7.80 mm. Those skilled in the art will appreciate that the present invention is applicable when wireless communicator **100** is manufactured with other dimensions, as well. As shown in FIGS. **3**A and **3**B, the housing for wireless communicator **100** includes an at least partially transparent portion **101** for a light source to show through.

Reference is now made to FIGS. **4**A and **4**B, which are pictorial illustrations of an embodiment of enhanced function device **200** in accordance with an embodiment of the present invention.

Reference is now made to FIG. **5**, which is a pictorial illustration of an embodiment of an internal antenna **140** of wireless communicator **100** in accordance with an embodiment of the present invention. As shown in FIG. **5**, antenna **140** includes an opening **141** for a light, such as an LED light, to show through. Antenna **140** is positioned so that opening **141** is aligned underneath at least partially transparent portion **101** of FIGS. **3**A and **3**B. The light for indicating a pouching connection between wireless communicator **100** and enhanced function device **200** thus shows through opening **141** and is visible through portion **101**.

Reference is now made to FIG. **6**, which is a simplified block diagram illustration of wireless communicator **100** in accordance with an embodiment of the present invention. Wireless communicator **100** includes six primary components, as follows: a pouching controller **110**, a memory storage **115**, a modem **120** for sending and receiving voice communications, a power management subsystem **125**, a power amplifier **135** and a native user interface **170**.

Pouching controller **110** executes programmed instructions that control the data flow between wireless communicator **100** and enhanced function device **200**. Modem **120** controls the wireless communication functionality of wireless communicator **100**. Power management subsystem **125** includes charging circuitry for charging a battery **145**. Power amplifier **135** includes a radio frequency (RF) interface **136**, and is connected to an antenna **140**. Native user interface **170** includes a microphone **171** and an earpiece **173**. Native user interface **170** also includes an optional speaker **175**, vibrator **177**, keyboard **180** and display **185**. It will be appreciated by those skilled in the art that native user interface **170** may included additional components, such as a headset audio jack.

Wireless communicator includes an optional audio/video subsystem **130**, which includes inter alia a voice, audio and video interface.

Wireless communicator **100** includes a connector **150**, which includes a pouch connector **160** and an optional USB connector **155**. Wireless communicator **100** optionally includes a SIM **190**.

Generally, each subscriber of a wireless communication network is uniquely identified. Various methods are known in the art for identifying subscribers, including inter an IP address and a subscriber identification module (SIM). Although the description herein refers to SIM cards, those skilled in the art will appreciate that other forms of subscriber identification may be used instead.

Wireless communicator **100** operates in standalone mode or in conjunction with enhanced function devices, such as enhanced function device **200** shown in FIGS. **2**A and **2**B, when it is pouched therein via pouch connector **160**.

Preferably the interface between pouching controller **110** and storage **115**, and the interface between pouching controller **110** and modem **120** are SD interfaces. The interface between pouching controller **110** and pouch connector **160** is a customized pouching interface.

Reference is now made to FIG. **7**A, which is a simplified block diagram illustration of first enhanced function device **200***a* in accordance with an embodiment of the present invention. Enhanced function device **200***a* is a jacket for wireless communicator **100**. Enhanced function device **200***a* includes a pouching controller **210***a* and a pouch connector **260***a*, for use when wireless communicator **100** is pouched with enhanced function device **200***a* via the wireless communicator's pouch connector **160**. Enhanced function device **200***a* includes an optional auxiliary processor **205***a*, an optional storage **215***a*, an optional power management subsystem **225***a*, and an optional battery **245***a*, and an optional SIM **290***a*.

Enhanced function device **200***a* includes a parent user interface **270***a* including an optional microphone **271***a*, an optional earpiece **273***a*, an optional mono speaker or optional stereo speakers **275***a*, an optional vibrator **277***a*, an optional keyboard **280***a* and an optional display **285***a*. It will be appreciated by those skilled in the art that native user interface **270***a* may included additional components, such as a headset audio jack.

Preferably the interface between pouching controller **210***a* and storage **215***a*, is an SD interface. The interface between pouching controller **210***a* and pouch connector **260***a* is a customized pouching interface.

Reference is now made to FIG. **7**B, which is a simplified block diagram illustration of second enhanced function device **200***b* in accordance with an embodiment of the present invention. Enhanced function device **200***b* is a host for wireless communicator **100**. Enhanced function device **200***b* includes a pouching controller **210***b*, a power management subsystem **225***b* and a pouch connector **260***b*. Enhanced function device **200***b* includes an optional host controller **205***b*, an optional battery **245***b* and an optional SIM **290***b*.

Enhanced function device **200***b* includes a parent user interface **270***b* including an optional microphone **271***b*, an optional earpiece **273***b*, an optional mono speaker or optional stereo speakers **275***b*, an optional keyboard **280***b*, and an optional display **285***b*. It will be appreciated by those skilled in the art that native user interface **270***b* may included additional components, such as a headset audio jack.

The interface between pouching controller **210***b* and pouch connector **260***b* is a customized pouching interface.

In accordance with an embodiment of the present invention, enhanced function device **200***a*/**200***b* includes SIM **290***a*/**290***b*, and when wireless communicator **100** is pouched with enhanced function device **200***a*/**200***b*, wireless communicator **100** can access SIM **290***a*/**290***b* via pouch connectors **160** and **260***a*/**260***b*. As such, wireless communicator **100** is able to identify itself to a wireless network using either SIM **190** or SIM **290***a*/**290***b*.

Having access to more than one SIM when pouched with enhanced function device **200***a*/**200***b*, provides many diverse advantages to wireless communicator **100**. Wireless communicator **100** is then able inter alia (i) to receive incoming communications for multiple subscribers, (ii) to select a desired subscriber identity for sending outgoing communications, and (iii) to change the identity of wireless communica-

tor **100** in a wireless network from the identity corresponding to SIM **190** to an alternate identity corresponding to SIM **290***a*/**290***b*.

In an embodiment of the present invention, SIM **290***a*/**290***b* is a prepaid SIM, which allows a limited amount of communication.

In another embodiment of the present invention SIM **190** and SIM **290***a*/**290***b* are associated with different billing programs of a wireless operator.

In another embodiment of the present invention, SIM **190** and SIM **290***a*/**290***b* may have different access rights to resources in a wireless network.

In another embodiment of the present invention, wireless communicator **100** uses SIM **290***a*/**290***b* in conjunction with SIM **190**, when wireless communicator **100** is pouched with enhanced function device **200***a*/**200***b*.

In another embodiment of the present invention, when wireless communicator **100** is pouched with enhanced function device **200***a*/**200***b*, enhanced function device **200***a*/**200***b* stores instructions on when to use SIM **290***a*/**290***b* for subscriber identification. For example, enhanced function device **200***a*/**200***b* may instruct wireless communicator **100** to use SIM **290***a*/**290***b* for international calls, for SMS messaging and for data services. For other communications, wireless communicator uses SIM **190**.

In another embodiment of the present invention, when wireless communicator **100** is pouched with enhanced function device **200***a*/**200***b*, wireless communicator **100** prompts a user to select between possible subscriber identifiers. Further, if wireless communicator **100** is connected to a network prior to being pouched with enhanced function device **200***a*/**200***b*, and if the user selects to change subscriber identity when wireless communicator is subsequently pouched with enhanced function device, then wireless communicator **100** disconnects from the network and reconnects to the network using the changed subscribed identify.

It will be appreciated by those skilled in the art that use of more than one SIM may enables wireless communicator **100**, when pouched with enhanced function device **200***a*/**200***b*, to access wireless networks for which wireless communicator alone does not have access thereto.

It will further be appreciated by those skilled in the art that enhanced function device **200***a*/**200***b* may include more than one SIM **290***a*/**290***b*.

Reference is now made to FIG. **8**A, which is a simplified flow chart illustration of operation of wireless communicator **100** when pouched within enhanced function device **200**, in accordance with an embodiment of the present invention. At step **1005** wireless communicator **100** is pouched with enhanced function device **200**. At step **1010** wireless communicator **100** and enhanced function device **200** authenticate each other.

In this regard, reference is now made to FIG. **8**B which is a simplified diagram of logic for alien rejection for wireless communicator **100** and enhanced function device **200** in accordance with an embodiment of the present invention. Wireless communicator **100** and enhanced function device **200** each have a private key and a certificate signed by a trusted third party private key. As shown in FIG. **8**B, the following sequence of events occurs at step **1010** of FIG. **8**A.

- Wireless communicator **100** sends its signed certificate to enhanced function device **200** for validation.
- Enhanced function device **200** validates the certificate using the third party public key.
- After validation, enhanced function device **200** sends its certificate to wireless communicator **100** for validation.
- Wireless communicator **100** validates the certificate using the third party public key.
- After validation, wireless communicator **100** generates a pseudo random number, a, encrypts it using the enhanced function device public key, and sends the encrypted value to enhanced function device **200**.
- Enhanced function device **200** generates a pseudo random number, b, encrypts it using the wireless communicator public key, and sends the encrypted value to wireless communicator **100**.
- Wireless communicator **100** decrypts b using its private key.
- Wireless communicator encrypts a*b using the enhanced function device public key, and sends the encrypted value to enhanced function device **200**.
- Enhanced function device **200** decrypts a*b using its private key, and validates a*b.
- Enhanced function device **200** decrypts a using its private key.
- Enhanced function device **200** encrypts a*b using the wireless communicator public key, and sends the encrypted value to wireless communicator **100**.
- Wireless communicator **100** decrypts a*b using its private key and validates a*b.

The logic shown in FIG. **8**B thus establishes a common key between wireless communicator **100** and enhanced function device **200**, and enables validation of each certificate to facilitate alien rejection at step **1010**.

Referring back to FIG. SA, at step **1015** a determination is made whether or not wireless communicator **100** and enhanced function device **200** are mutually alien, based on the outcome of the logic shown in FIG. **8**B. If so, then processing aborts at step **1020**. Otherwise, at step **1025** wireless communicator **100** reads information about enhanced device, the information including inter alia subscriber network identification information. At step **1028** wireless communicator **100** discovers the characteristics of the enhanced function device that it is pouched with. At step **1029** wireless communicator **100** auto-adapts itself to enhanced function device **200**.

At step **1030** wireless communicator **100** determines whether or not enhanced function device **200** has a subscriber network identifier suitable for wireless communicator **100**. If so, then at step **1035** pouching controller **110** determines the subscriber network identifier from enhanced function device **1035**. If not, then at step **1040** pouching controller **110** determines a subscriber network identifier from an embedded identifier. At step **1045** wireless communicator uses the determined identifier to connect to a wireless network.

In accordance with an embodiment of the present invention, enhanced function device **200** operates with a plurality of wireless communicators **100** simultaneously. Simultaneous pouching of the plurality of wireless communicators **100** with the same enhanced function device **200** has many advantages, including inter alia (i) battery charging, (ii) combining multiple wireless communication channels to expand bandwidth, (iii) enabling enhanced function device **200** to accept communication transmitted to any of the plurality of wireless communicators, (iv) usage of data storage in more than one wireless communicator, and (v) transfer of data from one wireless communicator to another wireless communicator.

According to an embodiment of the present invention, the pouching location of the plurality of wireless communicators within enhanced function device **200** dictates an order of priority for the plurality of wireless communicators.

According to an embodiment of the present invention, each of plurality of wireless communicators **100** has an identifier that is displayed by parenting user interface **270** of enhanced function device **200**.

According to an embodiment of the present invention, parenting user interface **270** enables modification of the wireless communicator identifiers.

Reference is now made to FIG. **9**, which is a simplified block diagram of a pouching interface between wireless communicator **100** and enhanced function device **200** in accordance with an embodiment of the present invention. As shown in FIG. **9**, the pouching interface includes two data channels; namely, a first data channel for use by a wireless communicator manager **113** and an enhanced function device manager **213**, and a second data channel for use by a wireless communicator bridge **114** and an enhanced function device bridge **214**. Said managers **113** and **213** and bridge **114** and **214** may be embodied in pouching controller.

The first data channel is used for exchanging mailbox messages between pouching controller **110** and pouching controller **210**. The second data channel is used to place peripherals such as camera/display **285**, in direct connection with modem **120**.

In accordance with an embodiment of the present invention, the interface for the peripherals is translated into a proprietary protocol in wireless communicator **100**, and is translated back to the original peripheral interface in enhanced function device **200**.

The pouching interface may include third data channel, for use in transferring large amounts of data between pouching controller **110** and pouching controller **210**.

The pouching interface includes inter alia audio channels and power supply lines.

In accordance with an embodiment of the present invention, pouching of wireless communicator **100** with enhanced function device **200** may reduce the functionality of wireless communicator **100**. Specifically, functions accessible to wireless communicator **100** may be limited when wireless communicator is pouched with enhanced function device **200**. For example, when pouched with enhanced function device **200**, wireless communicator **100** may be limited to only dialing designated phone numbers, or to only connecting to designated web sites, or to only using a text editor to send SMS messages. Similarly, wireless communicator **100** may be limited to air-time, and restricted to accessing configuration settings for wireless communicator **100**.

According to an embodiment of the present invention, the limiting of wireless communicator functionality is initiated automatically when wireless communicator **100** is pouched with enhanced function device **200**. According to another embodiment of the present invention, the limiting of wireless communicator functionality is initiated manually; e.g., by entering a password.

In an embodiment of the present invention, the user can manually remove the reduction of functionality whilst the wireless communicator is pouched within enhanced function device; e.g. by entering a password.

According to an embodiment of the present invention, the limiting of wireless communicator functionality is a parental control mechanism.

According to an embodiment of the present invention, jacket **200** is used to authenticate wireless communicator **100**. E.g., a children's wireless communicator **100** is only configurable when pouched within a parental jacket **200**; or vice versa a children's jacket **200** is only configurable when a parental wireless communicator **100** is pouched therewith. Moreover, according to an embodiment of the present invention when a parental wireless communicator **100** is pouched with a children's jacket **200**, the parental wireless communicator **100** assigns a parent's phone number to a designated programmable key in children's jacket **200**.

1. Three Operation States of Wireless Communicator

Embodiments of the present invention relate to the capability of wireless communicator **100** (*i*) to operate in a standalone mode, (ii) to be pouched with a jacket shell that is not an independent device and that cannot operate without the wireless communicator **100** being pouched thereto, and (iii) to be pouched with an enhanced function device that serves as the wireless communicator's host. In state (ii) wireless communicator **100** functions as a master, and in state (iii) the wireless communicator **100** functions as a slave.

It will thus be appreciated by those skilled in the art that wireless communicator **100** is operable in three states; namely, (I) a standalone state, (II) a state connected to a simple host, and (III) a state connected to a complex host. In State II the simple host is a jacket shell. Wireless communicator **100** operates as a master and the jacket operates as a slave. Conversely, in State III the complex host is an enhanced function host device. Wireless communicator **100** operates as a slave and the enhanced function host device operates as a master.

In State I as a standalone, wireless communicator **100** has its own user interface and provides communication data and voice over radio technology, in addition to other services including inter alia MP3 playing.

In State II connected to a simple host, the jacket is not an independent device and cannot operate without wireless communicator **100** being pouched therewith. The jacket may include only a display, a keyboard and a simple non-volatile storage chip. Optionally, the jacket may further include speakers, a microphone and a secondary power source. Wireless communicator **100** supplies power to jacket's keyboard, display speakers and microphone, and to the wireless communicator's own internal circuitry. Wireless communicator **100** uses the jacket's secondary power source to charge the wireless communicator's internal power source.

During initialization, after wireless communicator **100** is pouched with the jacket, or at boot time, static configuration parameters are read from the storage of the jacket to wireless communicator **100**. Thereafter, wireless communicator **100** provides the jacket with display information, in the form of screen shots such as bitmap images.

In State III connected to a complex host, the enhanced function host device is an independent device that operates independently of wireless communicator **100**, such as an MP3/MPP player or a digital camera. Commands and information are shared, and sent over an SD control bus during operation. The enhanced function host device includes its own host controller, user interface and power source. The user interface for both the device functionality and the wireless communicator functionality operates through the enhanced function host device. The interface to the enhanced function host device is via pouch connector **160**, where pins on the connector **160** have specifically assigned functionalities and use specific protocols.

It will thus be appreciated by those skilled in the art that the pouch connector to the jacket is via the same pouch connector as is the connector to the enhanced function host device, but the pins on pouch connector generally have different functionalities and use different protocols with the jacket than those used with the enhanced function host device.

The three operational states of wireless communicator **100** are summarized in TABLE I hereinbelow.

TABLE I

Three Operation States of Wireless Communicator 100

| | | |
|---|---|---|
| State I | Standalone | Wireless communicator uses its own interface |
| State II | Connected to a simple host | Wireless communicator is master; jacket is slave<br>Jacket cannot operate without wireless communicator<br>Wireless communicator provides jacket with screen shots, in the form of bitmap images, for display information<br>Communication is through SD bus |
| State III | Connected to a complex host | Wireless communicator is slave; Enhanced function device is master<br>Enhanced function device operates independently of wireless communicator<br>Wireless communicator provides enhanced function device with screen shots, in the form of bitmap images, for display information<br>Communication is through SD bus |

Reference is now made to FIG. **10**, which is a simplified block diagram of wireless communicator **100** with three operational states in accordance with an embodiment of the present invention. Wireless communicator **100** as shown in FIG. **10** supports the three operational states in TABLE I. The components of wireless communicator **100** shown in FIG. **10** enable it to function as a standalone device. When enhanced function device **200** is connected to wireless communicator **100**, wireless communicator **100** may operate as a master or as a slave, and the SD communication between pouch connectors **160** and **260** flows accordingly. Specifically, in State II wireless communicator **100** is the master and enhanced function device **200** is the slave, and in State III wireless communicator **100** is the slave and enhanced function device **200** is the master.

In accordance with an embodiment of the present invention wireless communicator **100** automatically detects its operational environment by monitoring the voltage on designated pins of pouch connector **160**. I.e., communication card **100** distinguishes between States I-III based on voltage. Enhanced function host devices and jacket shells generally drive the voltage on these pins differently, which enables wireless communicator **100** to discriminate whether or not it is pouched with an enhanced function device, and to detect the type of enhanced function device it is connected to.

In this regard, reference is made to FIG. **11**, which is a simplified flowchart of a method for wireless communicator **100** to detect the type of enhanced function device **200** it is pouched with in accordance with an embodiment of the present invention. At step **1110** battery subsystem **125** or optionally pouching controller **110** monitors the connector signal VBat_host, shown in FIG. **10**. If the VBat_host signal has a voltage level higher than logical zero (i.e., 0.5V or higher), as determined at step **1120**, then pouching controller **110** concludes that wireless communicator **100** is pouched with an enhanced function device. Otherwise, if VBat_host is logical zero (i.e., below 0.5V), then at step **1130** pouching controller **110** concludes that wireless communicator **100** is not pouched with an enhanced function device.

In order to detect which type of enhanced function device wireless communicator **100** is pouched with, pouching controller **110** monitors the HOST_INT/TYPE signal, shown in FIG. **10**. When pouching is detected, the HOST_INT/TYPE signal is sampled at step **1140**. If HOST_INT/TYPE is a logical zero (i.e., below 0.5V), as determined at step **1150**, then at step **1160** the pouching controller **110** concludes that enhanced function device **200** is a jacket shell. Otherwise, if HOST_INT/TYPE is higher than logical zero (i.e., 0.5V or higher), then at step **1170** the pouching controller **110** concludes that enhanced function device **200** is a host device.

The use of HOST_INT/TYPE for detecting the type of enhanced function device **200**, is made at the time of pouching wireless communicator **100** with enhanced function device **200**. Afterwards, the signal HOST_INT/TYPE is used as an interrupt signal.

In an alternative embodiment of the present invention, the SD_Vdd signal, shown in FIG. **10**, may be monitored at step **1110** instead of or in addition to the VBat_host signal. Whereas the VBat_host signal generally indicates whether or not communication card **100** is pouched with an enhanced function device, the SD_Vdd signal generally indicates whether or not the enhanced function device is turned on.

It will be appreciated by those skilled in the art that the threshold of 0.5V used in the above discussion is merely indicative of a general pre-designated threshold that is used to detect attachment of the host to the communication card, and to detect the type of the host.

In an embodiment of the present invention, pouching controller pouching controller **110** notifies modem **120** of pouching and the type of enhanced function device.

When wireless communicator modem **120** detects that wireless communicator is pouched with an enhanced function device, native user interface **170** of wireless communicator **100** is at least partially disabled at step **1180**. For enhanced function devices, wireless communicator modem **120** receives user interface inputs, and provides feedback as bitmap graphics BMP screen shots, or as single messages, via the pouching interface. The enhanced function device controls the device's display and keyboard. For enhanced function jackets, the wireless communicator modem **120** receives direct keyboard strokes from the jacket keyboard, and provides the displayed image pixels/characters directly to the jacket display, using the enhanced function device pouching controller **210***a*.

In an embodiment of the present invention, in order to be powered, jackets connect their internal circuitry to the Vbat_Comm signal that connects to connector **105**. If a jacket **200** has a secondary battery, then the secondary battery is connected to Vbat_Host, which connects to the wireless communicator's **100** power management subsystem **125** and is used to charge the wireless communicator's internal battery **145**.

Similarly, the internal circuitry of an enhanced function device **200** is powered by connecting its internal power source to Vbat_Host. Enhanced function device **200** does not use the Vbat_Comm signal as a power source, but may monitor it to detect when wireless communicator **100** is pouched therewith, or to monitor the wireless communicator's battery level.

2. Extending Functionality of Memory Cards

Embodiments of the present invention concern extending the functionality of SD cards, beyond the local storage functionality that is conventionally provided. Using the present invention, SD cards can provide wired or wireless communication channels to access remote content servers, and can stream content from, upload content to and download content from these servers.

Using the present invention, SD cards can also include applications that are controlled and displayed by enhanced function device **200**, and implemented on wireless communicator **100**.

Wireless communicator **100** is compatible with existing SD physical and logical interfaces, and operates transparently with enhanced function devices **200** that include SD slots.

Aspects of the present invention further provide an improved SD memory card that provides extended functionality, including (i) wired or wireless communication channels

for accessing remote content servers, and (ii) applications that are controlled and displayed by an SD host device, but are implemented on the SD card. Using the improved SD memory card of the present invention, wireless communicator **100** can stream music or video from remote content servers, download files from these servers, and upload files to these servers.

Reference is now made to FIG. **12**, which is a simplified diagram of an SD card interface that provides extended functionality in accordance with the present invention.

In accordance with a embodiment of the present invention shown in FIG. **12**. Wireless communicator **100** uses the same interface as a standard SD card, and thus operates seamlessly with enhanced function device **200**. Pouching controller **110** is controlled by embedded software. Wireless communicator storage **115** is embodied as flash memory storage. Wireless communicator **100** includes an SD slave controller **112**, for accessing a file system that is stored on flash memory **115**. Baseband modem **120** is embodied inter alia as a cellular modem, as a WLAN modem, as a WPAN modem, or as a wireless modem.

Further in accordance with an embodiment of the present invention shown in FIG. **12**, enhanced function device **200** as embodied in FIG. **12** includes a pouch. Pouching controller **210** is software controlled to process an SD instruction stack. Enhanced function device **200** also includes an SD driver **207**. Enhanced function device **200** also includes an SD application **208** that performs extended functionality enabled by wireless communicator **100**. Details of operation of SD application **208** are described hereinbelow with reference to FIG. **14**.

Pouch connectors **160** and **260** enable data communication between enhanced function device **200** and wireless communicator **100**. Pouch connectors **160** and **260** also enable wireless communicator **100** to receive electrical power from enhanced function device **200**.

In accordance with an embodiment of the present invention, wireless communicator **100** interfaces with enhanced function device **200** as a standard SD card, and provides information for a virtual file system. The file and directory structure reported by slave controller **112** to enhanced function device **200** does not necessarily reflect files and directories that are stored on wireless communicator **100**. Directory names may represent names of remote servers accessible via baseband modem **120**, and they may represent names of services that wireless communicator **100** provides. The operation of opening a directory by the host, signals pouching controller **210** to access a specific server or activate a specific service.

In accordance with the present invention, file names may represent names of files or streams that are stored remotely on a selected server. Opening a specific files triggers wireless communicator **100** to access the remote file or stream and download it to the card. Immediate access to the file by the host is provided via a dummy copy of the file that may include a place holder message such as "file is currently being downloaded, download will be complete within xx seconds". The place holder message may be provided in the form of an audio file, such as an MP3 or WMA file, or an image file, such as a JPEG of GIF file, depending on the type of file that was requested.

Writing a file to a designated location on wireless communicator **100** operates to upload the file to the selected remote server.

In accordance with the present invention, file names may also be used to designate controls for applications that are executed on wireless communicator **100**. Opening of a file designates activation of a corresponding control.

For one usage scenario, wireless communicator **100** may have a directory named "Radio". Selection of this directory activates a radio on the card. In turn, the Radio directory includes a list of files with names "Search Forward", "Search Backward", "Volume Up" and "Volume Down". Opening the "Search Forward" file, for example, activates an instruction to the radio to skip to the next channel.

For another usage scenario, enhanced function device **200** writes to a file in a directory named "ATComm". In response, an AT command, which includes content written to the file, is issued to baseband modem **120**. Thus, if the host writes "ATZ" to the file, which is a reset command, the command is transmitted to baseband modem **120**. The modem reply, which is typically "OK", is written to a second file in the ATComm directory, available for enhanced function device **200** to read.

For devices that support more advanced data formats such as HTML pages or Java applications, wireless communicator **100** provides a graphical user interface via an HTML file or Java application file that is stored on the card. The host device opens and executes such file, e.g., main.html, which in turn provides a graphical representation for accessing remote files or for controlling an application on wireless communicator **100**. File content and HTML links are changed dynamically corresponding to changes in information or changes in status.

With the graphical user interface, control wireless communicator **100** is still performed by selecting, opening and writing to files, but the interface is graphical, as coded in the HTML file or Java application.

As described hereinabove, directory names on wireless communicator **100** may represent names of remote servers, and file names on wireless communicator **100** may correspond to names of remote files and streams. Reference is now made to FIG. **13**, which is a simplified illustration of an arrangement of clusters in an SD card file system in accordance with an embodiment of the present invention. Shown in FIG. **13** is a flash memory in SSD card is represented as including 60 clusters, numbered consecutively from 1 to 60, although clusters 31-60 are virtual, non-physical clusters, as described in detail in what follows.

The physical memory on wireless communicator **100** is generally partitioned into 512 byte sectors, and four sectors are combined to form a 2 KB cluster, although it will be appreciated by those skilled in the art that other partitions are within the scope of the present invention. In FIG. **11** the physical memory includes clusters 1-30. Information regarding available clusters on wireless communicator **100** is maintained in a file allocation table (FAT). For each cluster, two bytes are stored in the FAT, as follows.

0, if cluster is empty

Next cluster in file, if cluster is not the last cluster in a file

0xFFF8, if cluster is the last cluster in a file

0xFFF7, if cluster is a bad cluster

Clusters 1-6 of FIG. **13** correspond to an MP3 file that is stored as a cluster chain. The first cluster in the chain is cluster 1, and the chain continues through clusters 2, 3, 4, 5 and 6, with cluster 6 being the last cluster in the file, designated as an EOF (end-of-file) cluster. The arrows drawn in these clusters represent pointers that advance through the chain of clusters. Clusters 7-9 of FIG. **13** correspond to an MP3 file that is currently being downloaded. As such, cluster 9 is not necessarily an EOF cluster since additional downloaded data may require additional clusters for storage. Similarly, clusters 26-28 correspond to a second MP3 file that is currently being downloaded. Clusters 23 and 24 correspond to an MP4 file

that is currently being downloaded. Clusters 10-22 and 25, 29 and 30 are free clusters. The cross-hatching in the clusters of FIG. **13** corresponds to the type of cluster, as indicated in the FAT legend.

Information about files is stored in a directory, designated "ROOT DIRECTORY" in FIG. **13**, having 32 byte directory entries generally including the following information.

File name with 8+3 characters
Type—regular file, directory
File size
Date & time
First cluster of file

File names longer than 8+3 characters are obtained by including additional entries for the same file with special attributes. The directory itself is stored in the file system as a regular file.

In an embodiment of the present invention illustrated in FIG. **13**, the SD file system is extended by declaring the volume to be of a size larger than the amount of available physical flash memory. Enhanced function device **300** is not aware of the discrepancy since it never needs to write to the excess volume.

The extended volume includes physical clusters, which are mapped to real flash memory locations, and virtual clusters, which have addresses beyond the available flash memory. Cluster 1-30 in FIG. **13** are physical clusters, and clusters 31-60 are virtual clusters. Upon initialization, the virtual clusters may be marked as bad clusters in the FAT, thereby ensuring that enhanced function device **100** does not try to write to these clusters. More generally, when host device is powered up, the flash memory is reset by erasing all file entries in the root directory and clearing the FAT. Physical clusters are marked as being free clusters, and virtual clusters may be marked as being bad clusters.

Virtual clusters are converted to stub locations when they are read. Stub locations include a directory list stub and a media stub, such as an MP3 stub. A directory list stub includes a file with a place holder message such as "file is currently being downloaded, download will be complete within xx seconds", as described hereinabove. A virtual cluster is mapped to an appropriate stub location in the flash memory in such a way that distinct virtual clusters correspond to distinct stub files.

Clusters 31 and 37 in FIG. **13** are directory list stubs. Clusters 44-46, clusters 50-52 and clusters 59-60 are media stubs. Media stubs are cluster chains that end at an EOF cluster. Clusters 44-46 and clusters 50-52 correspond to an MP3 stub, and cluster 59-60 corresponds to an MP4 stub. Clusters 32-36, 38-43, 47-49 and 53-58 are marked as bad clusters. It is noted that MP3 stubs are generally identical, since they generally contain the same place holder message. More generally, media stubs for a specific media type, such as MP3 stubs, JPG stubs or MP4 stubs, are identical.

The number of virtual clusters that are defined equals N*M, where N is the maximum number of concurrent stubs required, and M is the maximum number of clusters for stub data. Typically, one duster is used for a directory list stub, and 50 clusters, corresponding to 100 KB, are used for a media stub. For simplicity, FIG. **13** is drawn with N=5 and M=6. In practice, reasonable values for N and M are 256 and 64, respectfully, and accordingly the number of virtual clusters is 2^0.14. As such, the virtual clusters require 32 KB for their FAT entries.

A portion of the flash memory, designated in FIG. **13** as "STUB STORAGE AREA", that contains M clusters is used to stub file data and is not mapped to the file system. Only SD controller **112** can access this storage area of the flash memory. The M clusters in the stub storage area are hidden clusters; specifically, they are physical clusters in the flash memory but they are not mapped directly on the FAT. When virtual clusters are read, the virtual cluster locations are converted to hidden cluster locations.

Stub files have valid directory entries, which point to virtual clusters as the first file cluster. All subsequent clusters in the stub files are also virtual clusters. Referring to FIG. **13**, clusters 44-46, clusters 50-52 and clusters 59-60 are cluster chains for stub files. Each stub file points to a different virtual cluster, although they may contain the same stub data. Consequently, SD controller **112** knows which file to download based upon the virtual sector number requested by enhanced function device **300**. Specifically, the hidden sector number to read from the stub storage area is V (mod 4M), where V is the virtual sector offset inside the virtual sector area. The term 4M arises from the 4 sectors per cluster. More generally, if there are K sectors per cluster, then the hidden sector number to read is V (mod K*M).

When a remote file or stream is downloaded, it is stored on wireless communicator **100** in a FAT cluster chain, just as a local file is stored. However, the directory entry for the file does not point to the first cluster in the chain. A download map from virtual cluster number to {file name, file type, pointer to file on remote server, first real cluster} is used to maintain a list of all current stub files, including files in stub mode and files in downloading mode. Links that can be clicked on by a user have entries in the download map, along with a stub file directory entry with a file type of the form DIRECTORY, MP3, MP3_STREAM, or such other media type. When a file is finished being downloaded, it is removed from the download map.

Shown in FIG. **13** is a download map with entries for two directories and two MP3 files, corresponding to the stubs in the root directory. The MP3 files being downloaded are currently stored in clusters 7-9 and clusters 23 and 24.

Reference is now made to FIG. **14**, which is a simplified flowchart of a method for downloading a file from a remote server to wireless communicator **100** in accordance with an embodiment of the present invention. To supplement FIG. **14**, reference is also made to FIGS. **15**A-**15**D, which are snapshots of a user interface and a file system for a simple example use case, during various stages of file download during operation of the method of FIG. **14** in accordance with an embodiment of the present invention. Each of FIGS. **15**A-**15**D are divided into three portions. The leftmost portion illustrates a user interface, the middle portion illustrates directory entries and the download map, and the rightmost portion illustrates the FAT. Thus, whereas FIG. **14** describes the steps being performed, the accompanying FIGS. **15**A-**15**D illustrate states of the user interface and the file system during various ones of the steps. The legends for the cross-hatching on the FATs in FIGS. **15**A-**15**D are the same as the legend provided in FIG. **13**. It will be appreciated by those skilled in the art that the file system illustrated in FIGS. **15**A-**15**D is simplified, in order to emphasize the workings of an embodiment of the present invention.

Referring to FIG. **14**, in general at step **1205**, SD application **208** analyzes a downloaded directory file for new stub files to create. The directory content is recursively searched by SD application **208**. For each file discovered a directory listing stub or media stub is created, corresponding to the file type.

FIG. **15**A corresponds to an initial stage wherein a user is browsing a downloaded remote directory listing, as shown in the leftmost portion of FIG. **15**A. At this stage, the root directory has entries for two stub directories; namely, a "jazz" stub directory at virtual cluster 31, and a "rock" stub directory

at virtual cluster 37. The root directory also has entries for two local files; namely, a movie stored at clusters 1-6, and a pop song stored at clusters 7-9. The download map has URL entries for two remote directories; namely, a "jazz" directory at virtual cluster 31 has URL http://music.com/jazz, and a "rock" directory at virtual cluster 37 has URL http://music.com/rock.

Reference is now made to FIG. **16**, which is a simplified flowchart of a method for generating a stub file in step **1205** of FIG. **14** in accordance with the present invention. At step **1310**, SD application **208** searches the virtual clusters in the FAT, such as clusters 31-60 in FIG. **15**A, for the first free row; namely, the first row with clusters marked as bad clusters. At step **1320** the first applicable cluster in the row found at step **1310** is set as the first cluster of the stub file, according to the type of stub file. Specifically, for the example FAT shown in FIG. **13**, the applicable cluster for directory list stubs is the first cluster in the row, for MP3 stubs is the second cluster in the row, and for MP4 stubs is the fifth cluster in the row. Such an arrangement ensures that the different types of stubs correspond to different hidden cluster in the sub storage area.

At step **1330**, SD application **208** allocates additional virtual clusters, as required for storing the stub file, and the additional virtual clusters are chained to the first virtual cluster. Such virtual cluster chains are shown in FIG. **13**B as clusters 44-46 and clusters 50-52. Finally, at step **1340**, SD application **208** modifies the directory entry for the stub file, so that the first cluster of the stub file points to the first cluster from step **1320**, and so that the size of the stub file matches the actual length of the stub file.

At step **1210**, enhanced function device **200** refreshes and identifies the newly-downloaded directory listing. At step **1215** a determination is made whether a file is to be downloaded. If so, processing advances to step **1225**. Otherwise, processing ends.

As shown in FIG. **15**A, the user clicks on the "jazz" directory. Momentarily, a place holder message "downloading file list please wait" appears on the user interface. The place holder message is stored in the stub storage area, as shown in FIG. **13**, in the hidden cluster corresponding to cluster 31. In the meantime, enhanced function device **200** downloads the remote file list for the "jazz" directory, and displays the list shown at the top of the leftmost portion of FIG. **15**B. The list contains two files; namely, a "benny goodman" MP3 file, and a "louis armstrong" MP3 file.

At this stage, the root directory, includes a local directory for the "jazz" directory at data cluster 13. A "jazz" directory is generated, and includes entries for two stub MP3 files; namely, a stub MP3 file at virtual cluster 44, and a stub MP3 file at virtual cluster 50. The download map includes URLs for the remote "benny goodman" and "louis armstrong" files. The user clicks on "benny goodman" to initiate download of that file.

Referring back to FIG. **14**, in general at step **1220** enhanced function device **200** issues a file read request to the SD file system. The request is transmitted to SD driver **207**. SD driver **207** determines from the FAT, which appropriate cluster to read, and finds the cluster value, which corresponds to a virtual cluster. Enhanced function device **200** is unaware that the cluster value corresponds to a non-physical cluster, and interprets the value as a legitimate cluster value.

At step **1225**, SD driver **207** transmits the read request to SD slave controller **112**. SD driver **212** converts the virtual cluster value to a virtual sector value, using a conversion of the form K*V+constant, and issues a read request to the virtual sector. As above, the parameter K is the number of sectors per cluster.

At step **1230**, SD slave controller **112** receives the read request. In response, SD slave controller **112** sends a command to SD application **208** including the virtual sector value, and returns the corresponding hidden sector value to enhanced function device **200**, using the formula hidden_sector=virtual_sector (mod(K*M).

At step **1235**, SD application **208** receives the event from SD slave controller **112**, and converts the sector value to a URL, or to another such pointer to a file on a remote server, using the download map. SD application **208** then issues an HTTP GET command, or such other download command, to retrieve the remote file. This operation is performed only once, when the first sector of the file is read.

At step **1240**, SD driver **207** retrieves the stub data. Enhanced function device **200** is unaware that this data belongs to a stub file. The length matches the file length in the directory listing, to ensure consistency. The data is displayed to the user, and includes a message such as "file is currently being downloaded, download will be complete within xx seconds". Generally, the message is refreshed by enhanced function device **200**. In circumstances where enhanced function device **200** does not refresh, the SD card forces a refresh every 2-3 seconds by a refresh operation, or by a disconnect/connect operation using the SD protocol.

Referring to FIG. **15**B, in this embodiment the place holder message "Please wait, file is downloading" from the stub file is played to the user. It will be appreciated by those skilled in the art the place holder messages may be displayed to a user as a still image or video clip, or played as an audio file, or both. In one embodiment, the place holder message is the same media type as the file that is corresponds to; i.e., audio messages are played when audio files are being downloaded, and video messages are played when video files are being downloaded.

Referring to FIG. **15**C, the file being downloaded is stored in physical clusters 15, 16, 17, etc. This is reflected in the entry for the "benny goodman" file in the download map, where cluster 15 is designated.

Referring back to FIG. **14**, in general at step **1245** SD application **208** receives the real file content and stores it in the flash memory. The file is downloaded via baseband modem **120**. As it arrives, SD application **208** updates the download map for the file with the amount of data received, and updates the first cluster in the cluster chain for the file in the flash memory. Each cluster of the downloaded file is stored in a free cluster in the flash memory, which is then marked as full. Thus it will be appreciated by those skilled in the art that as the file is downloaded a regular file is generated in the FAT, but without a directory item for the file. Instead, the first sector of the file is stored in the download map.

At step **1250** enhanced function device **300** refreshes the file list. At step **1255** a determination is made whether or not the download for the file is complete. If not, processing returns to step **1245** where SD application **208** continues to download the file. Otherwise, if the download is complete then, at step **1260**, SD application **208** marks the last cluster of the downloaded file with an EOF.

At step **1265**, SD application **208** points the first cluster of the file to the downloaded data cluster chain. SD application **208** replaces the directory entry for the file from the virtual cluster value to the physical first cluster of the newly downloaded file. As such, the file entry now points to a legitimate file. The file size is also changed, so as to correspond to the received file length. The file is then removed from the download map.

Referring to FIG. **15**D, when enhanced function device **200** refreshes, the user interface displays the new file, and the user

listens to the real Benny Goodman song. The downloaded file is now stored in clusters 15-21, and cluster 21 is marked with an EOF. The downloaded file now appears as a local file in the "jazz" directory, and its entry is removed from the download map.

Reference is now made to FIG. **17**, which is a simplified flowchart of a method for playing a streamed file from wireless communicator **100** in accordance with an embodiment of the present invention. At step **1410**, enhanced function device **200** accesses a media stub. At step **1410** the stream data associated with the media stub begins downloading, and is dynamically stored in physical file clusters as it arrives, such as file clusters 7-9 in FIG. **13**. SD application **208** waits until sufficient data arrives to play a few seconds' worth of the media. Then, at step **1430**, SD application **208** links the downloaded file to the FAT. The file size is reported as being extremely long. At step **1440**, SD application **208** continues to write new clusters of data, as the stream if downloaded for several more seconds. At step **1450**, the FAT cluster link becomes circular, and SD application **208** loops back to the first stored cluster for the file.

In this regard, reference is now made to FIG. **18**, which is an illustration of file streaming using a circular cluster cycle in the FAT in accordance with an embodiment of the present invention. The cross-hatched clusters in FIG. **18** correspond to the FAT legend provided in FIG. **10**.

Referring back to FIG. **17**, at step **1460** a determination is made whether or not the user has stopped listening to the stream. Such a determination may be made by SD application **208**, by identifying a lack of access by enhanced function device **200** to the file clusters. If the user has not stopped listening to the stream, then processing returns to step **1440** as more data is streamed. Otherwise, if the user has stopped listening to the stream then, at step **1470**, enhanced application **208** updates the FAT to point to a stub in the virtual memory, and frees up all clusters that have been designated for the streamed file.

In addition to downloading of remote files to wireless communicator **100**, application **208** may also upload files from wireless communicator **100** to a remote server, and store them in a designated directory. SD application **208** may create a directory named "uploads" under the root directory, when the file system of wireless communicator **100** is initialized. The "uploads" directory is generated as a directory list stub in the virtual storage area, and includes a single data cluster. The "uploads" directory is initially set as an empty directory.

Reference is now made to FIG. **19**, which is a simplified flowchart of a method for uploading a file from wireless communicator **100** to a remote server in accordance with an embodiment of the present invention. To supplement FIG. **19**, reference is also made to FIGS. **20**A and **20**B, which are snapshots of a user interface and a file system for a simple example use case, during various stages of file upload during operation of the method of FIG. **19** in accordance with an embodiment of the present invention. FIG. **20**A is divided into three portions. The leftmost portion illustrates a user interface, the middle portion illustrates directory entries and the upload map, and the rightmost portion illustrates the FAT. FIG. **20**B is divided into two portions. The left portion illustrates directory entries and the upload map, and the right portion illustrates the FAT. Thus, whereas FIG. **19** describes the steps being performed, the accompanying FIGS. **20**A and **20**B illustrate states of the user interface and the file system during various ones of the steps. The legends for the cross-hatching on the FIGS. **20**A and **20**B are the same as the legend provided in FIG. **13**. It will be appreciated by those skilled in the art that the file system illustrated in FIGS. **20**A and **20**B is simplified, in order to emphasize the workings of an embodiment of the present invention.

Referring to FIG. **19**, in general at step **1510**, when enhanced function device **200** is instructed to upload a file to a remote server, it creates a new file in a virtual directory named "uploads". At step **1520**, SD slave controller **112** identifies a write request to the "uploads" directory. SD slave controller **112** may identify such request, since enhanced function device **200** issues the write request to a virtual cluster number. SD controller then sends an event to SD application **208**.

At step **1530**, the host's write request is re-directed to a hidden sector that holds the "uploads" directory listing content. SD application **208** recognizes that a new file is being created in the "uploads" directory, and it allows enhanced function device **200** to write the file content. At step **1540** the file content is written to the file created in the "uploads" directory. The file itself is treated as a regular file in the file system.

FIG. **20**A corresponds to a stage where the upload directory listing is displayed in the user interface, and a user has selected a file name "recording.mp3" for upload. As shown in FIG. **20**A, the root directory has an entry for a stub uploads directory located at virtual cluster 36. The root directory also has an entry for the music file "recording.mp3", which is stored at clusters 1-6.

FIG. **20**B corresponds to a stage where the selected file is copied to the physical storage area, and the upload process begins. Referring to FIG. **20**B, there is now an "uploads" directory with an entry for the file "recording.mp3" having first cluster 7.

At step **1550**, SD application **208** determines whether or not enhanced function device **200** has finished writing the file and has closed the file. If not, processing returns to step **1540**. If enhanced function device **200** has closed the file, then at step **1560** SD application **208** initiates a communication session with the remote server, and at step **1570** SD application **208** sends the file content to the remote server.

At step **1580**, SD application **208** determines whether or not the file has been successfully delivered to the remote server. If not, processing returns to step **1570**. If the file has been successfully delivered to the remote server, then at step **1590** the file is removed from the file system and from the outgoing directory listing.

3. Auto-Adaptation

Embodiments of the present invention provide methods and systems for maintaining a unified user interface look & feel when wireless communicator **100** is pouched with enhanced function device **200**. Using the present invention, a user experiences the same-looking interface when he switches from the enhanced function device configuration screen to the wireless communicator configuration screen. Both screens have the same look & feel, and wireless communicator **100** appears transparent to the user and does not appear as a foreign device.

Using the present invention, wireless communicator **100** is aware of the specific enhanced function device **200** with which it is pouched, and adapts its screen graphics to parent user interface **270**. As such, the same user interface displays both the enhanced function device and the wireless communicator configurations and a unified look & feel is maintained.

The present invention is of particular advantage with multi-source systems where many different types of wireless communicator **100** can be pouched with many different types of enhanced function devices **200**. Methods of the present invention ensure that the user experiences a homogenous look &

feel in each enhanced function device **200**, when he navigates from the enhanced function device configuration screen to the wireless communicator configuration screen.

Embodiments of the present invention provide methods and systems for on-line configuration of controlled software, which flexibly support wireless communicator **100** pouched with one of multiple enhanced function devices **200** yet retain the same operational control over wireless communicator **100**, and which adapt the look & feel so as to integrate the wireless communicator control software in the enhanced function device software environment in a homogeneous way. Enhanced function device **200** is used to configure the pouched system, and parent user interface **270** is maintained as a fixed point of reference for the user. Adaptation to the parent user interface **270** is carried out in wireless communicator **100**.

The look & feel of a user interface relates to visual elements that a user experiences when he interacts with the interface. The look & feel includes inter alia:

- screen size (pixel width and height);
- font type, font size, font color and other visual font characteristics;
- background color and background pattern (e.g., BMP or JPG image, or multiple images for animation);
- menu type (e.g., scroll with items selected marked by highlight or zoom);
- transitional entry effects (e.g., flip, zoom);
- screen and button topology (e.g., location of specific buttons on the screen, such as the X button at the top-right corner of a window for closing the window);
- menu topology (e.g., location of items in a specific menu); and
- screen template (e.g., usage and position of general progress keys, such as Next, Back, Cancel and Enter).

In accordance with an embodiment of the present invention, look & feel parameters may be defined in an XML document. Such an XML document may, for example, take the form provided below.

Sample XML document with look & feel parameters

```
<definitions>
<screen>
        <size=800*600>
        <touch=yes>
        <layout=portrait>
        <color quality=32 bit>
        .....
</screen>
<background>
        <color = black>
        <pattern = none>
        .....
</background>
<fonts>
        <font1>
                <color=yellow>
                <size=16>
                <type=bold italic>
                ......
        </font1>
        <font2>
                <color=blue>
                <size=12>
                <type=regular>
        ......
        </font2>
        ...
</fonts>
...
<buttons>
```

-continued

Sample XML document with look & feel parameters

```
        <button1>
                <location=bottom left>
                <icon="left_arrow.jpg">
        </button1>
        <button2>
                <location=bottom right>
                <icon="right_arrow.jpg">
        </button2>
</buttons>
...
</definitions>
```

Reference is now made to FIGS. **21**A and **21**B, FIGS. **22**A and **22**B, and FIGS. **23**A and **23**B, which are displays of various configuration screens for enhanced function device **200** and wireless communicator **100**, pouched together, wherein displays **185** and **285** are controlled so as to have the same look & feel, in accordance so with an embodiment of the present invention. The enhanced function device shown in FIG. **21**A is a media player, such as an MP3 player. Shown in FIG. **21**A is a sample parent-user interface **270**. The screen shown in FIG. **21**A corresponds to the enhanced function device configuration screen, before wireless communicator **100** is pouched to enhanced function device **200**, and the screen shown in FIG. **21**B corresponds to the enhanced function device configuration screen, after wireless communicator **100** is pouched to enhanced function device **200**. It is noted that both configuration screens have the same look & feel. Specifically, when wireless communicator **100** is pouched to enhanced function device **200**, the displayed font size, type and color remain the same, and the screen size and background color remain the same.

In addition, the screen template is preserved for two "soft-keys" **281** and **282** and a bar **283** above them that includes their corresponding function names. Soft keys are multi-function keys that use part of a display to identify their function at any moment. Soft-keys are generally located directly below the display. In FIG. **21**A soft keys **281** and **282** correspond respectively to Vol. Up and Vol. Down functions, as indicated by bar **283**; and in FIG. **20**B soft keys **281** and **282** correspond respectively to Call and End functions, respectively, as indicated by bar **283**.

The enhanced function device shown in FIG. **22**A is a digital camera. Shown in FIG. **22**A is a sample interface for enhanced function device **200**. Again, in accordance with the present invention, the look & feel of FIG. **22**B, namely, the wireless communicator configuration, is the same as that of FIG. **22**A, namely, the enhanced function device configuration. As may be seen in FIGS. **22**A and **22**B, the look & feel of the configuration interface includes a left panel **286** and a right panel **287**. The left panel **286** is created by enhanced function device **200**. When wireless communicator **100** is pouched to enhanced function device **200**, the left panel may be altered by enhanced function device **200**. Thus in FIG. **22**B the left panel includes a new control element **288** in the shape of a star, for toggling between parent functionality mode and native functionality mode.

Right panel **287** is controlled by enhanced function device **200** when the parent functionality mode is running, and controlled by wireless communicator **100** when the native functionality mode is running. In either case, the content displayed in the right panel conforms to the look & feel parameters for the host. The "look parameters" of right panel **287**, including inter alia the dimensions of right panel **287**, its background color, its font type, size and color, and its menu

header and location, are the same in FIGS. **22**A and **22**B. Similarly, the "feel" parameters of right panel **287**, including inter alia assignment of client options 1, 2 and 3 to corresponding host buttons and the jog dial options, are also the same in FIGS. **22**A and **22**B.

The enhanced function device shown in FIG. **23**A is a GPS navigator. Shown in FIG. **23**A is a sample interface for enhanced function device **200**. Again, in accordance with the present invention, the look & feel of FIG. **23**B, namely the native wireless communication configuration, is the same as that of FIG. **23**A, namely the parent functionality configuration. It is noted, for example, that the "X" remains in the top right corner when wireless communicator **100** is pouched with enhanced function device **200**.

More generally, reference is now made to FIG. **24**, which is a simplified block diagram of a system with a uniform interface for configuring wireless communicator **100** and enhanced function device **200** in accordance with an embodiment of the present invention. Shown in FIG. **24** is enhanced function device **200**, with its pouching controller **210**, its display **285** and its optional power management subsystem **225**. Enhanced function device **200** has its own look & feel parameters **216** stored therein. In accordance with an embodiment of the present invention, requisite font files are also stored with look & feel parameters **216**.

Also shown in FIG. **24** is wireless communicator **100**, with its pouching controller **110**, its optional display **185** and its power management subsystem **125**. Wireless communicator **100** also includes a configuration program **114**, which enables a user to select configuration settings for wireless communicator **100**.

Enhanced function device **200** and wireless communicator **100** communicate via respective pouch connectors **260** and **160** over a communication channel. The communication channel may be a physical or a wireless channel. Parent look & feel parameters **216** are transmitted by pouch connector **260** over the communication channel, and received by pouch connector **160**. In turn, the parent look & feel parameters are transmitted to configuration program **114**, the transmission being controlled by corresponding pouching controllers. **110** and **120**.

Configuration program **114** has a native look & feel. In accordance with an embodiment of the present invention, configuration program **114** adapts its look & feel accordingly, so as to conform to parent look & feel parameters **216** of enhanced function device **200**. Configuration program **114** generates a graphics screen image that conforms to parent look & feel parameters **216**. The graphics screen image is transmitted to pouch connector **160**, and is further transmitted to pouch connector **260** over the communication channel. The graphics image is then transmitted to display **285**, for display to a user.

As the user interacts with the displayed graphics image and issues successive commands, the commands are transmitted via the communication channel back to configuration program **114**, which generates successive graphics screen images in response to the user commands. The successive graphics screen images, based again on parent look & feel parameters **216**, are transmitted to display **285** for further display to the user.

Pouching controllers **110** and **210** control transmission of the commands from enhanced function device **200** to wireless communicator **100**, and transmission of the graphics screen images from wireless communicator **100** to enhanced function device **200**.

Reference is now made to FIG. **25**A, which is a simplified flowchart of a first embodiment of a method for controlling a configuration interface for wireless communicator **100** so as to conform to the look & feel of parent user interface **270** in accordance with an embodiment of the present invention. The flowchart of FIG. **25**A is divided into three columns. The leftmost column indicates steps performed by a user who is operating a multi-source system including enhanced function device **200** and wireless communicator **100**. The middle column indicates steps performed by enhanced function device **200**, and the rightmost column indicates steps performed by wireless communicator **100**.

At step **1603** wireless communicator **100** is pouched to enhanced function device **200**. At step **1606** enhanced function device **200** transfers the look & feel parameters for parent user interface **270**, to the client. As described hereinabove, the parent look & feel parameters may be specified in an XML document. Enhanced function device **200** may also transfer requisite font files, for fonts specified in the look & feel parameters.

At step **1609** wireless communicator **100** adapts the look & feel of its configuration program according to the parent look & feel parameters. At step **1612** the wireless communicator configuration program generates a configuration screen, in the form of a bitmap image, which conforms to the look & feel of parent user interface **270**.

At step **1615** enhanced function device **200** receives the bitmap image of the configuration screen from wireless communicator **100**, and at step **1618** enhanced function device **200** displays the bitmap image, which conforms to the parent look & feel. As such, the user interface displayed by enhanced function device **200** preserves a unified look & feel, even when being used to configure wireless communicator **100**.

It may thus be appreciated that enhanced function device. **200** displays its own configuration options and wireless communicator **100** configuration options on the same screen, and with a common look & feel. Enhanced function device **200** may display both configurations at the same time, or may switch between the parent options and the native options, but in each case the same visual user interface is presented to the user.

At step **1621** the user interacts with the system and issues a command, the response to which may require a change in the display screen. At step **1624** enhanced function device **200** sends to wireless communicator **100** a notification of the user command. At step **1627** the wireless communicator configuration program generates a new bitmap image for a configuration screen, in response to the user command, as appropriate. At step **1630** enhanced function device **200** receives the new configuration screen, in the form of the new bitmap image, from wireless communicator **100**. Finally, at step **1633** enhanced function device **200** displays the altered screen, which again conforms to the look & feel of the parent. The method then returns to step **1621**, as the user continues to interact with the system.

Reference is now made to FIG. **25**B, which is a simplified flowchart of a second embodiment of a method for controlling a configuration interface for wireless communicator **100** so as to conform to the look & feel of parent user interface **270**, in accordance with an embodiment of the present invention. The flowchart of FIG. **25**B is divided into three columns. The leftmost column indicates steps performed by a user who is operating a multi-source system including wireless communicator **100** and enhanced function device **200**. The middle column indicates steps performed by enhanced function device **200**, and the rightmost column indicates steps performed by wireless communicator **100**. The method of FIG. **25**B uses a web interface for a user to configure wireless communicator **100**.

At step **1636** wireless communicator **100** is pouched to enhanced function device **200**. At step **1639** enhanced function device **200** transfers the look & feel parameters for parent user interface **270** to wireless communicator **100**. Enhanced function device **200** may also transfer requisite font files, for fonts specified in the parent look & feel parameters. At step **1642** the wireless communicator configuration program sets it parameters according to the parent look & feel parameters.

At step **1645** the wireless communicator configuration program generates a web page, which conforms to the parent look & feel parameters. At step **1648** wireless communicator **100** uploads the web page to a URL on a web server. At step **1651** enhanced function device **200**, using a web browser installed therein, browses the URL and renders and displays the web page.

Referring back to FIG. **24**, in this second embodiment enhanced function device **200** includes a web browser **295**, which browses and renders web pages stored in a web server **395**. The web pages are generated by configuration program **114** so as to comply with parent look & feel parameters **216**, and are uploaded to web server **395**.

Proceeding now with FIG. **25**B, at step **1654** a user who is viewing the web page displayed at step **1651** issues a user command. At step **1657** enhanced function device **200** sends the user command to wireless communicator **100**. At step **1660** the wireless communicator configuration program generates a new web page, in response to the user command, as appropriate. At step **1663** wireless communicator **100** uploads the web page to a URL on the web server. At step **1666** enhanced function device **200** browses the URL and renders and displays the new web page. The method then returns to step **1654**, as the user continues to interact with the system.

Reference is now made to FIG. **25**C, which is a simplified flowchart of a third embodiment of a method for controlling a configuration interface for wireless communicator **100** so as to conform to the look & feel of parent user interface **270**, in accordance with an embodiment of the present invention. The flowchart of FIG. **25**C is divided into three columns. The leftmost column indicates steps performed by a user who is operating a multi-source system including enhanced function device **200** and wireless communicator **100**. The middle column indicates steps performed by enhanced function device **200**, and the rightmost column indicates steps performed by wireless communicator **100**.

At step **1669** wireless communicator **100** is pouched to enhanced function device **200**. At step **1672** wireless communicator **100** transfers its configuration program to enhanced function device **200**, thus enabling enhanced function device **200** to generate the appropriate user interfaces.

At step **1675** enhanced function device **200** sets parameters of the wireless communicator's configuration program corresponding to the look & feel parameters of parent user interface **270**. At step **1678** enhanced function device **200** by itself generates a screen image for wireless communicator configuration, running the wireless communicator's configuration program. At step **1681** enhanced function device **200** displays the screen image.

At step **1684** a user who is viewing and interacting with the user interface issues a command. At step **1687** enhanced function device **200** generates a new screen image, in response to the user command, as appropriate, running the wireless communicator's configuration program. At step **1690** enhanced function device **200** displays the new screen image. The method then returns to step **1684**, as the user continues to interact with the system.

It will thus be appreciated by those skilled in the art that the methods of FIGS. **25**A, **25**B and **25**C enable wireless communicator **100** to display both parent configuration settings and native configuration settings on enhanced function device screen **285**, simultaneously, with a uniform look & feel. As such, a user of the system experiences a homogeneous interface, and it is transparent to the user that two different standalone devices are operating.

Shown in TABLES IIA and IIB are example button key assignments for a host mode and a client mode, respectively, within a multi-source system. TABLES IIA and IIB correspond to FIGS. **21**A and **21**B, respectively, where the enhanced function device is an MP3 player running in media player mode. The buttons of the system are labeled B1-B15, together with a TOUCH button on the touch screen displayed with a question mark. The buttons have one assignment of functions in host mode and another assignment of functions in client mode. Button B8, for example, is assigned a play function in TABLE IA, and is assigned a function to enter the numeral "8" in TABLE IIB.

Reference is now made to FIG. **26**, which is an illustration of button keys that have different key assignments for parent mode and native mode, but a common look & feel user interface for setting the wireless communicator and the enhanced function device configuration parameters in accordance with an embodiment of the present invention. As shown in FIG. **26**, buttons B1-B12 correspond to the four rows of three buttons on the keypad, in the order from top left to bottom right. Buttons B13 and B14 correspond to the soft keys **281** and **282** in FIGS. **21**A and **21**B. Button B15 corresponds to a speaker button.

It is also noted that buttons B4, B6, B13 and B14 have dual functions, corresponding to a short duration press and a long duration press. Key-press and key-release events may be analyzed so as to distinguish between long duration and short duration presses.

When running in parent mode, the key assignments correspond to media player key assignments, as in TABLE IIA. However, when running in native mode, the key assignments correspond to conventional cell phone key assignments, as in TABLE IIB. It may be seen from TABLE IIA that in parent mode, buttons B5 and B15 are not used, and long button presses are not distinguished from short presses.

TABLE IIA

Parent Key Assignments

| Screen | Function | Assigned Key |
|---|---|---|
| Media Player Mode | Play | B8 |
| | Stop | B11 |
| | Next | B9 |
| | Prev | B7 |
| | FWD | B12 |
| | BKD | B10 |
| | Record | B2 |
| | Vol. Up | B13 |
| | Vol. Down | B14 |
| | Up | B1 |
| | Down | B3 |
| | Right | B6 |
| | Left | B4 |
| | Help | TOUCH |

TABLE IIB

Native Key Assignments

| Screen | Function | Assigned Key |
|---|---|---|
| Dialer Mode | 0 | B11 |
| | 1 | B1 |
| | 2 | B2 |
| | 3 | B3 |
| | 4 | B4 |
| | 5 | B5 |
| | 6 | B6 |
| | 7 | B7 |
| | 8 | B8 |
| | 9 | B9 |
| | # | B12 |
| | * | B10 |
| | Left | LONG B4 |
| | Right | LONG B6 |
| | Call | B13 |
| | End | B14 |
| | Erase | LONG B14 |
| | Options | LONG B13 |
| | Speaker | B15 |
| | Help | TOUCH |

In accordance with the present invention, when wireless communicator **100** is not pouched to enhanced function device **200**, or when wireless communicator **100** is pouched to enhanced function device **200** but the pouched system is running in parent mode, the parent key assignments, such as those indicated in TABLE IIA, are used. Switching between parent mode and native mode may be performed, for example, using a toggle switch such as control element **288** in FIG. **22**B. When wireless communicator **100** is pouched to enhanced function device **200**, wireless communicator **100** sends enhanced function device **200** a list of user functions it supports, such as the various functions indicated in TABLE IIB. Enhanced function device **200** then assigns the functions to buttons, and sends wireless communicator **100** the key assignments.

When wireless communicator **100** is pouched to enhanced function device **200** and the pouched system is running in native mode, the graphic image displayed on display **285**, or a portion of the graphic image that is assigned to wireless communicator **100**, is generated by wireless communicator **100** and transmitted to enhanced function device **200** for display. When the user presses a button, the button press event is sent to wireless communicator **100**, and translated by wireless communicator **100** according to the key assignment for that button. If the user presses a touch screen, then the X-Y coordinates of the press location are sent to wireless communicator **100**. In response, wireless communicator **100** generates a new graphic image, conforming to the parent look & feel parameters that wireless communicator **100** received from enhanced function device **200**. The new graphic image is transmitted to enhanced function device **200** for display, thus completing a cycle of user input and screen display in response to the input. Generally, several such cycles are performed in an interactive session.

When the key assignments distinguish between short and long duration presses, as in TABLE IIB, enhanced function device **200** performs the analysis to make the distinction and passes the result (long press or short press) to wireless communicator **100**. In an alternative embodiment, enhanced function device **200** may send the key-press and key-release events to wireless communicator **100**, and wireless communicator **100** then determines the type of press (long or short) from these events.

4. Parent User Interface Package

Embodiments of the present invention concern a handset body that can be dressed with a variety of physical exteriors, visual presentation characteristics and audible presentation characteristics, according to a user's tastes. Each such dressing, referred to herein as a "parent user interface (UI) package", is a jacket housing to which wireless communicator **100** is pouched, and each such dressing provides a different all-around look & feel. The parent UI package may include inter alia the physical appearance of the handset, the visual presentation of the handset, and the audible presentation of the handset

Generally, a parent UI package has a common theme. For example, a UI package may be themed to a celebrity, a TV show, or a soccer team. There may be a Barbie Doll UI package, a Harry Potter UI package, a Star Wars UI package, a Microsoft UI package, a Google UI package, etc. Thus a UI package for "The Simpson's" may include a yellow colored device with Simpson characters on the front and back, screen savers for Homer, Marge, Bart, Lisa and Maggie Simpson, and ring tones with the Simpson's theme song or other phrases or sounds related to the Simpson's.

The user interface package of the present invention uses storage **215**, embodied as EEPROM, to store data describing the look & feel of a handset, and a mailbox for communicating with wireless communicator **100** when it is pouched with the parent UI package.

Reference is now made to FIGS. **27**A and **27**B, which are illustrations of handset body dressed up in jacket housings **200** with two different parent user interface packages in accordance with an embodiment of the present invention. Each housing **200** includes a decorative shell, a decorative display **285** and a decorative keypad **280**. Each parent user interface package includes a keypad mapping with buttons assignments, as shown in FIGS. **27**A and **27**B.

As seen in FIGS. **27**A and **27**B, a parent UI package includes both physical and software-related look & feel characteristics. Physical look & feel characteristics relate to the exterior of a device, including inter alia its size, color, shape, weight, and interaction functionality such as keypad, touch screen, mouse and jog dial. Software-related look & feel characteristics include inter alia display properties such as screen resolution, background color or template, font properties, menu appearance and screen saver, and audible properties such as ring tones and dial tones.

In accordance with an embodiment of the present invention, pouching controller **210** is coupled to display **285** using a display interface having an 8-bit parallel bus, similar to an 8080 or a 6800 controller bus. Pouching Controller **210** is coupled to input device **280** with a general purpose I/O interface that monitors state, or provides matrix scanning functionality, or both. Pouching Controller **210** is connected to wireless communicator **100** via pouch connector **260**.

EEPROM **215** stores information describing the parent UI package **200**, including inter alia

- display resolution, bits per pixel, and word size;
- display specific initialization sequence and control;
- keypad matrix size;
- keypad mapping, such as the button assignments shown in FIGS. **27**A and **27**B that govern which key is mapped to which combination in the matrix;
- preferred screen saver image or images; and
- customization information for handset menu presentation.

In accordance with an embodiment of the present invention, pouching controller **210** implements a mailbox that is mapped to SD memory or SDIO memory, or to I/O space. Wireless communicator **100** and pouching controller **210**

communicate via the mailbox. Pouching controller **210** notifies wireless communicator **100** that there are pending messages for wireless communicator **100** in the mailbox, by issuing an interrupt using either an SDIO defined in-band interrupt mechanism, or by using a dedicated line on the pouch connector, in addition to the SD bus signals. Examples of such messages are provided in TABLE III.

TABLE III

Messages between wireless communicator and parent UI package

| Message | Message Attributes |
|---|---|
| Write buffer to display | Command/Date - identifying if this the message is a command or data for display<br>Buffer length - size of buffer to write to display<br>Buffer content |
| Read key | Code of key pressed returned by controller |
| Read EEPROM request | Offset from start - offset in EEPROM memory space Number of bytes to read |
| Read EEPROM response | Content of EEPROM request provided by controller |

It will be appreciated by those skilled in the art that the same wireless communicator **100** can be connected to various UI packages **200**, as shown in FIGS. **27**A and **27**B, each of which presents a different look & feel experience for the user.

In reading the above description, persons skilled in the art will realize that the present invention applies to other consumer electronic devices, in addition to wireless communicator **100**. Thus the present invention applies inter alia to producing theme-based packages, including decorative shells and user interfaces, for portable data assistants (PDA's), portable media players, digital cameras, camcorders and portable game stations. For each type of consumer electronic device, the parent UI package includes a decorative shell, a decorative display for output, a decorative keypad or other such device for input, EEPROM, a controller, and a connector for pouching a modular device. In addition, the controller includes a mailbox for communicating via messages between the controller and the modular device.

5. Bi-Directional Power Control

Embodiments of the present invention relate to power management and control between wireless communicator **100** and enhanced function device **200**. Using special circuitry, each device **100** and **200** is able to turn the other device on and off, by generating wakeup events at one device to power the other device on or off, over a single connection line. A circuit with a single connection line between wireless communicator **100** and enhanced function device **200** enables wireless communicator **100** to turn enhanced function device **200** on and off, and enhanced function device **200** to turn wireless communicator **100** on and off. The circuit uses the single connection line for wireless communicator **100** to generate wakeup events to power enhanced function device **200** on or off, and for enhanced function device **200** to generate wakeup events to power wireless communicator **100** on or off. A wakeup event is either a button press and release, or a switch being closed and released thereby changing its logical level from 1 to 0 and back to 1.

Reference is now made to FIG. **28**, which is a simplified diagram of a circuit **400** that provides bi-directional power control in accordance with an embodiment of the present invention. Shown in FIG. **28** is wireless communicator **100** pouched to enhanced function device **200** via pouch connectors **160** and **260**. Also shown in FIG. **28** is wireless communicator modem **120**.

Wireless communicator **100** and enhanced function device **200** are battery-operated devices, and have their own batteries for power. Power sources for wireless communicator **100** and enhanced function device **200** are designated by VBAT_Comm and VBAT_Enhanced, respectively, in circuit **400**. Typical voltage ranges for the batteries are 4.2V for a fully charged battery, to 3.2V for a low battery. Circuit **400** uses an optional voltage level shifter **126** to control the potential voltage gap between power sources VBAT_Comm and VBAT_Enhanced. One of the device batteries may be full charged at 4.2V, for example, and the other may be at the low range of 3.2V.

Voltage level shifter **126** is powered from VBAT_Comm, and its output level is based on VBAT_Comm. Specifically, logical bit 1 corresponds to an output of VBAT_Comm, and logical bit 0 corresponds to an output level of zero voltage. Voltage level shifter **126** also manages I/O levels of wireless communicator **100**, which may differ from the level VBAT_Comm.

Circuit **400** includes grounds to protect the I/O units of the two devices from exposure to a high supply voltage, and to protect the devices' power sources from being shorted to one another.

Wireless communicator **100** and enhanced function device **200** are assumed to have respective power management ICs **160** and **170** that power them on and off when wakeup events occur. Additionally, wireless communicator **100** and enhanced function device **200** are physically connected by a single line that enables each device to generate wakeup events to power the other device-on and off.

Wireless communicator **100** and enhanced function device **200** are powered on and off independently; i.e., wireless communicator **100** is able to be turned on when enhanced function device **200** is turned on or off, and enhanced function device **200** is able to be turned on when wireless communicator **100** is turned on or off. Moreover, circuit **400** of FIG. **28** enables wireless communicator **100**, when it is turned on, to turn enhanced function device **200** on and off; and enables enhanced function device **200**, when it is turned on, to turn wireless communicator **100** on and off.

In an embodiment of the present invention, enhanced function device **200** includes an internal watchdog timer which is used to turn on wireless communicator **100** after a predefined period of time.

Circuit **100** includes two on/off buttons, **127** and **227**, and two on/off switches, **128** and **229**, which cause each of wireless communicator **100** and enhanced function device **200** to power the other on or off. Buttons **127** and **227** are physical buttons that can be activated by a user. Switches **128** and **228** are electronic switches that are inaccessible to the user. Instead, switches **128** and **228** are controlled by respective controllers **120** and **205**.

Circuit **400** provides simultaneous and non-simultaneous power on/off control. Use of switch **128** to turn enhanced function device **200** on or off, does not affect regular operation of wireless communicator **100** and, vice versa, use of switch **228** to turn wireless communicator **100** on or off, does not affect regular operation of enhanced function device **200**.

Specifically, when operating alone, wireless communicator **100** is turned on and off by button **127**. When button **127** is pressed to turn on wireless communicator **100**, a wakeup event is detected in its power management system **125**. When wireless communicator is pouched to enhanced function device **200**, button **127** is generally physically inaccessible, and wireless communicator **100** can only be turned on simultaneously with enhanced function device **200**, via switch **128**, button **227** or switch **228**.

Similarly, when operating alone, enhanced function device is turned on and off by button **227**. When button **227** is pressed to turn on enhanced function device **200**, a wakeup event is detected in its power management system **225**. When wireless communicator **100** is pouched to enhanced function device **200**, enhanced function device **200** can be turned on asynchronously by button **227**, and can also be turned on synchronously with wireless communicator **100**, via switch **228**.

If enhanced function device **200** is a jacket device, instead of a host device, wireless communicator **100** is turned on and off via switch **228** on enhanced function device **200**, which generates a wakeup event for power management system **125**.

Power off events are generally reported to modem **120** and enhanced function device host controller **205** before each respective device is turned off. In a embodiment of the present innovation When button **227** is used to turn off one or both of wireless communicator **100** and enhanced function device **200**, button **227** must be pressed for a long press. The time duration of a press of button **227** is calculated in software, by host controller **205**, generally via telemetries that host controller **205** receives from enhanced function device power management subsystem **225**.

Similarly, when wireless communicator **100** is not pouched to enhanced function device **200**, button **127** is accessible, and may be used to turn wireless communicator **100** on and off. The time duration of a press of button **127** is calculated in software, by modem **120**, generally via telemetries that modem **120** receives from host power management subsystem **125**.

In an embodiment of the present invention pouching controllers within both wireless communicator **100** and enhanced function device **200**, are responsible for performing on/off events instead of modem **120** and power management system **225** and host controller **205**.

TABLE IV summarizes an embodiment of the simultaneous and non-simultaneous power on/off control enabled by button **227**, and switches **127** and **227**, when wireless communicator **100** is pouched to enhanced function device **200**.

TABLE IV

Power on/off control when wireless communicator 100 is pouched to enhanced function device 200

| Before wakeup event | | | After wakeup event | |
|---|---|---|---|---|
| Enhanced device (200) State | Communicator (100) state | Wakeup event | Enhanced device (200) State | Communicator (100) state |
| Off | Off | Button 227 pushed | On | On |
| On | Off | Switch 228 activated | On | On |
| | | Button 227 pushed | Off | Off |
| Off | On | Button 227 pushed | On | On |
| On | On | Switch 228 activated | On | Off |
| | | Button 227 pushed | Off | Off |

TABLE IV indicates that when switch **228** is activated to turn off wireless communicator **100**, enhanced function device **200** remains on. In such case enhanced function device **200** turns itself off in a different manner, as appropriate, not using switch **228**.

Circuit **400** is designed with grounds to protect the I/O units of the two devices from exposure to a high supply voltage, and to protect the devices' power sources from being shorted to one another. Circuit **400** uses voltage level shifter **126** to manage the potential voltage gap between power sources of the two devices. One of the device batteries may be full charged at 4.2V, for example, and the other may be at the low range of 3.2V. Voltage level-shifter **126** also manages I/O levels of the devices, which may differ from the level of VBAT_Comm.

An advantage of circuit **400** is that it uses a single connection line between wireless communicator **100** and enhanced function device **200**, for carrying wakeup signals.

In reading the above description, persons skilled in the art will realize that some power management systems have two input signals for waking up a device. In such case, the on/off button of a device may be connected to one of its power management inputs, with the other power management input being used for a remote wakeup signal coming from another device.

6. Bi-Directional Battery Charging

Embodiments of the present invention relate to battery supply and battery charging of wireless communicator **100** and enhanced function device **200**. Each device **100** and **200** has its own rechargeable battery and internal battery charger, and the coupling enables the battery of one device to supply power to the other device, and to charge the other device's battery. Using the present invention, optimized logic for controlling power supply and battery charging of the pouched devices, provides extended operational time.

The optimized logic decides when to supply battery power from one battery to the other device, and when to charge one battery from the other, based on the voltages of the two batteries, and based on the operational modes of the two devices **100** and **200**.

The present invention applies generically to a wide variety of electronic devices that use single or dual input battery chargers, voltage boosts, and USB chargers to power manage their electrical components.

Referring back to FIG. **6**, power management subsystem **125** of wireless communicator **100** includes circuitry for a battery charger, shown as element **124** in FIGS. **28** and **30**. Battery charger **124** includes a power management integrated circuit. In accordance with an embodiment of the present invention, battery charger **124** supports fixed current and fixed voltage operational modes, and is capable of measuring voltage and current. Battery charger **124** is controlled by modem **120**.

Referring back to FIGS. **7**A and **7**B, power management subsystem **225** of enhanced function device **200** includes circuitry for a battery charger, shown as element **224** in FIGS. **28** and **30**. In accordance with an embodiment of the present invention, battery charger **224** supports both a fixed voltage mode and a fixed current mode. Battery charger **224** independently controls internal current and voltage of enhanced function device **200**.

Reference is now made to FIG. **29**, which is a simplified block diagram of bi-directional battery charging for a simple enhanced function device **200**, in accordance with an embodiment of the present invention. Shown in FIG. **29** are wireless communicator modem **120**, battery charger **124** and battery **145**. Battery charger **124** is a dual input charger. A first input is connected to USB connector **155** for a USB charger **156**, and a second input is connected to the output of a voltage boost **123**.

Also shown in FIG. **29** are host controller **205**, battery charger **224**, and battery **245**. Battery charger **224** is a single input charger, with its input connected to USB connector **255** for a USB charger **256**.

Pouch connectors **160** and **260** provide signals paths between components of wireless communicator **100** and components of enhanced function device **200**. Via pouch connectors **160** and **260**, the input of USB charger **266**, denoted by Vbus in FIG. **29**, is routed to USB charger **166**.

Modem **120** is able to track the voltage on battery **245**, either by directly measuring a battery pin on pouch connector **160**, or by receiving notifications from battery charger **224** via pouch connectors **160** and **260**.

In an embodiment of the present invention pouching controllers **110** and **210** report the notification to the modem **120**.

Voltage boost **123** receives a standard battery voltage as input and generates as output a minimal charging voltage of battery charger **124**. Typical input to boost **123** is in the range 2.7V-4.2V, and typical output is 4.7V. When enabled, boost **123** up-converts its input voltage. When disabled, boost **123** simply passes its input voltage through to its output, minus any internal voltage drop. Preferably Boost **123** is enabled by modem **120** via an enable signal. The input of boost **123** is connected to a pin of pouch connector **160**, such that when wireless communicator **100** is pouched to enhanced function device **200**, boost **123** has a direct connection to battery **245**.

In an embodiment of the present innovation boost **123** is not used and battery **245** is directly connected to battery charger **124** via pouch connector **160** while wireless communicator **100** is pouched to enhanced function device **200**.

The system of FIG. **29** applies advantageously to simple enhanced function devices **200**, which have limited power consumption, lower than a threshold current, typically 500 mA. In such case, battery **145** supplies current to the electronic components of device **200** through pouch connector **160**.

It will be appreciated by those skilled in the art that the bi-directional battery charging diagram in FIG. **29** applies to a general setting whereby a mobile device can be docked to an accessory device. The present invention may be used advantageously for bi-directional battery charging for general electronic devices that include controllers, rechargeable batteries, boosts and battery chargers as shown in FIG. **29**.

Reference is now made to FIG. **30**, which is a summary of bi-directional battery charging logic for the hardware of FIG. **29**, in accordance with an embodiment of the present invention. In the notation of FIG. **30** wireless communicator **100** is referred to as a standalone (SA) device, and enhanced function device **200** is referred to as a jacket (JKT), into which wireless communicator **100** can be pouched.

FIG. **30** is divided into six columns. The first column refers to a state of the SA battery, and the second column refers to a state of the jacket battery. Referring to FIG. **30**, the following notation is used in these two columns.

- CC is the charging current for the SA battery. CC should conform to the maximal charging current authorization set by the JKT, and is typically between 200 mA-500 mA. For example, if the SA battery has a charge of 500 mAh, charging with a current greater than 500 mA may be harmful to the battery.
- JKT is the voltage of the JKT battery.
- SA is the voltage of the SA battery.
- STBC is the average standby current of the SA device. STBC is typically between 5 mA-50 mA.
- Vc is the voltage drop across the SA boost, the SA battery charger and the SA battery, when being charged with charge CC. Vc is typically approximately 0.3V and corresponds to 50%-100% of the SA battery capacity.
- Vh is the maximal voltage to which the SA battery is charged when being charged from the JKT battery. Vh is typically between 3.7V-4V corresponding to approximately 50% capacity of the SA battery.
- Vl is the minimal voltage for the SA battery, below which charging from the JKT is forced. Vl is typically between 3.4V-3.5V corresponding to approximately 10% capacity of the SA battery.
- Vm is the minimal voltage for the JKT battery, below which charging from the SA device is forced. Vm is typically between 3.4V-3.5V corresponding to approximately 10% capacity of the JKT battery.

The third column in FIG. **30** refers to the mode in which the SA device is operating. There are three operational modes for the SA device, as follows:

I. High Current Consumption. This mode occurs when the SA device is active and transmitting between the SA device and a base transceiver station (BTS). In this mode the SA has a typical current consumption greater than 100 mA, with peak currents possibly greater than 1 A, depending on power requirement factors, such as the distance of the SA device from the BTS. Using the JKT battery to supply the SA device is undesirable in this mode, due to the high peak currents. Transfer of such high current over pouch connectors poses difficult requirements on the quality and current drive of the JKT battery, boost current and charger current, resulting in increased cost and size of the hardware. Charging in this mode is limited to fixed current, since fixed voltage charging draws peak currents from the JKT, which is undesirable.

II. Standby Current Consumption. This mode occurs when the SA device is not communicating with the BTS. In this mode the SA device has a typical current consumption less than 100 mA, and no peak currents above 100 mA. Such current levels are suitable for supply from the JKT battery, and do not impose limitations on charging.

III. Shutdown. In this mode the SA device is shutdown and has negligible current consumption.

The fourth column in FIG. **30** refers to the mode of charging the batteries. There are five charging modes, as follows:

I. No Charge. The SA battery supplies all SA current. Efficiency is high, since no extra conversion is applied. The SA battery is being depleted during this mode.

II. Supply from JKT Battery. In this mode, the JKT battery supplies current. Efficiency is lower than in the No Charge mode, due to voltage drop on the SA boost and SA charger, but in general this mode is efficient and preserves power of the SA battery for standalone operation of the SA device.

III. Supply from SA and JKT Battery. In this mode, when there are peaks, the current is drawn from both the SA and the JKT battery. When there are not peaks, the current is drawn from the JKT battery alone. Current peaks are prevalent in many wireless communication systems, including inter alia Global System for Mobile Communication (GSM), General Packet Radio System (GPRS), Code Division Multiple-Access (CDMA), and Integrated Digital Enhanced Network (IDEN). For the GSM system, peaks occur due to time division multiplexing and are caused by time slots usage.

IV. Charge from JKT Battery. In this mode the JKT battery charges the SA battery. This mode is inefficient, in some circumstances possibly less than 50% efficiency. If the SA boost is enabled, the efficiency is even lower, by approximately 10%. When the JKT battery is empty, charging from the JKT battery is disabled.

V. Charge from SA Battery. In this mode the SA battery charges the JKT battery. This mode is inefficient, in some circumstances possibly less than 50% efficiency. If the JKT boost is enabled, the efficiency is even lower, by approximately 10%.

The fifth column in FIG. **30** refers to enablement of disablement of the SA boost. The sixth column in FIG. **0** refers to the SA charger.

The logic in FIG. **30** is implemented as programming logic for SA and JKT battery chargers and SA boost, to, optimize their operation. The logic in FIG. **30** prescribes columns 4-6 (charging mode, SA boost enablement and SA charger) in terms of columns 1-3 (SA battery voltage, JKT battery voltage and SA operational mode). For example, referring to the first two rows in FIG. **30**, if JKT>SA>Vh and if the SA device is in Standby Current Consumption mode, then the charging mode is set for the JKT battery to supply current to the SA device, the SA boost is disabled, and the SA charger is set to fixed voltage level. If instead the SA device is in High Current Consumption mode, then the charging mode is set for both the SA and JKT battery to supply current to the SA device, and the SA charger is set to fixed current level. The logic in FIG. **30** optimizes usage of the SA and JKT batteries, in order to provide extended operation time for SA device in combination with the JKT, and in standalone mode; and in order to facilitate charging the SA battery from JKT.

Reference is now made to FIG. **31**, which is a simplified block diagram of bi-directional battery charging for a complex enhanced function device **200**, in accordance with an embodiment of the present invention. Shown in FIG. **31** are controller **105**, battery charger **124** and battery **145**. Battery charger **124** has a dual input. A first input is connected to USB connector **155** for a USB charger **156**, and a second input is connected to the output of voltage boost **123**.

Also shown in FIG. **31** are host controller **205**, battery charger **224**, and battery **245**. Battery charger **224** has a dual input. A first input is connected to USB connector **255** for a USB charger **256**, and a second input is connected to the output of a voltage boost **223**. Battery charger **224** is a hardware-based charging controller that controls charging, including constant current charging and constant voltage charging, based on its input voltage levels and its output HST battery status.

Pouch connectors **160** and **260** provide signals paths between components of wireless communicator **100** and components of enhanced function device **200**. Via pouch connectors **160** and **260**, the input of USB charger **256**, denoted by Vbus in FIG. **31**, is routed to USB charger **156**.

modem **120** is able to track the voltage on battery **245**, either by directly measuring a battery pin on pouch connector **160**, or by receiving notifications from battery charger **224** via pouch connectors **160** and **260**.

Voltage boosts **123** and **223** receive standard battery voltage as input and generate as output a minimal charging voltage of battery charger **124** and battery charger **224**, respectively. Typical inputs to boosts **123** and **223** are in the range 2.7V-4.2V, and typical outputs are 4.7V.

When enabled, boosts **123** and **223** up-convert their input voltages. When disabled, boost **123** simply passes its input voltage through to its output, minus any internal voltage drops. When disabled, boost **223** blocks its input voltage from going out as output.

In an alternative embodiment of the present invention, controller **205** enables and disables battery charger **224**, and boost **223** operates similarly to boost **123**; namely, when disabled, boost **223** passes its input voltage through to its output, minus any internal voltage drops.

Boost **123** is enabled by modem **120** via an enable signal. The input of boost **123** is connected to a pin of pouch connector **160**, such that when wireless communicator **100** is pouched to enhanced function device **200**, boost **123** has a direct connection to battery **245**. Similarly, boost **223** is enabled by host controller **205** via an enable signal. The input of boost **223** is connected to a pin of pouch connector **260**, such that when pouched to wireless communicator **100**, boost **223** has a direct connection to battery **245**.

In yet another alternate embodiment of the present invention, controller **205** enables and disables battery charger **224**, and boost **223** is eliminated. Instead of enabling and disabling a voltage boost, controller **205** enables battery charger **224** when charging is desired, and disables battery charger **224** when charging is not desired.

The system of FIG. **31** applies advantageously to complex enhanced function devices **200**, which have current consuming components above a threshold current, typically 500 mA. For such devices, it is impractical to supply their current from battery **145**. Such current would require too much draw from battery **145**, and would be too high for transfer over pouch connectors **160** and **260**. Instead, battery **245** supplies current for the components of enhanced function device **200**.

As mentioned above with reference to FIG. **29**, it will be appreciated by those skilled in the art that the bi-directional battery charging diagram in FIG. **31** applies to a general setting whereby a mobile device can be docked to an accessory device. The present invention may be used advantageously for bi-directional battery charging for general electronic devices that include controllers, rechargeable batteries, boosts and battery chargers as shown in FIG. **31**.

Reference is now made to FIG. **32**, which is a summary of bi-directional battery charging logic for the hardware of FIG. **31**, in accordance with an embodiment of the present invention. As with FIG. **30**, in the notation of FIG. **32** wireless communicator **100** is referred to as a standalone (SA) device, and enhanced function device **200** is referred to as a host (HST) device, into which the SA device can be pouched. The notation indicated above for FIG. **30** applies to FIG. **32** as well, with HST being used for the docking device instead of JKT.

The logic in FIG. **32** is implemented as programming logic for SA and HST battery chargers to optimize their operation. FIG. **32** uses the same six columns as FIG. **30**, with an additional column for indicating enablement/disablement of the HST charger and boost. The logic in FIG. **32** prescribes the settings in columns 4-7 (charging mode, SA boost enablement, SA charger, HST charger and boost) based on the states in columns 1-3 (SA battery voltage, HST battery voltage and SA operational mode). For example, referring to the first two rows in FIG. **32**, if HST>SA>Vh and if the SA device is in Standby Current Consumption mode, then the charging mode is set for the HST battery to supply current to the SA device, the SA boost is disabled, the SA charger is set to fixed voltage level, and the HST charger and boost are disabled. If instead the SA device is in High Current Consumption mode, then the charging mode is set for both the SA and HST battery to supply current to the SA device, and the SA charger is set to fixed current level. The logic in FIG. **32** optimizes usage of the SA and HST batteries, in order to provide extended operation time for SA device in combination with the HST, and in standalone mode; and in order to facilitate charging the SA battery from the HST.

It will be appreciated by those skilled in the art that the distinction of JKT vs HST in the systems of FIGS. **29** and **31** and in the logic of FIGS. **30** and **32** is merely for the purpose of clarity of exposition. The system and logic of FIGS. **29** and **30** also apply to simple host devices **200**, in addition to jackets **200**; and the system and logic of FIGS. **31** and **32** also apply to complex jackets **200**, in addition to host devices **200**. In general, the system and logic of FIGS. **29** and **30** apply to devices (jackets or hosts) with limited power consumption;

e.g., less than 500 mA; and the system and logic of FIGS. **31** and **32** apply to devices (jackets or hosts) with higher current consumption.

7. Audio and USB Multiplexing

Embodiments of the present invention relate to a switching device that routes analog audio signals and digital USB signals for wireless communicator **100** and enhanced function device **200**. The switching device of the present invention includes circuitry that detects multiple audio/USB configurations. Regarding audio Configurations, the switching device supports left and right audio signals for a headset, for stereo speakers and for an earpiece. Regarding USB, the switching device supports connection of a PC or a USB charger to wireless communicator **100** operating as a standalone device, and to wireless communicator **100** pouched with enhanced function device **200**.

In accordance with an embodiment of the present invention, when wireless communicator **100** is pouched with enhanced function device **200**, enhanced function device **200** provides data regarding its audio configuration to wireless communicator **100**, the information including inter alia the presence of mono or stereo speakers, and their gains, and the presence of earpiece and microphone, and their gains. Wireless communicator **100** provides signals to enhanced function device **200** via pouch connector **160**, the signals including inter alia headset L/R, D+/−, audio L/R and microphone (elements L, R, D+/L, D−/R and mic of FIG. **33**A).

Considering wireless communicator **100** both as a standalone device, and as a device pouched to enhanced function device **200**, twelve audio/USB configurations are identified, as summarized in TABLE V.

TABLE V

Audio/USB Configurations of Wireless Communicator and Enhanced Function Device

| | State | Audio | USB |
|---|---|---|---|
| Standalone Wireless Communicator | S1 | no audio; | no USB connection |
| | S2 | audio via wireless communicator's speakers/earpiece | no USB connection |
| Pouched Wireless Communicator | S3 | audio via headset attached to wireless communicator | no USB connection |
| | S4 | no audio | charging via wireless communicator USB charger/PC |
| | S5 | audio via wireless communicator speaker | charging via wireless communicator USB charger/PC |
| | J1 | no audio | no USB connection |
| | J2 | audio via enhanced function device speaker | no USB connection |
| | J3 | audio via enhanced function device earpiece | no USB connection |
| | J4 | audio via headset attached to enhanced function device | no USB connection |
| | J5 | no audio | charging wireless communicator and enhanced function device via USB charger connected to e enhanced function device |
| | J6 | audio via jacket's speaker | charging wireless communicator and enhanced function device via USB charger connected to enhanced function device |
| | J7 | audio via headset attached to jacket | charging wireless communicator and enhanced function device via USB charger connected to enhanced function device |

Reference is now made to FIGS. **33**A and **33**B, which are simplified diagrams of a switching circuit **500** that distinguishes between twelve audio/USB configurations of TABLE V, in accordance with an embodiment of the present invention. Specifically, the detection methods and control settings for supporting the twelve audio/USB configurations of TABLE V are summarized in TABLE VI.

TABLE VI

Control Settings and Detection Methods for Audio/USB Configurations

| Mode | Wireless Communicator Speaker/ Earpiece Amplifier | Wireless Communicator Headset Amplifier | USB/Audio Switch | Enhanced Function Device Speaker Amplifier (SPK_EN) | Enhanced Function Device Earpiece Amplifier (EAR_EN) | Detection (Vbus/ Headset/ Enhanced Function Device) |
|---|---|---|---|---|---|---|
| S1 | Disabled | Disabled | Audio | NA | NA | No/No/No |
| S2 | Enabled | Disabled | Audio | NA | NA | No/No/No |
| S3 | Disabled | Enabled (G1) | Audio | NA | NA | No/Yes/No |
| S4 | Disabled | Disabled | USB | NA | NA | Yes/x/No |
| S5 | Enabled | Disabled | USB | NA | NA | Yes/x/No |
| J1 | Disabled | Disabled | Audio | Disabled | Disabled | No/No/Yes |
| J2 | Disabled | Enabled (G2) | Audio | Enabled | Disabled | No/No/Yes |
| J3 | Disabled | Enabled (G3) | Audio | Disabled | Enabled | No/No/Yes |
| J4 | Disabled | Enabled (G1) | Audio | Disabled | Disabled | No/Yes/Yes |
| J5 | Disabled | Disabled | USB | Disabled | Disabled | Yes/x/Yes |
| J6 | Disabled | Enabled (G2) | USB | Enabled | Disabled | Yes/x/Yes |
| J7 | Disabled | Enabled (G3) | USB | Disabled | Enabled | Yes/x/Yes |

The values G1, G2 and G3 in TABLE VI denote different gain levels. The headset amplifier is set to different gain levels, depending on the type of speakers it has to drive. Thus a different setting is generally required for headset connection, amplified jacket speakers and amplified jacket earpiece.

Circuit **500** includes the following elements shown in FIG. **33**A:

- respective D+ and D− signal lines **505** and **510** connecting to power/audio subsystems **125**/**130** of wireless communicator **100**;
- a first analog/digital switch **515** connected to D+ signal line **505**, for multiplexing an input D+ signal to an output USB data signal or audio left signal, the multiplexed signal feeding into pouch connector **160**;
- a second analog/digital switch **520** connected to D− signal line **510**, for multiplexing an input D− signal to an output USB data signal or audio right signal, the multiplexed signal also feeding into pouch connector **160**;
- a control signal line **525** for controlling the switching between audio and USB outputs at switches **515** and **520**;
- a headset left signal line **530** connected to power/audio subsystems **125**/**130** and to the output audio left signal of analog/digital switch **515**;
- a headset right signal line **535** connected to power/audio subsystems **125**/**130** and to the output audio right signal of second analog/digital switch **520**;
- a first USB signal line **540** connected to USB connector **155** and to the output USB data signal of analog/digital switch **515**;
- a second USB signal line **545** connected to USB connector **155** and to the output USB data signal of analog/digital switch **520**;
- a headset microphone signal line **550** connected to power/audio subsystems **125**/**130** and to pouch connector **160**;
- a third USB signal line **555** connected to USB connector **155** and to headset microphone signal line **550**;
- a headset detection line **560** for detecting connection of a headset to a headset port; and
- a USB detection line **565** connected to the power/audio subsystems **125**/**130** and to USB connector **155**, for detecting a USB charger or a PC attached to USB connector **155**.

Circuit **500** also includes an amplifier (not shown) for amplifying the output audio left signal and the output audio right signal at gain levels appropriate for (i) a headset jack **272** connected to enhanced function device **200**, (ii) left and right speakers **275** and **276** connected to enhanced function device **200**, and (iii) an earpiece **273** connected to enhanced function device **200**.

Circuit **500** is designed so that the same detection mechanisms are used to detect direct connection of a charger to wireless communication device **100** or to enhanced function device **200**, and to detect amplified enhanced function device speakers or amplified enhanced function device earpiece. Generally, when wireless communicator **100** is pouched with enhanced function device **200**, access to the wireless communicator's charger and the wireless communicator's audio connector is physically blocked, being covered by enhanced function device **200**.

In an embodiment of the present invention, when the wireless communicator **100** is in a middle of a phone conversation, and detects insertion into pouch of enhanced function device **200**, it mutes its embedded microphone to avoid disturbance on the other participant of the voice conversation. The microphone is muted until the insertion is complete and both pouch connectors **160** and **260** are fully mated, and the adaption to interoperation is complete.

8. SD Bridge Design

Embodiments of the present invention relate to a bi-directional data bus that connects a terminal A with a terminal B. The data bus may be an SD or MMC bridge, wherein terminal A is generally connected to enhanced function **200** device and terminal B is connected to wireless communicator **100**. The bridge of the present invention is capable of determining signal direction without the need for external directional signals, and without the need for decoding exact content of messages being transmitted over the bridge.

In one embodiment, the present invention employs two data buffers, a first buffer that drives signals in a data bus in a direction from a terminal A to a terminal B, and a second buffer that drives signals in the opposite direction. The buffers may be in an enabled or disabled state. When a buffer is enabled, it drives the signal direction.

Special logic is introduced to determine when to enable and disable each of the buffers, based on logical processing of sampled bits at terminals A and B.

Reference is now made to FIG. **34**, which is a simplified diagram of an electrical circuit **600** that determines bus direction in bi-directional SD and MMC signal lines in accordance with an embodiment of the present invention. Circuit **600** connects two terminals, A and B, and carries signals in both directions; i.e., from A to B, and from B to A.

Generally, terminal A connects to enhanced function device **200**, which is an SD host, and terminal B connects to wireless communicator **100**, which is an SD slave. In such case, there are multiple bi-directional data lines D0-D3 and CMD. The data lines D0-D3 are synchronized so that they change their signal directions simultaneously.

The voltages at terminals A and B may be the same, or may be different. To accommodate different voltages at the terminals, circuit **600** includes two level-shifter buffers, **610** and **615**, which drive signals from A to B and from B to A, respectively. Level shifting generates voltage drops across the buffers in order to drive the signal direction. Each buffer has two states; namely, enabled and disabled. When buffer **610** is enabled, signal data is transmitted from A to B, and when buffer **615** is enabled, signal data is transmitted from B to A.

Circuit **600** also includes four data flip flop (DFF) modules; namely, module **620** designated DFF_A, module **625** designated DFF_B, module **630** designated DFF_EnAB, and module **635** designated DFF_EnBA. Each DFF module has an input value, an output value and a clock value. The output of a DFF module delays the input by one clock count; i.e., a DFF module captures the input signal at the moment of a rising clock edge, when the clock goes high, and subsequent input changes to not influence the output until the next rising clock edge.

Modules **630** and **635** are used to enable buffers **610** and **615**, respectively. Specifically, when DFF_EnAB.out=0, buffer **610** is enabled, and when DFF_EnAB.out=1, buffer **610** is disabled. Similarly, when DFF_EnBA.out=0, buffer **615** is enabled, and when DFF_EnBA.out=1, buffer **115** is disabled.

Circuit **600** also includes respective by-pass lines **640** and **645**, so that previous signal values A and B, denoted A_Delayed and B_Delayed, respectively, are accessible, together with current signal values A and B.

Circuit **600** includes four logical processing units, **650**, **655**, **660** and **665**. Processing unit **650** has inputs A and A_Delayed; processing unit **655** has inputs B and B_Delayed; processing unit **660** has input DFF_EnBA.out in addi-

tion to the data coming from processing unit **650** into processing unit **660**; and processing unit **665** has input DFF_EnAB.out in addition to the data coming from processing unit **655** into processing unit **665**. Operation of processing units **650**, **655**, **660** and **665** is described in the discussion of FIG. **35** hereinbelow.

Circuit **600** includes two pull-up resistors, **670** and **675**, pull the circuit bus up to logical 1 when both sides of the SD or MMC link are not driving signals.

Reference is now made to FIG. **35**, which is a simplified flowchart of a method for determining bus direction in bi-directional SD and MMC signal lines in accordance with an embodiment of the present invention. Specifically, FIG. **35** summarizes a portion of the logic for enabling and disabling buffers **610** and **615** of FIG. **30**.

The rationale for the logic illustrated in FIG. **35** is based on three characteristics of SD and MMC buses; namely:

1. The SD and MMC bus D0-D3 and CMD lines have pull-up resistors **670** and **675** connected thereto, which pull the bus up to logical 1 when both sides of the SD or MMC link are not driving signals.
2. Each SD and MMC transaction on the D0-D3 and CMD lines begins with a start bit of logical 0 and ends with a stop bit of logical 1.
3. Since the SD and MMC buses include direction transition, the side driving a signal stop driving a bus **2** clock cycles before the opposite side starts driving the bus.

The logic of FIG. **35** begins at step **1705** where both buffers are set to their-disabled states. At step **1710** the A and B signal values are initialized to logical 0. Steps **1715** and **1720** are iterative steps that save previous A and B signal values and sample new values.

As seen at steps **1725-1750**, when one side of circuit **600**, A or B, is sampled to have a logical 0 input, circuit **600** enables the buffer in the direction from that side to the opposite side, and locks the buffer in the enabled state.

As seen at steps **1755-1775**, circuit **600** disables the enabled buffer when two consecutive logical 1 bits are detected. The event of detecting two consecutive logical 1 bits may represent an end of transaction, or may be part of a transaction. In the former case, both buffers are disabled, and circuit **600** is ready to detect a next transaction, and switch direction as required. In the latter case, the SD or MMC bus remains in its correct logical level due to the pull-up resistors. Since the previous bit was a logical 1, no delay in bus signal stabilization is incurred, due to device and bus capacitance.

In order to avoid potential problems with transient conditions and synchronization to the SD_CLK signal, an embodiment of the present invention includes a sampling mechanism that delays transfer of bits from one direction to the other direction by a single clock, as indicated at steps **1720**, **1735**, **1750**, **1770** and **1775** of FIG. **35**. Such delays are implemented by DFF modules **620**, **625**, **630** and **635** of FIG. **34**, and do not affect proper operation of the SD or MMC bus, since transaction starts are determined by start bits, and not based on exact timing. Internally in a transaction, the delay is fixed and thus no change to transaction content occurs.

Reference is now made to the Verilog pseudo-code presented herein, which summarizes one cycle of the logic for enabling and disabling buffers **610** and **615** of FIG. **34**. Logical processing units **650** and **660** are used to evaluate the Boolean expression ! (A & A_Delayed) &!DFF_EnBA.out, and logical processing units **655** and **665** are used to evaluate the Boolean expression ! (B & B_Delayed) &!DFF_EnAB.out.

```
DFF__A.in = A
DFF__A.clk = SD__CLK
A__Delayed = DFF__A.out
DFF__B.in = B
DFF__B.clk = SD__CLK
B__Delayed = DFF__B.out
BufferAtoB.in = A__Delayed
B = BufferAtoB.out
BufferBtoA.in = B__Delayed
A = BufferBtoA.out
DFF__EnAB.in = !(A & A__Delayed) &!DFF__EnBA.out
DFF__EnAB.clk = SD__CLK
BufferAtoB.enable = DFF__EnAB.out
DFF__EnBA.in = !(B & B__Delayed) &!DFF__EnAB.out
DFF__EnBA.clk = SD__CLK
BufferBtoA.enable = DFF__EnBA.out
```

The logic of FIG. **35** applies to all bi-directional signals in an SD or MMC bus. However, since the D0-D3 data lines change direction simultaneously, it is only necessary to apply the logic of FIG. **35** to one of these data lines. The buffer enable/disable signals derived for the one data line suffices to control the buffers for the other three data lines.

Reference is now made to FIG. **36**, which is a sample simulation of the Verilog code for A and B signals 110010101110111 and 0010111, respectively, in accordance with an embodiment of the present invention. Each column in FIG. **36** represents one clock cycle. As may be seen in FIG. **36**, the signal direction goes from A to B, and out A is a one clock delay of A, for bits 0010101 and for bits 01. During the time Out A is used, the buffer from A to B is locked (represented by logical 1), and the buffer from B to A is unlocked (represented by logical 0). Signal direction goes from B to A, and Out B is a one clock delay of B, for bits 00101. During the time Out B is used, the buffer from B to A is locked, and the buffer from A to B is unlocked.

It will be appreciated by those skilled in the art that although detection of two logical 1 bits triggers circuit **600** to disable the enabled buffer, as indicated in FIGS. **35** and **36**, detection of three or more logical 1 bits may be used instead to trigger the disabling.

It will further be appreciated by those skilled in the art that circuit **600** may be used as a component of a more complex circuit that selectively connects terminal A with two terminals, B and C, or more than two terminals. To this end, reference is now made to FIG. **37**, which is a simplified diagram of an electrical circuit **690** that determines bus direction in multiplexed directional SD and MMC signal lines in accordance with an embodiment of the present invention. Generally, terminal A is connected to a host device, and terminals B and C are connected to slave devices.

As shown in FIG. **37**, circuit **690** includes two sub-circuits, each similar in operation to circuit **600**. The elements of one of the sub-circuits are labeled with numerals **610***b*-**675***b*, and the corresponding elements of the other sub-circuit are labeled with numerals **610***c*-**675***c*. Each of the sub-circuits is bi-directional, with one direction enabled and the other direction disabled, at any moment.

Circuit **690** includes a B/C_SELECT signal line **680**, for selecting terminal B or terminal C. B/C_SELECT line **680** originates from a controller for the host device connected to terminal A.

In distinction from logical processing unit **660** of circuit **600**, logical processing units. **660***b* and **660***c* have four input lines. For each logical processing unit, two of its input lines carry signals from the sub-circuit in which the processing unit is located, one signal for examining two previous bits in the enabled direction and the other signal for examining a bit in

the disabled direction. One of its input lines carries a signal from the other sub-circuit, for examining a bit in the disabled direction; and one of its input lines carries a signal from B/C_SELECT line **680**. Terminals A, B and C may have the same voltage levels, or different voltage levels.

9. Automated Consumer Electronic Appliance Reporting

Embodiments of the present invention enable automated generation and submission of reports about consumer electronic appliances. The reports may include technical information about an appliance, personal information about the owner of the appliance, and information describing the owner's usage of the appliance. According to an embodiment of the present invention, generation and submission of reports is enabled by pouching wireless communicator **100** to consumer electronic appliances.

The consumer electronic appliances supported by the present invention are of many types, including inter alia cameras, media players, computers, home entertainment systems, home appliances, kitchen appliances, and electric tools.

The consumer electronic appliance generally includes storage that stores technical and usage information about the appliance, and wireless communicator **100** stores information about the owner of the appliance in its storage **115**. When pouched with an appliance, wireless communicator **100** automatically generates and sends reports about the appliance and about the owner of the appliance and about the owner's usage behavior, to one or more appropriate recipients, including inter alia sellers and manufacturers of the appliance, and technical support centers.

Report generation and submission for an appliance may be automatically initiated when one or more pre-designated events involving the appliance occur, may be scheduled periodically, and may be manually initiated either by the owner of the appliance or by a remote recipient of the report.

Reports may be sent to recipients in the form of SMS messages, MMS messages, e-mail messages, voice messages, or other such GPRS or IP network messages. In addition, wireless communicator **100** may open voice channels, thereby enabling owners of appliances to speak directly with recipients.

The present invention applies to a wide variety of different types of reports, including inter alia registration of appliances, maintenance and diagnostic reports, and marketing-based consumer reports.

The present invention also applies to access control security, whereby an appliance only operates if an authorized wireless communicator **100** is pouched therewith. Moreover, if the appliance is reported as being missing or stolen, then it does not operate at all, even if an authorized wireless communicator **100** is pouched therewith.

Further aspects of the present invention apply to jacket covers for wireless communicator **100**. Using the present invention, reports may be automatically generated and submitted about jackets and their usages.

Wireless communicator **100** operates within a variety of wireless communication networks, including inter alia GSM, CDMA and WiFi. These exemplary networks are respectively illustrated in FIGS. **38-40** hereinbelow.

Reference is now made to FIG. **38**, which is a simplified illustration of an exemplary GSM communication network **700**, within which wireless communicator **100** transmits information about a consumer electronic appliance to remote sites, in accordance with an embodiment of the present invention. Being an embodiment of an enhanced function device, the appliance is denoted as enhanced function device **200** in FIGS. **38-40**.

Communication network **700** is a General Packet Radio Service (GPRS) network. GPRS is a packet-switched service for the Global System for Mobile Communications (GSM), similar to the Internet. GPRS provides packet radio access for mobile GSM users. GPRS also supports Wireless Application Protocol (WAP) services.

Appliance **200** be any of a wide variety of devices. Appliance **200** may be an entertainment device, including inter alia a home entertainment center, a play station, a multimedia player, a television, an audio system and a DVD player. Appliance **200** may be a communication device, including inter alia a telephone, a fax machine and a cell phone. Appliance **200** may be a piece of office equipment including inter alia an office computer, and printer and a scanner. Appliance **200** may be a home appliance including inter alia a refrigerator, a microwave oven, a stove, a washing machine, a drying machine, an air conditioner. Appliance **200** may be a personal appliance including inter alia a personal computer, a personal data assistant (PDA), an automobile, a treadmill and a camera.

Wireless communicator **100** communicates with a base transceiver station (BTS) **715** via an over-the-air interface. Base transceiver stations are components of communication network **700** that terminate the over-the-air interface, over which subscriber traffic is communicated to and from wireless communicator **100**. Communication network **700** also includes a base station controller (BSC) **720**. Base station controllers are switching modules that provide handoff functions and power level control in base transceiver stations.

BSC **720** is controlled by a mobile switching center (MSC) **725**. MSC **725** performs functions of a landline network switching node, including search, signal path switching, and processing of supplementary services. When a request is made for connecting to a subscriber in a landline network, the request is forwarded by MSC **725** to the landline network over a switching path.

BSC **720** controls the interface between MSC **725** and BTS **715**, and, as such, controls BTS **715** in call set-up, signaling, and use of radio channels. BSC **720** also controls the interface between a serving GPRS support node (SGSN) **730** and BTS **715**.

SGSN **730** services wireless communicator **100** by sending or receiving packets via a base station subsystem (BSS), and more specifically via BSC **720**, in the context of GSM systems. SGSN **730** is responsible for delivery of data packets to and from wireless communicator **100**, within a service area. SGSN **730** also performs packet routing and transfer, mobility management, local link management, authentication and charging functions.

In order to accommodate a multitude of services, a provider of communication network **700** stores various types of data. The provider must know which subscribers are using communication network **700**, and which services the subscribers use. Subscriber profiles, such as the International Mobile Subscriber Identify Number (IMSI), of GPRS subscribers registered with SGSN **730**, are stored in a home location registry (HLR) **735**. The owner of wireless communicator **100** is such a GPRS subscriber.

To determine whether a subscriber is entitled to use communication network **700**, the network provider maintains an authentication center (AUC) **735**. Generally, AUC **735** includes algorithms and subscriber-related encryption keys, which are used for authentication. AUC **735** determines, inter alia, whether a subscriber has a valid service contract.

The provider of communication network **700** may optionally maintain an equipment identity registry (EIR) **735**, which includes details of mobile transceivers permitted on the net-

work. Generally, EIR **735** stores a "white list", a "grey list" and a "black list". The white list includes mobile phones that function reliably, the grey list includes mobile phones that may be defective, and the black list includes mobile phones which are either faulty or have been reported missing or stolen.

In order to establish a connection to a subscriber's mobile phone, the network provider must determine where the subscriber is located and whether his mobile phone is turned on. Such information is stored in a visitor location registry (VLR) **740**.

While GSM forms the underlying technology, SGSN **730** is a network element introduced through GPRS technology. HLR/AUC/EIR **735** is also in communication with a gateway MSC **745**, which acts as a gateway to a public-switched telephone network (PSTN) **750**.

Another network element introduced in the GPRS context is the gateway GPRS support node (GGSN) **755**, which acts as a gateway to Internet **760** and to an external server **765**, respectively. External server **765** may be used by a manufacturer of appliance **200**, a seller of appliance **200**, a service provider for appliance **200**, or a combination of the above.

Reference is now made to FIG. **39**, which is a simplified illustration of an exemplary Code Division Multiple Access (CDMA) communication network **800**, within which wireless communicator **100** transmits information about appliance **200** to remote sites, in accordance with an embodiment of the present invention. The specific communication network shown in FIG. **39** conforms to the CDMA2000 1X standard. Communication network **800** includes several components of FIG. **38**; namely, wireless communicator **100**, appliance **200**, base station transceiver **715**, base station controller **720**, mobile switching center **1125**, HLR/AUC/EIR **735**, VLR **740**, gateway MSC **745**, PSTN **750**, Internet **760** and external server **765**.

In communication network **800**, BSC **720** is in communication with a packet control function (PCF) **805**. In turn, PCF **805** is in communication with a packet data serving node (PDSN) **810**, which is part of a packet core network (PCN) **815**. A packet core network generally includes a succession of interconnected routers, or such other communication nodes, that carry Internet protocol (IP) data traffic.

PDSN **810** provides both mobility management functions, similar to SGSN **730**, and packet routing functions, similar to GGSN **755**. PDSN **810** serves as a connection point between a radio access network and an IP network, and manages point-to-point sessions between a mobile phone and an IP address.

PCF **805** provides a relay from PDSN **810** to a mobile phone. PCF **805** tracks registration expiration, and ensure that sessions are renewed as necessary. PCF **805** also controls available radio resources, and buffers data received from PDSN **810** when radio resources are not available. PCF **805** also controls dormancy.

PCN **815** also includes a home agent (HA) **820**. Generally, HA **820** manages roaming and handoff of mobile data. HA **820** is used for registration of a mobile IP (MIP), and transfer of mobile packet data in PDSN **810**. Through tunneling, HA **820** transfers MIP data from a home network to PDSN **810**, and from PDSN **810** to the home network through a reverse tunnel.

PCN **815** also includes an authentication, authorization and accounting (AAA) server **825**. Generally, AAA server **825** is responsible for access control. AAA server **825** processes user requests for access to computer resources and, for enterprises, provides authentication, authorization and accounting services. Authentication is used to identify subscribers. Authorization is used to manage policies and service profiles that govern which resources and services a subscriber may access, and to manage and distribute security keys. Accounting services track usage of time and data resources, and manage billing. AAA server **825** interacts with network access and gateway servers, and with databases and directories containing user information.

In communication network **800**, MSC **725** is in communication with an interworking function (IWF) **830**. An interworking function provides an interface between wireless data networks and data packet networks such as Internet **760** or so corporate intranets, and also between wireless data networks and wireline networks such as PSTN **750**. The interworking function converts and sends data to a data packet network or a wireline network, based on the data type. Generally, IWF **830** includes modems or data terminal adapters, or both, to convert data transmitted over a wireless network to a format suitable for recognition and carrying by a public telecommunications network.

Reference is now made to FIG. **40**, which is a simplified illustration of an exemplary IEEE 802.11b WiFi communication network **900**, within which wireless communicator **100** transmits information about appliance **200** to remote sites, in accordance with an embodiment of the present invention. Communication network **900** includes several components of FIGS. **38** and **39**; namely, wireless communicator **100**, appliance **200**, Internet **760** and external server **765**.

A wireless router **905** communicates with a modem **910**, and modem **910** sends and receives data to and from Internet **760**.

It will be appreciated by those skilled in the art that although FIGS. **38-40** illustrate operation of wireless communicator **100** in GSM network **700**, CDMA network **800** and WiFi network **900**, the present invention applies to other current and future technologies, including inter alia packet-switched and circuit-switched technologies, and 3G technologies.

Referring back to FIG. **6**, storage **115** includes information about the owner of appliance **200**, such as information INF-3 listed below in TABLE V. Information INF-3 may include inter alia subscriber identification module (SIM) information for wireless communicator **100**.

Similarly, referring back to FIGS. **7**A and **7**B, storage **215** includes technical and usage information about appliance **200**, such as information INF-1 listed below in TABLE VII.

In accordance with an embodiment of the present invention, wireless communicator **100** and appliance **200** communicate with one another via a pair of mailboxes within wireless communicator **100**. Specifically, pouching controller **110** includes two mailboxes, an outgoing mailbox that is written to by base band modem **120** and read from by appliance **200**, and an incoming mailbox that is written to by appliance **200** and read from by base band modem **120**. Pouching controller **110** initiates an interrupt to pouching controller **210** when base band modem **120** completes a write operation to the wireless communicator's outgoing mailbox. Such interrupt may be implemented as an SDIO interrupt on an SD bus, or as a dedicated signal. Similarly, pouching controller **210** initiates an interrupt to base band modem **120** when appliance **200** completes a write operation to the wireless communicator's incoming mailbox.

It will thus be appreciated by those skilled in the art that wireless communicator's incoming and outpoint mailboxes may be used for direct transfer of data between wireless communicator **100** and appliance **200**. In one embodiment of the present invention, each mailbox includes 512 bytes, of

which the first two bytes are header bytes that store a message type, and the remaining bytes store the message itself.

Wireless communicator's incoming and outgoing mailboxes may be mapped to an SDIO register map on the modem side and on the appliance side, respectively. Alternatively, wireless communicator's incoming and outgoing mailboxes may be mapped to SD memory space. In such case an arbitration algorithm is used to resolve conflicts when both appliance **200** and wireless communicator **100** try to access SD storage at the same time.

Reference is now made to FIG. **41**, which is a simplified flowchart of a method for automated reporting for appliance **200**, using wireless communicator **100**, in accordance with an embodiment of the present invention. At step **3705**, a manufacturer of appliance **200** stores information about the appliance, designated by INF-1, and contact information for a recipient, designated by INF-2, in appliance **200** storage **215**.

At step **1810**, a consumer purchases appliance **200**. At step **1815**, the consumer attaches wireless communicator **100** to appliance **200**. When wireless communicator **100** is attached to appliance **200**, wireless communicator **100** collects and monitors real-time information related to operation and usage of appliance **200**. In an embodiment of the present invention, wireless communicator **100** stores details about the user, designated by INF-3, in its local storage **115**.

In an embodiment of the present invention, INF-3 may be stored in SIM **190**.

At step **1820**, wireless communicator **100**, wishing to receive appliance information INF-1 and recipient contact information INF-2 from appliance **200**, writes an information request to the wireless communicator's outgoing mailbox. At step **1825** pouching controller **110** raises an interrupt to appliance **200**. At step **1830**-host appliance **200** reads the request message, and at step **1835** host appliance **200** writes the requested information INF-1 and INF-2 to the wireless communicator's incoming mailbox.

At step **1840** pouching controller **210**, in turn, raises an interrupt to baseband modem **120**, and at step **1845** wireless communicator **100** reads the requested information INF-1 and INF-2.

At step **1850** wireless communicator **100** prepares an appropriate report for recipient **765**, based on INF-1 and INF-3. At step **1855** wireless communicator **100** sends the report to recipient **765** at the recipient's address as specified in INF-2.

The report may be sent to recipient **765** in the form of an SMS message, an MMS message, a voice message, a GPRS message, or such other message transmitted by wireless communicator **100**. Alternatively or in addition, the report may be transmitted as an e-mail message over an IP or alternate network. The report may be transmitted over a GDSM network, as in FIG. **38**, over a CDMA network as in FIG. **39**, over a WiFi network as in FIG. **40**, or via WIMAX communication.

Steps **1815-1855** of FIG. **41** are summarized in the following simplified pseudo-code.

```
//declarations for variables
OWNER DETAILS = {NAME, CONTACT_INFO};
HOST_DETAILS = {HOST_TYPE, MODEL_NUM, SERIAL_NUMBER, MANUFACTURER,
RECIPIENT_NUMBER};
IF (IS_CC_INSERTED) {                                                    // step
1815
        CC_MAILBOX_WRITE("INFO REQUEST"};                                // step
1820
        INTERRUPT_HOST( );                                               // step
1825
        HOST_MAILBOX_READ_MAILBOX( );                                    // step
1830
        HOST_MAILBOX_WRITE(HOST_DETAILS);                                // step
1835
        INTERRUPT_CC( );                                                 // step
1840
        CC_MAILBOX_READ(HOST_DETAILS);                                   // step
1845
        MESSAGE = PREPARE_MESSAGE(OWNER_DETAILS, HOST_DETAILS);          // step
1850
        SEND_TO_RECIPIENT(RECIPIENT_NUMBER, MESSAGE);                    // step
1855
}
```

TABLE VII summarizes exemplary information data that is accessed by wireless communicator **100** in performing the method of FIG. **41**.

TABLE VII

Exemplary information accessed by wireless communicator 100 for automated reporting of appliance 200 or of the communicator's jacket 200

| INF-1: Appliance information/ INF-1: Communicator jacket information | INF-2: Recipient contact information | INF-3: Owner information |
|---|---|---|
| Manufacturer | Phone number | ID |
| Type of appliance | E-mail | Membership number |
| Model Number | IP address | Full name |
| Serial Number | | Address |
| SKU | | Phone number |
| Date of purchase | | Cell phone number |

TABLE VII-continued

| Exemplary information accessed by wireless communicator 100 for automated reporting of appliance 200 or of the communicator's jacket 200 | | |
|---|---|---|
| INF-1: Appliance information/ INF-1: Communicator jacket information | INF-2: Recipient contact information | INF-3: Owner information |
| Point of purchase | | E-mail |
| Capabilities - screen type | | Web site |
| Capabilities - screen size | | SIM subscriber information |
| Capabilities - user interface | | |
| Usage-related information | | |

Generally, appliance information, INF-1, is controlled by the manufacturer or seller of the appliance, and is stored in the appliance itself. Appliance information, INF-1, may be updated by the manufacturer or seller up to the time when the appliance is sold. In another embodiment of the present invention, some or all of appliance information, INF-1, may be manually entered. Such information may be attached to or printed on the appliance, for reference.

Generally, owner information, INF-3, is controlled by the owner of appliance **200**, and is stored in wireless communicator **100**. Alternatively, some or all of owner information, INF-3, may be accessible on a network such as the Internet. In such case, wireless communicator **100** accesses the owner information from the network, prior to sending the report to recipient **765** at step **1850**. In another embodiment of the present invention, some or all of owner information, INF-3, may be manually entered.

The usage-related information listed in TABLE VII may include a variety of present and past usage information. Such usage-related information includes inter alia,

- wireless communicator insertion time;
- wireless communicator extraction time;
- battery status of the appliance;
- battery status of the wireless communicator;
- memory status of the appliance;
- memory status of the wireless communicator;
- geographical movement of the appliance;
- mode of the appliance (e.g., silent, flight mode, meeting mode)
- accessories connected to the appliance (e.g., earphones, speaker, charger);
- accessories connected to the wireless communicator (e.g., PC);
- software installed on the appliance (e.g., drivers, operation system, applications, codecs);
- software and firmware versions on the appliance;
- file types in memory of the appliance (e.g., audio, video, documents); and
- file types in memory of the wireless communicator.

For purposes of illustration, the following is an exemplary simplified report that is submitted by wireless communicator **100** to recipient **765** at step **1855**.

Device Details
Type: Digital Camera
Manufacturer: Olympus
Model: C-765
SKU: 12345-ABCDE
Additional Information (report specific)
Owner Details
Name: Jack Times
Phone: 123-456-7890
Cell Phone: 987-654-3210
E-mail: Jack.Times@mailserver.com

Reporting step **1855** may be performed either while wireless communicator **100** is pouched with appliance **200**, or while wireless communicator **100** is not pouched with appliance **200**, or both. When wireless communicator **100** is pouched with appliance **200**, automated reporting may be event driven. Events that may initiative the reporting include inter alia

- Attachment of the wireless communicator to the appliance
- Detachment of the wireless communicator from the appliance
- Performing a device-specific function, e.g., begin listening to a song on an audio player
- Appliance is turned on
- Appliance is turned off
- Wireless Communicator is pouched with the appliance for the first time

Wireless communicator **100** may generate and save a usage history log in the wireless communicator storage **115** or in the appliance storage **215**. Wireless communicator **100** may generate and save a history log for a plurality of appliances. Information from the history log can be sent periodically to the recipient, such as daily or weekly.

Reporting step **1855** may be performed in real-time, or at a later time via a PC or via GPRS. Reporting step **1855** may be initiated by the owner of appliance **200**. For example, the owner may initiate generating a report and submitting the report to a service provider, if appliance **200** is malfunctioning.

Reporting step **1855** may be initiated by software or firmware running on appliance **200** or on wireless communicator **100**. Such software or firmware initiated reporting may occur as a one-time event, or as a recurring event.

Reporting step **1855** may be initiated remotely over a network. For example, recipient **765** may initiate generating a report and submitting it to the recipient.

Alternatively or in addition to step **1855**, wireless communicator **100** may open a voice channel for the user of appliance **200** and the recipient to speak with one another, or to leave voice messages for one another. Thus, when wireless communicator **100** is pouched with appliance **200** for the first time, the owner of appliance **200** and the recipient may be connected via a voice channel. The recipient may thereby introduce the owner to operation of appliance **200**, assist the owner in configuring appliance **200**, and offer the owner of CE appliance **200** a tutorial. In addition, incoming voice messages may be saved in a voice mailbox within wireless communicator **100**.

As described hereinabove, wireless communicator **100** may have one or more jackets **200**. In an embodiment of the present invention, distinct jackets **200** of wireless communicator **100** have distinct identification codes. The identification code of a jacket **200** may include some or all of information, INF-1. In this embodiment, the jacket identification code may be reported to the recipient at step **1855**.

In accordance with an embodiment of the present invention, reporting step **1855** may advantageously use a user-agent header, which prefaces transmissions from wireless communicator **100**. User-agent headers are text strings that are transmitted by a device, such as wireless communicator **100**, via an HTTP header, to identify the device that is sending data. User-agent headers generally include a wireless device model and manufacturer. User-agent headers may also include additional information such as the device's operation system version, browser version and Java capabilities. Examples of user-agent headers are:

Nokia 6230

User-Agent: Nokia6230/2.0 (03.14) Profile/MIDP-2.0 Configuration/CLDC-1.1

Sony Ericsson Z1010

User-Agent: SonyEricssonZ1010/R1A SEMC-Browser/4.0

Modu

User-Agent: Modu-A1.0/SKY.Browser 1.1/Music.

In accordance with an embodiment of the present invention, user-agent headers are modified according to capabilities of appliance **200**, so that recipient **765** may identify content and services that appliance **200** supports. User-agent headers are also modified according to properties of the wireless communicator's jacket, so that recipient **765** may identify the jacket. The user-agent headers are modified in the HTTP header upon pouching of wireless communicator **100** with appliance **200**, or upon pouching of wireless communicator **100** with its jacket.

Wireless communicator **100** also uses a user-agent profile (UAProf). Specifically, wireless communicator **100** sends a universal resource identifier (URI) with a link to its UAProf, within an HTTP header or a Web Service Provider (WSP) header. The UAProf resides on the manufacturer's web site—either the manufacturer of wireless communicator **100** or the manufacturer of appliance **200** or the manufacturer of jacket **200**. The UAProf is maintained by the manufacturer, and is unique per communicator/appliance combination and per communicator/jacket combination and per software version. The URI is updated when a UAProf parameter value is changed.

The system and method of the present invention illustrated in FIGS. **38-41** may be used advantageously in many application areas where automated reporting is useful, including inter alia:

- medical reports;
- police reports;
- insurance reports;
- driver and automobile safety reports;
- taxi cab reports;
- credit card reports;
- ATM card reports;
- registration of CE devices;
- diagnostics and maintenance;
- software/firmware updates;
- warranties and guarantees;
- access control security;
- offer of services;
- time-stamping;
- advertising;
- market segmentation;
- understanding user behavior; and
- networking.

The present invention is advantageous for automated registration, diagnostic testing and malfunction reporting for electrical appliances. In an embodiment of the present invention, when wireless communicator **100** is pouched with a new appliance, wireless communicator **100** automatically collects information about the appliance and its owner, and transmits the collected information to a remote manufacturer or seller for registering the appliance.

Wireless communicator **100** also includes program code for diagnostic testing of the appliance. When wireless communicator **100** is pouched with the appliance, the program code runs diagnostic maintenance tests on the appliance. Wireless communicator **100** automatically collects information about the appliance and its owner, and transmits the collected information along with a diagnostic report, to the seller or service provider for the appliance. In turn, if a malfunction is reported, the seller or service provider contacts the owner about repairing the appliance. In this way, the seller or service provider is able to maintain the appliance, and proactively repair appliance malfunctions before they become severe.

Reference is now made to FIG. **42**, which is a simplified illustration of a communications network with wireless communicator **100** that wirelessly transmits registration information about appliance **200** to one or both of a remote manufacturer and a remote seller **300** in accordance with an embodiment of the present invention. When wireless communicator **100** is pouched with appliance **200**, wireless communicator **100** automatically registers appliance **200** by transmitting appropriate information **310** about the appliance, its purchase, and its owner to remote manufacturer or a seller **300**.

Referring back to FIG. **6**, in accordance with an embodiment of the present invention, storage **115** stores information about the so owner of appliance **200**, and appliance registration program code for registering appliance **200**. Similarly, referring back to FIGS. **7**A and **7**B, storage **215** stores information about appliance **200** and its purchase. Such details may include inter alia a serial number for appliance **200**, a model number, a date of purchase and an identifier for the store where appliance **200** was purchased.

Wireless communicator **100** is used to send registration information about appliance **200** and its owner to one or more of manufacturer and seller **300**.

When wireless communicator **100** is pouched with appliance **200**, appliance **200** serves as an enhanced function host device. To register appliance **200**, the appliance registration program code programs wireless communicator **100** (i) to collect requisite appliance and purchase information from the appliance storage **215**, and owner information from the wireless communicator storage **115** or SIM **190**; and (ii) to forward the collected information to the seller or to the manufacturer **300**, as appropriate, using modem **120**. Contact information for seller or manufacturer **300** may be available in the appliance storage **215**. Alternatively, contact information for seller or manufacturer **300** may be entered manually to wireless communicator **100**. Yet alternatively, contact information for seller or manufacturer **300** contact information may be available in wireless communicator storage **115**. Specifically, wireless communicator **100** may store a list of manufacturers and their appliances, and looks up the appropriate contact information based on appliance **200**.

In an alternative embodiment of the present invention, owner information does not reside in wireless communicator storage **115** or SIM **190**. Instead, wireless communicator **100** obtains the owner information from an external server.

In accordance with one embodiment of the present invention, connection to the seller or manufacturer **300** is initiated by wireless communicator **100**, and transmitted over GPRS (GSM mobile data service). Wireless communicator **100** creates a file or text message that includes the relevant registra-

tion data, shown as message **310** in FIG. **42**. An example of such file or text message is as follows.

Device Details
Type: Audio Receiver
Brand: Yamaha
Model: RX-V2700
S/N: 12345-ABCDE
Purchase Details
Date of Purchase: Jan. 1, 2007
Store: 1280 Lexington Ave., New York, N.Y. 10028
Owner Details
Name: John Smith
Phone: 123-456-7890
Cell Phone: 098-765-4321
E-mail: John.Smith@anonymous.com

In another embodiment of the present invention, wireless communicator **100** transmits the registration information via an SMS or MMS message. In yet another embodiment of the present invention, wireless communicator **100** places a voice call to the seller or manufacturer **300** with the information indicated in the text above, using text-to-speech conversion.

An alternate embodiment of the present invention, owner information is not stored in wireless communicator **100**. Instead, owner information is retrieved by the seller and manufacturer **300** after receipt of registration data sent from wireless communicator **100**. Alternatively or additionally, owner information, together with an optional owner log history, is stored within appliance **200** itself.

After wireless communicator **100** has registered appliance **200**, a corresponding flag is set in wireless communicator storage **115** or appliance memory **215**. Thereafter, when wireless communicator **100** is pouched with appliance **200** it knows not to register appliance **200** a second time.

Reference is now made to FIG. **43**, which is a simplified illustration of a communications network with wireless communicator **100** that wirelessly transmits diagnostic information about appliance **200** to one or more of a remote seller, a remote manufacturer and a remote service provider **300** in accordance with an embodiment of the present invention. When wireless communicator **100** is pouched with appliance **200**, wireless communicator **100** (i) automatically runs diagnostic tests on appliance **200**, and (ii) automatically prepares diagnostic summary reports **320** for appliance **200** and transmits them to remote seller, manufacturer or service provider **300** for the appliance.

Referring back to FIG. **6**, in an embodiment of the present invention the wireless communicator storage **115** stores information about the owner of wireless communicator **100**, and also store application diagnostic program code for reporting diagnostics of appliance **200**, as described hereinbelow. Similarly, referring back to FIGS. **7**A and **7**B, the appliance storage **215** stores information about appliance **200** and its purchase. Such details may include inter alia a serial number for appliance **200**, a model number, a software/firmware version, a date of purchase and an identifier for the store where appliance **200** was purchased.

Further in accordance with an embodiment of the present invention, electrical appliance **200** includes sensors for use in diagnostics. A sensor is a type of transducer which converts a signal into a reading for the purpose of information transfer. There are direct-indicating sensors which are human-readable, e.g., a mercury thermometer. Other sensors that may be embedded in an electrical appliance are sensors that produce an output voltage or such other electrical output which is interpreted by another device. Most sensors are electrical or electronic, although other types exist. Sensors used in diagnostics of appliance **200** in accordance with the present invention include inter alia thermal sensors, electromagnetic sensors, mechanical sensors, chemical sensors, optical radiation sensors, ionizing radiation sensors and acoustic sensors.

Wireless communicator **100** is used to send information about electrical appliance **200** and its owner to one or more of seller, manufacturer and service provider **300**. The information sent by wireless communicator **100** includes diagnostic reports for appliance **200**.

When wireless communicator **100** is pouched with appliance **200**, appliance **200** serves as an enhanced function host device. For maintenance and repair of appliance **200**, the appliance diagnostic program code programs wireless communicator **100** (i) to run diagnostic tests on appliance **200**; and (ii) to forward the test results to seller, to manufacturer or service provider **300** for appliance **200**, as appropriate, using modem **120**. As above, wireless communicator **100** creates a file or text message that includes the relevant diagnostic monitoring data, shown as service report **320** in FIG. **43**. An example of such file or text message is as follows.

Device Details
Type: Audio Receiver
Brand: Yamaha
Model: RX-V2700
S/N: 12345-ABCDE
Problem Diagnosed
Description: Over-heating
Owner Details
Name: John Smith
Phone: 123-456-7890
Cell: 098-765-4321
Email: John.Smith@anonymous.com

In another embodiment of the present invention, wireless communicator **100** transmits the service report using an SMS or MMS message. In yet another embodiment of the present invention, wireless communicator **100** places a voice call to seller, manufacturer or service provider **300** with the information indicated in the text above, using text-to-speech conversion.

In accordance with an embodiment of the present invention, diagnostic tests may be scheduled periodically, or initiated manually by the owner, or initiated remotely via wireless communicator **100**.

Reference is now made to FIG. **44**, which is a simplified flowchart of a method for registering electrical appliances using wireless communicator **100** in accordance with an embodiment of the present invention. At step **1910** a buyer purchases an electronic appliance, which serves as a host device, such as appliance **200** of FIG. **42**. At step **1920** the buyer pouches wireless communicator **100** with the appliance **200**. At step **1930** the wireless communicator pouching controller **110** recognizes its being pouched to appliance **200**.

At step **1940** pouching controller **110**, under program instruction from code stored on wireless communicator **100**, such as the appliance registration program code, collects appliance information and purchase information from the appliance storage **215**. Such appliance and purchase information includes inter alia a serial number, a model number, a date of purchase, and an identifier of a store where the appliance was purchased. At step **1950** pouching controller **110** collects information about the owner from wireless communicator storage **115** or SIM **190**. At step **1960** pouching controller **110** collects contact information for the seller or manufacturer of appliance **200**, with whom the appliance is to be registered. Such contact information may be stored in appliance **200**, or may be manually entered. Finally, at step **1970** wireless communicator **100** opens a connection to the seller or manufacturer, and transmits the registration information.

Wireless communicator **100** may transmit the registration information as data transmitted over GPRS. Alternatively, wireless communicator **100** may transmit the information as a voice transmission by making a phone call to the seller or manufacturer.

Reference is now made to FIG. **45**, which is a simplified flowchart of a method for reporting diagnostics for electrical appliances using wireless communicator **100** in accordance with an embodiment of the present invention. At step **2010** a consumer inserts wireless communicator **100** into appliance **200**, which serves as an enhanced function host device for wireless communicator **100**. At step **2020** wireless communicator **100** monitors appliance **200** by running diagnostic testing program code that is stored in the wireless communicator storage. At step **2030** a determination is made whether a problem has been detected. If not, the method returns to step **2020** to continue monitoring appliance **200** while wireless communicator **100** is pouched therewith. Such monitoring may be continuous monitoring or scheduled periodic monitoring.

Referring back to step **2030**, if a problem is detected, then at step **2040** the wireless communicator pouching controller **110** collects appliance information that is stored in appliance storage **215**. Such information includes inter alia an appliance serial number and a model number. Pouching controller **110** also identifies a malfunction type corresponding to the detected problem. At step **2050** pouching controller **110** collects owner data that is stored in wireless communicator storage **115**. At step **2060** pouching controller **110** collects contact information for the seller, manufacturer or service provider of appliance **200**. At step **2070** wireless communicator **100** contacts the seller, manufacturer or service provider and transmits an alert notification regarding the malfunction. Finally, at step **2080** the seller, manufacturer or service provider contacts the owner of appliance **200** regarding the malfunction.

The present invention is advantageous for updating software and firmware. The generated report may include identifiers of versions of software and firmware for an enhanced function device, in response to which appropriate updated versions are remotely accessed. In accordance with an embodiment of the present invention, wireless communicator **100** maintains a history log of the various enhanced function devices it was pouched with. The history log includes the enhanced function devices' current installed software and firmware versions. In an embodiment of the present invention, specific settings that were last defined or modified for the enhanced function devices are kept in a log file. When wireless communicator **100** reports its history log, appropriate software/firmware updates are made accessible for wireless communicator **100** to download. After downloading the updates, when wireless communicator **100** is subsequently pouched with one of the enhanced function devices in its history log, the software/firmware in these enhanced function devices is updated as appropriate. The updated software/firmware may be installed automatically when wireless communicator **100** is pouched with an enhanced function device, or may be prompted manually by a user.

According to an embodiment of the present invention, the settings for the enhanced function devices are restored on the enhanced function device from the log file on the wireless communicator when wireless communicator **100** is subsequently pouched with any of the enhanced function devices.

Reference is now made to FIG. **46**, which is a simplified flow chart of a method for provisioning software and firmware updates to a plurality of jackets and appliances using the wireless communicator in accordance with an embodiment of the present invention. At step **2110** wireless communicator **100** is pouched in a plurality of jackets and appliances over time. At step **2120** wireless communicator collects information relating to the plurality of jackets and appliances over time, the collected information including versions of installed software/firmware and last defined or modified settings for the jackets and appliances.

At step **2130** wireless communicator **100** maintains a history log of the collected information. At step **2140**, wireless communicator **100** is connected to a PC, and the PC reports the history log to one or more remote update servers. At step **2150** the remote update servers transmit new versions of software/firmware to wireless communicator, as appropriate for the plurality of jackets and appliances. At step **2160**, upon subsequent pouching of wireless communicator **100** to any of the plurality of jackets and appliances, the updated versions of software/firmware are installed on the jacket or appliance.

10. SD Switch Box in the Wireless Communicator

Embodiments of the present invention enable the wireless communicator baseband modem **120** to bypass NOR flash memory when booting up, enable communication between baseband modem **120** and an enhanced function host device **200**, and enable baseband modem **120** to switch in and out of sleep mode without loss of state parameters and code image.

In accordance with an embodiment of the present invention, pouching controller **110** is used to couple enhanced function host device **200** with the wireless communicator's baseband modem **120** and with the wireless communicator's storage **115** embodied as NAND flash memory. Pouching controller **110** serves as an SD switch box, which connects two SD devices, namely, the baseband modem **120** and enhanced function host device **200**, and enables switching access to SD storage between the two SD devices.

In an embodiment of the present invention, while pouching controller **110** operates as an SD switch, it is used for allowing two SD hosts embedded within the same housing to access the SD storage. Pouching controller **110** thus enables use of a single storage area accessible by multiple controllers in the same housing, such as modem **120** and an optional application processor. Similarly, pouching controller **110** enables use of a single storage area accessible by modem **120** and external controller **205**.

Pouching controller **110** includes a communication mechanism through which baseband modem **120** and enhanced function host device **200** communicate with one another. Such communication mechanism includes an outgoing communicator mailbox via which baseband modem **120** sends a message to enhanced function host device **200**, and an incoming communicator mailbox via which enhanced function host device **200** sends a message to baseband modem **120**.

The two mailboxes are used to resolve conflicts when both enhanced function host device **200** and the baseband modem **120** want to access SD memory at the same time. Baseband modem **120** sends an access request message to enhanced function host device **200** via the outgoing mailbox, and enhanced function host device **200** responds by sending an access granted message to baseband modem **120** via the incoming mailbox.

Pouching controller **110** is used to couple enhanced function host device **200** with baseband modem **120**. When enhanced function host device **200** and baseband modem **120** are coupled, they share use of the wireless communicator's NAND flash memory **115**. Pouching controller **110** serves as an SD switch box, which connects two SD devices, namely,

baseband modem **120** and enhanced function host device **200**, and enables switching access to SD storage between the two SD devices.

Reference is now made to FIG. **47**, which is a simplified block diagram of wireless communicator **100** with pouching controller **110** in accordance with a first embodiment of the present invention. Wireless communicator **100** includes baseband modem **120**, pouching controller **110**, a NAND controller **102***a*, and NAND flash memory **115**.

Pouching controller **110** is connected to baseband modem **120** via both a UART port **106** and a baseband SD host port **107**. Correspondingly, modem **120** includes a UART interface **161** and an SD interface **162**, respectively.

Pouching controller **110** is connected to SD NAND controller **102***a* via an SD port **108**. During normal operation, baseband modem **120** accesses flash memory **115** via SD port **108**.

Pouching controller **110** also includes pouched connector **160** for pouching wireless communicator **100** to enhanced function host device **200**, which supports SD connections. When wireless communicator **100** is pouched with enhanced function host device **200**, enhanced function host device **200** accesses NAND flash memory **115** via pouching controller **110**. It is noted that access to NAND flash memory **115** is not required to pass through base band modem **120**. As such, baseband modem **120** may be in sleep mode or shutdown mode during operations between enhanced function host device **200** and NAND flash memory **115**.

For memory storage, wireless communicator **100** also includes an internal SRAM memory **163**, and an external memory interface (EMIF) **164** connected to an SDRAM memory **166**.

Reference is now made to FIG. **48**, which is a simplified flowchart of a method for booting the wireless communicator's baseband modem **120**, and for performing subsequent operations in accordance with an embodiment of the present invention. At step **2210** the baseband modem is booted in peripheral mode. In general, when a baseband modem is booted in peripheral mode, the internal ROM code in the modem looks for code that is input via a peripheral interface, including inter alia a UART or a USB interface. The base band modem retrieves such code and transfers it to internal SRAM **163**, and then transfers control to SRAM **163**.

At step **2220** pouching controller **110** reads a secondary boot code image from NAND flash **115**, via NAND controller **102***a*. At step **2230** pouching controller **110** loads the secondary boot code image via its UART port **106** to baseband modem **120**.

At step **2240** a boot loader of baseband modem **120** loads the secondary boot code to internal SRAM **163**, and begins executing the secondary boot code. At step **2250** the executing code loads the full code image from NAND flash **115** via the pouching controller's SD port **108**, to internal SRAM **123** or to external SDRAM **166**, or to both. At step **2260**, during operation, baseband modem **120** accesses NAND flash **115** via the pouching controller's SD port **108**, as a standard SD memory card.

In accordance with an embodiment of the present invention, baseband modem **120** communicates with enhanced function host device **200** via its controller **260**, using mailboxes implemented in pouching controller **110**. Specifically, pouching controller **110** includes two mailboxes, an outgoing communicator mailbox **117** that is written to by baseband modem **120** and read from by enhanced function host device **200**, and an incoming communicator mailbox **118** that is written to by enhanced function host device **200** and read from by baseband modem **120**. Pouching controller **110** initiates an interrupt to enhanced function device pouching controller **210** when modem **120** completes a write operation to mailbox **117**. Such interrupt may be implemented as an SDIO interrupt on an SD bus, or as a dedicated signal. Similarly, enhanced function device pouching controller **210** initiates an interrupt to baseband modem **120** when enhanced function host device **200** completes a write operation to mailbox **118**.

It will thus be, appreciated by those skilled in the art that mailboxes **117** and **118** may be used for direct transfer of data between baseband modem **120** and enhanced function host device **200**. In one embodiment of the present invention, each mailbox **117** and **118** includes 512 bytes, of which the first two bytes are header bytes that store a message type, and the remaining bytes store the message itself.

Mailboxes **117** and **118** may be mapped to an SDIO register map on the base band modem side and on the enhanced function host device side. Alternatively, mailboxes **117** and **118** may be mapped to SD memory space. In such case an arbitration algorithm is used to resolve conflicts when both enhanced function host device **200** and baseband modem **120** try to access SD storage at the same time.

Reference is now made to FIG. **49**, which is a simplified flowchart of a method for communicating between enhanced function host device **200** and the wireless communicator's baseband modem **120**, and accessing SD storage **115** in accordance with an embodiment of the present invention. At step **2310**, base band modem **120** requests access to SD storage **115** from enhanced function host device **200**, by writing an access request message to mailbox **117**. At step **2320** pouching controller **110** issues an interrupt to enhanced function host device **200**, to notify enhanced function host device **200** of the message that was written. At step **2330** enhanced function host device **200** reads the message from mailbox **117**.

At step **2340** enhanced function host device **200** grants the storage access request by writing an access granted message to mailbox **118**. The write operation at step **2340** is performed as a multiple block write operation. Multi-block writes are described in the SD specification, Part I: Physical Layer, Simplified Specification Version 2.00, Sep. 25, 2006.

At step **2340**, the first block of the multi-block write includes the grant of access message, and the rest of the blocks are dummy blocks that are filled with zeros. At step **2350** pouching controller **110** recognizes the first block of the message as a grant of access, and holds a busy state on the SD host bus before reading the second block, thereby forcing the enhanced function device pouching controller **210** to hold and not access the SD bus.

At step **2360** baseband modem **120** is notified that its access request was granted, via a dedicated interrupt line, by reading mailbox **118**. Baseband modem **120** can then proceed to access SD storage **115**. At step **2370** base band modem **120** performs its operations on SD storage **115**. At step **2380**, upon completion of using SD storage **115**, baseband modem **120** writes a free message to pouching controller **110**. Finally, at step **2390** pouching controller **110** removes the busy state from the SD host bus.

Generally there is a timeout of 250 msec for a busy period. As such, pouching controller **110** ensures that access to SD storage **115** is shorter than this time.

Reference is now made to FIG. **50**A, which is a simplified diagram illustrating a process of enabling a baseband modem to access SD storage, where pouching controller **110** coordinates between the baseband modem and enhanced function host device in accordance with a first embodiment of the present invention. FIG. **50**A is arranged as a time line advancing from left to right. Three types of data flow are illustrated

along the time line; namely, a logical arbitration state, communication between enhanced function host device **200** and pouching controller **110**, and communication between the wireless communicator's base band modem **120** and pouching controller **110**.

Logical arbitration involves a protocol for switching access to SD storage **115** between baseband modem **120** and enhanced function host device **200**, which share SD storage **115**. As described hereinabove with respect to FIG. **49**, arbitration operates by means of access requests and access grants written to mailboxes **117** and **118**.

Communication between enhanced function host device **200** and pouching controller **110**, and between the wireless communicator's baseband modem **120** and pouching controller **110**, occurs via command signals, data signals and interrupt signals. Data blocks are followed by CRC error checking codes.

As shown in FIG. **50**A, when the wireless communicator's baseband modem **120** wants to access SD storage **115**, it writes an access request message to the wireless communicator's outgoing mailbox **117**. Thereafter, pouching controller **110** issues an interrupt to enhanced function host device **200**, informing it that there is a message waiting in mailbox **117**. Enhanced function host device **200** then reads the access request message in mailbox **117**, and writes a multi-block access grant message to the wireless communicator's incoming mailbox **118**. Pouching controller **110** recognizes the first block of the multi-block as an access grant message, and holds a busy state. Pouching controller **110** issues an interrupt to baseband modem **120**, indicating that access to SD storage **115** is granted. Baseband modem **120** then accesses SD storage **115** and performs its requisite operations. Upon completion, baseband modem **120** writes a release message to pouching controller **110**, which then releases the busy state. In turn, enhanced function host device **200** is then able to write the second block (dummies) to the wireless communicator's incoming mailbox **118**.

Reference is now made to FIG. **50**B, which is a simplified diagram illustrating a process of enabling a baseband modem to access SD storage, where pouching controller **110** coordinates between the baseband modem and enhanced function host device in accordance with a second embodiment of the present invention. As shown in FIG. **50**B, an access grant write command is not needed, and the reading of the baseband modem access request suffices to trigger the busy state for enhanced function host device **200**. Whereas in the embodiment of FIG. **50**A a multi-block write by enhanced function host device **200** is used to generate the busy state, in the embodiment of FIG. **50**B a single-block read suffices to initiate the busy state.

Baseband modem **120** may be idle for a long period of time if no call or data exchange is underway and there is time to wait until a next signaling session with a cellular network. In such case, base modem **120** may drop to a sleep mode. Moreover, in order to conserve power consumption in sleep mode, baseband modem **120** may shut off SDRAM power, which results in losing the code image on SDRAM **166**. In order to enable proper operation, baseband modem **120** maintains state parameters in internal SRAM **163**. Alternatively, or in addition, base band modem **120** backs up state parameters in internal SRAM **163** prior to going to sleep.

In this regard, reference is now made to FIG. **51**, which is a simplified flowchart of a method for a sleep mode in accordance with an embodiment of the present invention. At step **2410** baseband modem **120** is idle for a long period of time. At step **2420** base band modem **120** backs up state parameters in internal SRAM **163**. At step **2430** baseband modem **120** sets the secondary boot code that was loaded to SRAM **163** at step **2240** as the code to be executed upon resumption of power. At step **2440** baseband modem **120** sets a timer for resumption of power, halts internal controller operation, and then disconnects power to external SDRAM **166**.

Reference is now made to FIG. **52**, which is a simplified flowchart of a method for resuming operation after a sleep mode in accordance with an embodiment of the present invention. At step **2510** the timer that was set at step **2440** expires. At step **2520** power is resumed. At step **2530** baseband modem **120** begins executing the secondary boot code, based on the setup defined at step **2430**. Finally, at step **2540** the secondary boot code loads the code image into external SDRAM **166**, and transfers control thereto.

In reading the above description, persons skilled in the art will realize that there are many apparent variations that can be applied to the methods and systems described. In particular, components of FIG. **47** that are shown integrated may be separated, and components that are shown as separated may be integrated. In this regard, reference is now made to FIG. **53**, which is a simplified block diagram of a cellular handset in accordance with a second embodiment of the present invention. In the embodiment illustrated in FIG. **53**, an SD NAND controller **102***b* is integrated within pouching controller **110**. In distinction, SD NAND controller **102***a* is external to pouching controller **110** in FIG. **47**.

When SD NAND controller **102***b* is integrated within pouching controller **110**, pouching controller **110** can directly access NAND flash **115**. As such, at step **2120** of FIG. **48**, pouching controller **110** reads the boot code image directly from NAND flash **115**, without using an external NAND controller.

11. Power Management of the Wireless Communicator when its Battery Lapses

Embodiments of the present invention concern power management of wireless communicator **100**, so as to mitigate the problem of inability to turn on and use wireless communicator **100** even when wireless communicator **100** is connected to an external power source, by graduating power modes via an intermediate limited use mode prior to shut down mode.

More generally, aspects of the present invention concern power management for a mobile electronic device in order to preserve life of a battery, or a battery pack, within the device. The mobile device can run in standalone mode, or in an external power mode. When running in standalone mode the battery loses charge, and when running in external power mode the battery is re-charged by the external power source.

In order to prevent a shutdown of the device, without being able to turn the device back on, when the charge of the battery drops below a power-on reset (POR) threshold, a lockout power mode is enabled prior to the POR threshold being reached. The lockout power mode, referred to as a "provisional mode" and also as an "emergency mode", enables the mobile device to be used only for limited actions and only for a pre-specified period of time. Thus a cellular telephone, for example, in provisional mode, may be turned on and used only for making emergency calls. This enables the user of the telephone to turn on the phone and call for help for a limited time period after his cell phone has shut down. In another scenario, the cellular telephone in provisional mode may be enabled for speed dial calls, thus enabling a child to turn on his phone and call his parents for a limited time period after the child's cell phone has shut down.

The present invention monitors the mobile device's battery voltage and places the mobile device in one of several power mode states, depending on the battery voltage and depending on whether the mobile device is running on its internal battery

or connected to an external power source. The transitions between power mode states are controlled so that a user of the mobile device is able to make limited emergency-type actions for a limited time period after the mobile device has been shut down.

Multiple power modes for the mobile device are managed, including a fully operation power mode, a non-operational (shutdown) power mode, and a provisional power mode. The provisional power mode enables the device to be turned on for limited emergency-type use, for a short period of time. Transitions between power modes are governed by increases and decreases in battery voltage, and by the mobile device being connected to or disconnected from an external power source.

Reference is now made to FIG. **54**, which is a simplified block diagram of a power management system, for preserving life of battery **145** in wireless communicator **100** in accordance with an embodiment of the present invention. Shown in FIG. **54** is wireless communicator **100** and its baseband modem **120** for transmitting and receiving digital audio signals via its GSM antenna **140**. power amplifier **135** is used to amplify signals transmitted by antenna **140**. Wireless communicator **100** operates under control of its dedicated controller **105**.

Wireless communicator **100** uses its internal battery **145** for supplying power. In addition, wireless communicator **100** uses an external power adapter **146**, for connecting wireless communicator **100** to an external source such as an AC electrical socket, or to an external device, such as a computer, which is able to supply some of its own power to wireless communicator **100**.

Wireless communicator **100** may operate in a standalone mode, powered by battery **145**. Alternatively, wireless communicator **100** may operate in an external power mode, powered by an external source. In accordance with an embodiment of the present invention, battery **145** is a re-chargeable lithium ion battery, and generally when wireless communicator **100** operates in external power mode, some of the external power is used to charge battery **145**.

The voltage on battery **145**, denoted by VBat, changes continuously with time. Without being re-charged, VBat for a lithium ion battery typically decays according to a known discharge curve. Wireless communicator's power manager **125** ensures that wireless communicator **100** is shut down when VBat falls below a reset threshold, in order to avoid damage to battery **145** and to wireless communicator **100**.

In accordance with an embodiment of the present invention, power manager **125** includes logic for a lockout mechanism that is functional when LTOT<VBat<UTOT, for predefined lower and upper turn-on thresholds LTOT and UTOT, respectively, and when wireless communicator **100** is not connected to an external power source. The lockout mechanism serves to put wireless communicator **100** into a provisional mode, also referred to as an emergency mode, in which operation of wireless communicator **100** is limited to one or more emergency functions. Emergency functions may include inter alia making an emergency phone call, and making a speed dial phone call.

In an embodiment of the present invention, LTOT is a threshold below which wireless communicator **100** cannot be turned on, and UTOT is slightly higher than LTOT. Sample settings are LTOT=3.2V and UTOT=3.3V. The provisional mode of the present invention enables wireless communicator **100** to shut down methodically and in a controlled manner, so that it can be turned on for emergency calls after being shut down.

Power manager **125** controls wireless communicator **100** in accordance with TABLE VIII. As indicated in TABLE VIII, when VBat drops below 2.7V, referred to as a "power-on reset" (POR) threshold, then power manager **125** shuts down wireless communicator **100** and prevents it from being turned on. This protects battery **145** from suffering permanent damage. Generally, when VBat drops below 2.7V, power manager **125** asserts a reset signal. The reset remains asserted until a safety period after VBat rises above 2.7V.

When VBat is between 2.7V and 3.2V, then power manager **125** enables wireless communicator **100** to operate in external power mode, but not in standalone mode. The threshold of 3.2V is referred to as a "turn-on" threshold, and also referred to herein as the lower turn-on threshold (LTOT). When wireless communicator **100** is operating in standalone mode and VBat falls below 3.2V, then power manager **125** turns wireless communicator **100** off, and prevents it from being turned back on until VBat rises above 3.2V.

When VBat is above 3.2V then power manager **125** enables wireless communicator **100** to operate in external power mode, and when VBat is above 3.3V then power manager **125** enables wireless communicator **100** to also operate in standalone mode. The threshold of 3.3V is referred to herein, as the upper turn on threshold (UTOT).

However, when VBat is between 12V and 3.3V, then power manager **125** limits wireless communicator **100** to operate in provisional mode. In provisional mode wireless communicator **100** can be turned on for a pre-defined time period, such as 30 seconds, and can only be used for one or more emergency functions, such as making an emergency call.

It will be appreciated by those skilled in the art, from the nature of the steep decline at the end of battery discharge curves, that raising the turn-on threshold for cellular telephone **200** from 2.7V to 3.3V has negligible impact on usage time. The drop from 13V to 2.7V occurs in a few minutes.

TABLE VIII

Power Management Logic for Wireless Communicator

| Battery Voltage (VBat) | External Power Mode | Standalone Mode |
|---|---|---|
| VBat ≤ 2.7 V | Communicator cannot be turned on. During operation, if the voltage drops below this threshold, then the communicator is automatically turned off. | |
| 2.7 V < VBat ≤ 3.2 V | Communicator cannot be turned on. During operation, communicator operates normally unless the voltage drops below POR threshold (2.7 V) | |
| 3.2 V < VBat ≤ 3.3 V | Communicator can be turned on. Communicator operates normally. | Communicator can be turned on in provisional mode. After a pre-defined time period, the communicator is automatically turned off. |
| VBat > 3.3 V | | Communicator operates normally. During operation, if the voltage drops below the upper threshold (3.3 V), then the communicator is automatically turned off. |

It will further be appreciated by those skilled in the art that the parameter values POR=2.7V, LTOT=3.2V and

UTOT=3.3V are example values, and that other values for these parameters are within the scope of the present invention.

Reference is now made to FIG. **55**, which is a simplified flowchart of a method for preserving life of a battery in wireless communicator **100** in accordance with an embodiment of the present invention. At step **2605** wireless communicator **100** is turned on. At step **2610** the voltage of wireless communicator's battery **145** is continually monitored. At step **2615** a determination is made whether wireless communicator **100** is connected to an external power source.

If wireless communicator **100** is connected to an external power source, then its internal battery **145** is being charged. At step **2620** a further determination is made whether the battery voltage is higher than a lower turn-on threshold, denoted LTOT. If so, then at step **2625** wireless communicator **100** is power controlled so as to be fully operational. If not, then at step **2630** wireless communicator **100** is power controlled so as to be able to operate, but cannot be turned on after it has been turned off.

Referring back to step **2615**, if wireless communicator **100** is not connected to an external power source, then it is running in standalone mode and being powered by its internal battery. The charge on its internal battery is being drained. At step **2635** a determination is made whether the battery voltage is higher than an upper turn-on threshold, denoted UTOT. It so, then at step **2640** wireless communicator **100** is power controlled so as to be fully operational. If not, then at step **2645** a further determination is made whether the battery voltage is higher than the lower turn-on threshold, LTOT. If not, then at step **2650** wireless communicator **100** is power controlled so that it cannot be turned on.

Referring back to step **2645**, if the battery voltage is higher than LTOT, then at step **2655** wireless communicator **100** is power controlled so as to turn on to operate only in a limited provisional mode, and only for a pre-specified short period of time. When operating in provisional mode, only limited use of wireless communicator **100** is enabled. Generally, use of wireless communicator **100** is limited to one or more emergency actions. An emergency action may be making an emergency phone call. An emergency action may also be making a speed dial call. This would enable a child to call his parents, for example, if his cell phone battery runs low.

When wireless communicator **100** is operating in provisional mode, and a person uses wireless communicator **100** to make a phone call, a determination is made at step **2660** whether or not the call is an emergency call. If so, then the call is enabled at step **2665**. If not, wireless communicator **100** is shut down at step **2670**.

The voltage on wireless communicator's battery **145** continually changes. The battery's charge decreases when wireless communicator **100** is operating in standalone mode, and the charge increases when wireless communicator **100** is connected to an external power source. The flowchart of FIG. **55** continually returns to step **2610** to monitor the voltage and power manage the telephone accordingly.

Reference is now made to FIG. **56**, which is a simplified state transition diagram for power modes of wireless communicator **100** in accordance with an embodiment of the present invention. As shown in FIG. **56**, wireless communicator **100** can be in one of four power modes; namely,

- a fully operational power mode **2610**, wherein wireless communicator **100** can be turned on and operates normally;
- a provisionally operational mode **2620**, wherein wireless communicator **100** can be turned on for a pre-specified amount of time, such as 30 sec., and used for one or more emergency actions;
- a critical mode **2630**, wherein wireless communicator **100** is operational, but cannot be turned on once it is turned off; and
- a non-operational mode **2640**, wherein wireless communicator **100** is shut down and cannot be turned on.

State transitions from one power mode to another in FIG. **56** occur when the battery voltage, VBat, drops below or rises above one of the thresholds POR, LTOT and UTOT. Voltage drops occur when wireless communicator **100** is operating in standalone mode, and the charge on battery **145** is being drained. Voltage rises occur when wireless communicator **100** is operating in external power mode, and battery **145** is being charged by an external power source.

State transitions in FIG. **56** also occur when wireless communicator **100** is connected to or disconnected from an external power source. The state transitions summarized in FIG. **56** are controlled by power manager **125** and correspond logically to the flowchart of FIG. **55**.

In reading the above description, persons skilled in the art will realize that there are many apparent variations that can be applied to the methods and systems described. In particular, the power management system described hereinabove with reference to FIG. **54**, and the power management method described hereinabove with reference to FIG. **55** apply to a wide variety of other mobile electronic devices, in addition to wireless communicator **100**. Among the actions supported by such devices, certain actions among them are designated as being emergency actions. When the devices are placed into provisional power mode (step **2555** of FIG. **55**), only the emergency actions are enabled, and only for a pre-specified period of time.

12. Wireless Communicator Memory Expansion with Direct USB Connection

Embodiments of the present invention relate to wireless communicator **100** and a USB disk drive. The USB disk drive is situated within an enhanced function jacket, referred to herein as USB jacket **200**. USB jacket **200** includes a keypad, and attaches to wireless communicator **100**.

When wireless communicator **100** is pouched with USB jacket **200**, each device enhances the other. Wireless communicator **100** is enhanced by having additional storage and USB connectivity, and USB jacket **200** is enhanced by have wireless communication capability. Wireless communicator **100** may further enhance USB jacket **200** with additional capabilities including a music player and GPS location based services.

When wireless communicator **100** is pouched with USB jacket **200**, the jacket's keypad **280** is used to input commands for wireless communicator **100**. Such commands for wireless communicator **100** include inter alia dialing a phone call, playing music, and commands for location based applications.

When wireless communicator **100** is not pouched with USB jacket **200**, the jacket's keypad **280** may be used to input commands for the USB disk drive. Such commands for the USB disk drive include inter alia locking and unlocking the USB disk drive using a password.

Reference is now made to FIGS. **57**A and **57**B, which are illustrations of wireless communicator **100** pouched with USB jacket **200** in accordance with an embodiment of the present invention. USB jacket **200** has a storage and functions as a USB disk drive. USB jacket **200** has a USB connector **255** and, as such, USB jacket **200** is readily plugged into a personal computer, or such other device having a USB receptacle.

USB connector **255** is mechanically fastened so that it slides into USB jacket **200**. USB jacket **200** includes a strap **289** which, when pulled, causes USB connector **255** to slide back out.

In accordance with an embodiment of the present invention, when wireless communicator **100** is pouched with USB jacket **200**, USB jacket **200** enhances the capabilities of wireless communicator **100** by providing inter alia additional storage and USB connectivity. Similarly, wireless communicator **100** enhances USB jacket **200** with wireless communication, and may further enhance USB jacket **200** with GPS location based services, speaker capability, and headset support.

The USB jacket's keyboard **280** has dual functionality. When wireless communicator **100** is not pouched with USB jacket **200**, keyboard **280** is used to operate USB jacket **200**. For example, keyboard **280** may be used to lock the storage of USB jacket **200** using a password; i.e., the disk drive of USB jacket **200** may be locked and unlocked by entering a password using keyboard **280**. When wireless communicator **100** is pouched with USB jacket **200**, then keyboard **280** is used to operate wireless communicator **100**.

Reference is now made to FIG. **58**, which is a simplified block diagram of wireless communicator **100** and USB jacket **200** in accordance with an embodiment of the present invention. Wireless communicator **100** is shown in FIG. **58** with six primary components; namely, pouching controller **110**, storage **115**, modem **120**, power management subsystem **125**, power amplifier **135** and pouch connector **160**. Wireless communicator **100** is shown with four optional components; namely, audio subsystem **130**, keyboard **180**, display **185** and SIM **190**.

USB jacket **200** is shown in FIG. **58** with six primary components; namely, storage controller **205**, pouching controller **210**, storage **215**, USB connector **255**, pouch connector **260** and keyboard **280**. USB jacket **200** is shown with an optional USB hub **257** and optional display **285**.

In the embodiment shown in FIG. **58**, keyboard **280** is connected to storage controller **205**, which interprets the keyboard scan codes. Storage controller **205** mediates between keyboard **280** and a USB connected device, such as a personal computer, connected to USB connector **255**.

In general, a USB hub allows many USB devices to be connected to a single USB port. USB hub **257** is connected via a USB line to modem **120** or to pouching controller **110** of wireless communicator **100**, or to both of them. USB hub **257** enables a device connected to USB connector **255** to access both storage **215** and storage **115**.

In the embodiment shown in FIG. **58**, access to storage **115** is made via USB hub **257**, without passing through pouching controller **210**.

In the embodiment shown in FIG. **58**, keyboard **280** is connected to storage controller **205** and pouching controller **210**. When wireless communicator **100** is pouched with USB jacket **200**, pouching controller **210** scans the matrix keyboard for keyboard **280**, and passes the scan-code to wireless communicator **100**. To avoid ambiguity, only pouching controller **210** initiates the matrix keyboard scanning.

Reference is now made to FIG. **59**, which is a simplified block diagram of wireless communicator **100** and USB jacket **200**, in accordance with a second embodiment of the present invention. The USB jacket shown in FIG. **57** includes pouching controller **210**, USB connector **255**, pouch connector **260** and keyboard **280**.

In addition, the USB jacket in FIG. **59** includes a micro-SD card **296**, a single-pole double-throw (SPDT) switch **292**, and a USB2SD bridge **293** between USB to SD. The AU6336 SD/MMC card reader controller manufactured by Alcor Micro, Corp. of Taiwan, may be used for USB2SD bridge **293**. Micro-SD card **296** includes a controller **297** and a storage **298**. It is noted that in distinction, the jacket controller and storage are separate components in the embodiment shown in FIG. **58**. SPDT switch **292** is controlled by pouching controller **210**, and enables connection of USB jacket **200** with wireless communicator **100** directly via modem **120** or via pouching controller **110**. A proprietary command over the USB channel, such as an SCSI transparent method, instructs pouching controller **210** to changes the state of SPDT **292**.

It will be appreciated by those skilled in the art that The system of FIG. **9** enables a USB host device that is connected to USB Jacket **200** via USB interface **255** to directly access storage **298**, by translating the USB protocol into the SD protocol, and routing through pouching controller **210**, or to indirectly access storage **115**.

Pouching controller **210** dynamically routes access to appropriate storage **115** or **298** to the USB host device. Pouching so controller **210** introduces the USB host device to both storage **115** and **298**, as a combined storage area or as two separate storage areas.

13. Modular Audio Player that Pouches with a Host Media Player

Embodiments of the present invention relate to a modular audio player, referred to herein as the "modular player", that may be pouched with a digital media player, referred to herein as the "host" or the "host player", such as an MP3 player that may be pouched with an MP3/MP4 player. Both players have memories for storing digital files, and the host's controller or the modular audio player's controller, or both controllers, are able to automatically or manually synchronize files stored in the two memories.

The host player has its own battery, its own non-volatile memory for storing media files, and its own controller. The host player generally includes a display, and includes user interface controls to organize, select, play and view metadata for songs or video files.

The modular player may be hosted by the host player when pouched therewith. The modular player is also a standalone audio player, but with limited features in comparison to the host player. The modular player includes its own battery sub-system, its own removable non-volatile memory for storing digital audio files, and its own controller. The modular player also includes a wireless modem, including inter alia a cellular modem, a WLAN modem or a WiMax modem, which enables download of digital media files from remote sources. The modular player generally does not have its own display, and generally has a limited user interface to play a song, to advance to a next song, and to return to the beginning of a song.

The modular player is used in circumstances where it is convenient for a user to handle a small player. When a user is jogging, for example, it is easier for him to carry a small player.

The media files played by either player may be obtained via the host's connection to remote media sources, via physical USB or SD connection, or via wireless connection. The media files may also be obtained via the modular player's wireless modem connection. Media files obtained via the modular player's wireless modem may be transferred to the host player. As such, the modular player may be used to download files intended for the host player, such as video files, which generally cannot be played on the modular player.

In one embodiment of the present invention the host controller synchronizes the media files stored on the host player and the modular player. In another embodiment of the present

invention, the modular player's controller synchronizes the media files stored on the host player and the modular player. Synchronization of media files is based primarily on the media formats that each player supports. Generally, the modular player supports only audio formats, such as MP3 formats, where the host player supports also video formats, such as MP4 formats. As such, when the two players interact to synchronize their respective memories, only files supported by each player are stored in the player.

Additionally, synchronization is governed by user preferences. For example, a user may specify that those songs which are most often played or most recently played, or which have high rankings, are to be shared on both players.

Reference is now made to FIGS. **60**A and **60**B, which are simplified block diagrams of a modular audio player pouched with a digital media player in accordance with an embodiment of the present invention. Shown in FIGS. **60**A and **60**B are a host media player **200***c* and a modular audio player **100**. Modular audio player **100** can be pouched with host media player **200***c*. Modular audio player **100** slides in and out of host media player **200***c* along tracks **261***c*. Host media player **200***c* and modular audio player **100** are operative to play songs stored in digital audio files. Host player **200***c* is also operative to play video files.

Host media player **200***c* includes a player module **230***c*. Host player **200***c* also includes a storage unit **215***c*, which is generally HD or flash memory, for storing digital media files. Host media player **200***c* also includes a battery subsystem **225***c* for powering player module **230***c*.

Modular audio player **100** includes a player module **130**. Modular audio player **130** also includes a storage unit **115**, which is generally a built-in flash memory such as NAND flash or a detachable memory card such as an SD card, or both, for storing digital audio files.

Modular audio player **100** is powered by a battery subsystem **125** that includes a small removable battery. Battery subsystem **125** is charged by battery subsystem **225***c*, when modular audio player **100** is pouched with host player **200***c*. When modular audio player **100** is not pouched with host player **200***c*, it is powered by battery subsystem **125**, until the stored charge in battery subsystem **125** is exhausted. Battery subsystem **125** may also be charged from an external power source, via a charger, or via a USB connection.

Pouch connectors **160** and **260***c* are used to transfer data and power between host media player **200***c* and modular audio player **110**.

Incoming data may be transferred to host media player **200***c* via an external connector **255***c*, such as a USB port or an SD connector, or both. Host media player **200***c* may optionally include a wireless modem **220***c*, through which data is received from remote sources.

Modular audio player **100** includes a wireless modem **120***c*, which is generally a cellular modem.

Host player **200***c* includes pouch controller **210***c*, and removable audio player **100** includes pouch controller **110**. Controllers **110** and **210** are operative to store incoming digital files on either or both of host memory **215***e* and removable player memory **115**, automatically or manually as instructed by a user. Synchronization of files between the host media player **200***c* and modular audio player **100** is described hereinbelow with respect to FIGS. **61** and **62**.

Host media player **200***e* is large enough to include a display **285***c*, for displaying command menus and song metadata to a user, and for displaying videos. Host media player **200***c* also includes user interface controls **270***c*, for organizing, playing and selecting media files. User interface controls **270***c* also enable a user to manage files stored in host memory **215***c* and removable player memory **115**. User interface controls **270***c* enable a user to select to which or both of memories **115** and **215***c* incoming files are to be saved. User interface controls **270***c* also enable a user to add and delete files from memories **115** and **215***c*, and to copy media files from one memory to another.

As distinct from host media player **200***c*, modular audio player **100** may not have a display at all, or may have a simple LCD display **185**. Modular audio player **100** includes limited user interface controls **170** including a small keyboard **180**. Keyboard **180** enables a user to perform basic functions, including inter alia playing a song, advancing to a next song, and returning to the beginning of a song.

Host media player **200***c* may or may not be operative to play media when modular player **100** is not pouched therewith.

It will be appreciated by those skilled in the art that the configuration illustrated in FIGS. **60**A and **60**B is but one of many possible implementations of the present invention, and that the various components in FIGS. **60**A and **60**B may be positioned and inter-connected differently than the specific configuration illustrated in FIGS. **60**A and **60**B, within the scope of the present invention.

Reference is now made to FIG. **61**, which is a simplified flowchart of a method for synchronizing media files between host media player **200***c* and modular audio player **100**, when the media files are received by modular audio player **100** in accordance with an embodiment of the present invention. At step **2805** new media files are downloaded via cellular wireless modem **120** of modular audio player **100**. At step **2810** the files are stored in a temporary allocated memory of storage **115**, and marked as new files. The new files are classified as being audio files or other files.

At step **2815** a determination is made whether or not modular audio player **100** is currently pouched with host media player **200***c*. If so, then at step **2820** a determination is made whether there are more new files to process. If so, then at step **2825** processing advances to the next new file. At step **2830** a message is sent to host media player **200***c*, indicating that there is a media update. At step **2835** a determination is made whether the new file currently being processed is an audio file. If so, then at step **2840** a duplicate copy of the file is written to storage **215***c* of host media player **200***c*. Processing then advances to step **2820**, to process the next file. If all of the new files have already been processed, then the synchronization ends. If the new file currently being processed is not an audio file, as determined at step **2835**, then at step **2845** the file is copied to storage **215***c* of host media player **200***c*, and at step **2850** the new files is erased from storage **115**. Processing then advances to step **2820**.

If modular audio player **100** is not currently pouched with host media player **200***c*, as determined at step **2715**, then at step **2855** a determination is made whether there are more new files to process. If so, then at step **2860** processing advances to the next new file. At step **2865** a determination is made whether the new file currently being processed is an audio file. If not, then at step **2870** a determination is made, generally based on user preferences, whether or not to erase the new file from storage **115** or else to keep the new file in storage **115** until modular player **100** is subsequently attached to host player **200***c*. If so, then at step **2875** the new file is erased. Otherwise, at step **2880** no operation is required. Processing then advances to step **2855**, to process the next file. If the new file currently being processed is an audio file, as determined at step **2865**, then at step **2880** no operation is required. When modular audio player **100** is subsequently attached to host media player **200***c*, the new audio files in

storage **115** may be transferred to host storage **215***c*. Processing then advances to step **2855**.

Reference is now made to FIG. **62**, which is a simplified flowchart of a method for synchronizing media files between host media player **200***c* and modular audio player **100**, when the media files are received by host player **200***c* in accordance with an embodiment of the present invention. At step **2905** new media files are received by host media player **200***c*, via wireless modem **220***c* or external connector **255***c*. At step **2910** the files are stored in host memory **215***c* and marked as new files. The new files are classified as being audio files or other files.

At step **2915** a determination is made whether modular audio player **100** is currently pouched with host media player **200***c*. If so, then at step **2920** a determination is made whether there are more new media files to process. If so, processing advances to the next new media file at step **2925**. At step **2930** a determination is made whether the new media file currently being processed is an audio file. If so, then at step **2935** the new file is copied to storage **115**. Processing then advances to step **2920**, to process the next new file. If all of the new files have been processed, then the synchronization ends. If the new file currently being processed is not an audio file, as determined at step **2930**, then processing advances directly to step **2920**.

If modular audio player **100** is not currently pouched with host media player **200***c*, as determined at step **2915**, then at step **2940** no operation is required, and the new files may be transferred to modular audio player **100** when it is subsequently pouched with host media player **200***c*. The synchronization then ends.

Reference is now made to FIG. **63**, which is a simplified flowchart of operations carried out when modular audio player **100** is pouched with host media player **200***c* in accordance with an embodiment of the present invention. At step **3005** modular audio player **100** is pouched with host media player **200***c*. When the two players are pouched, host player **200***c* receives a corresponding interrupt, and is thus informed of the pouching at step **3010**. Such interrupt may be implemented as an SDIO interrupt on the SD bus, or via a dedicated signal.

At step **3020**, memories **115** and **215***c* are searched and a determination is made whether there are new media files in one or both of the memories. If so, then the host player are modular player are synchronized in accordance with FIGS. **61** and **62**. Specifically, steps **2820-2850** are performed to copy new files from memory **115** to memory **215***c*, and steps **2920-2935** are performed to copy new files from memory **215***c* to memory **115**.

Processing then proceeds to step **3025**, whereat the players are synchronized according to predefined user preferences. User preferences may indicate, for example, that all audio files are synchronized, subject to memory availability; or that audio files most often or more frequently listened to are synchronized, subject to memory availability; or that audio files with high user ratings are synchronized, subject to memory availability.

If there are no new media files in memories **115** and **215***c*, as determined at step **3020**, the processing proceeds directly to step **3025**. After step **3025**, the synchronization ends.

In the foregoing specification, the invention has been described with reference to specific exemplary embodiments thereof. It will, however, be evident that various modifications and changes may be made to the specific exemplary embodiments without departing from the broader spirit and scope of the invention as set forth in the appended claims. Accordingly, the specification and drawings are to be regarded in an illustrative rather than a restrictive sense.

What is claimed is:

**1**. A wireless communicator comprising:

a housing;

wireless communication functionality located within said housing; and

pouching responsive electrical interconnection functionality responsive to pouching orientation of said housing in a pouch of an enhanced function device for causing said wireless communication functionality to authenticate itself to the enhanced function device by (i) generating a random number, A, (ii) encrypting A using a public key of the enhanced function device, (iii) transmitting the encrypted A to the enhanced function device, (iv) receiving an encrypted number, B, from the enhanced function device, encrypted using a public key of the wireless communicator, (iv) decrypting B using a private key of the wireless communicator, (v) encrypting the product A*B using the public key of the enhanced function device, and (vi) further transmitting the encrypted A*B to the enhanced function device.

**2**. A wireless communicator comprising:

a housing;

wireless communication functionality located within said housing; and

pouching responsive electrical interconnection functionality responsive to pouching orientation of said housing in a pouch of an enhanced function device for causing said wireless communication functionality to authenticate the enhanced function device by (i) receiving an encrypted number, A, from the enhanced function device, encrypted using a public key of the wireless communicator, (ii) decrypting A using a private key of the wireless communicator, (iii) generating a random number, B, (iv) encrypting B using a public key of the enhanced function device, (v) transmitting the encrypted B to the enhanced function device, (vi) further receiving the encrypted number, C, from the enhanced function device, encrypted using a public key of the wireless communicator, and (vii) verifying that C=A*B.

**3**. A method for a pouchable wireless communicator, comprising, in response to orienting the wireless communicator in a pouch of an enhanced function device, authenticating itself to the enhanced function device, comprising:

generating a random number, A;

encrypting A using a public key of the enhanced function device;

transmitting the encrypted A to the enhanced function device;

receiving an encrypted number, B, from the enhanced function device, encrypted using a public key of the wireless communicator;

decrypting B using a private key of the wireless communicator;

encrypting the product A*B using the public key of the enhanced function device; and

further transmitting the encrypted A*B to the enhanced function device.

**4**. A method for a pouchable wireless communicator, comprising, in response to orienting the wireless communicator in a pouch of an enhanced function device, authenticating the enhanced function device, comprising:

receiving an encrypted number, A, from the enhanced function device, encrypted using a public key of the wireless communicator;

decrypting A using a private key of the wireless communicator, generating a random number, B;

encrypting B using a public key of the enhanced function device;

transmitting the encrypted B to the enhanced function device;

further receiving the encrypted number, C, from the enhanced function device, encrypted using a public key of the wireless communicator; and

verifying that C=A*B.

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