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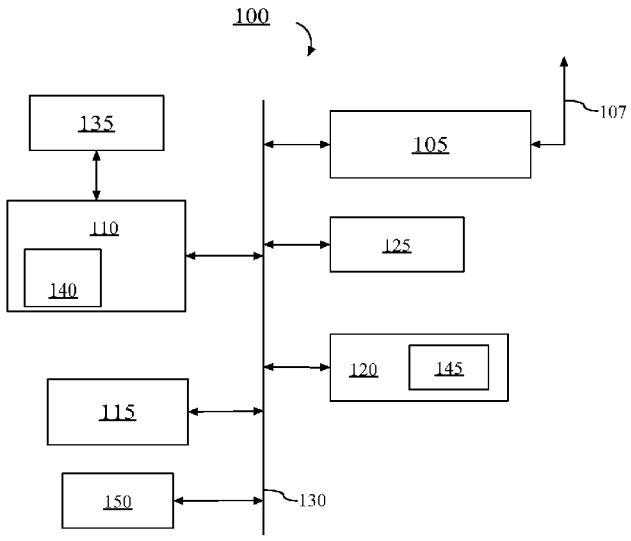
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(54) **Title:** METHOD, SYSTEM, AND APPARATUS FOR ENERGY CONSUMPTION ESTIMATION IN A WIRELESS TERMINAL



(57) **Abstract:** An embodiment generally relates to a method of estimating power consumption in a wireless device. The method includes receiving a request to execute an application on the wireless device and determining at least one key parameter of a set of key parameters associated with the application. The method also includes determining estimated power consumption based on at least one key parameter for the wireless device. Accordingly, a user may be warned that the estimated energy consumption has enough battery life to perform the requested application/service if a duration parameter is provided or the battery life is sufficient if the application/service is continues in the event that duration information is not provided.

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METHOD, SYSTEM, AND APPARATUS FOR ENERGY CONSUMPTION ESTIMATION IN A WIRELESS TERMINAL

FIELD OF THE DISCLOSURE

[0001] This invention relates generally to energy management, more particularly, to a method, system, and handset for energy consumption estimation.

BACKGROUND

[0002] Recently, the expectations for cellular telephone and other wireless devices were focused on being able to reliably conduct voice calls. However, technological innovations have provided additional services and/or applications to be implemented on these devices. For example, television broadcast, video streaming, large file downloads, etc., are now integrated into the communication infrastructure supporting these wireless devices.

[0003] Although the new applications/services are useful, they consumer additional energy from the battery. For example, a television broadcast will use significant CPU time, radio frequency (RF) resources, and memory transfers, which all put a demand on the battery for an extended period of time. As a result, the "battery power meter", commonly used on embedded systems such as cellular telephones, is not reliable enough to determine whether or not the phone is capable of executing a highly energy consuming unique service/application for an extended period of time.

[0004] Many patents describe and technologies exist that predict battery life. However, all these technologies are focused on battery voltages and

charging studies or they are based on some general user activity profile. For example, European patent application, EP1588176 to Schoch Eberhard (published on 27 October 2005) describes a charge predictor that determines the available charge from a current discharge curve that represents the electrical properties of the battery and a condition value or parameter estimator that uses actual operating values (U_{batt}, I_{batt}, C_{batt}) of the battery to calculate battery operating values (Z) or parameters (P) for the mathematical battery model. Thus, conventional battery prediction technologies do not predict based on the unique attributes of a selected application/service. Moreover, conventional technologies may not predict on critical parameters of a selected application/service such as service duration, average network transfer speed, data format to profile energy consumption.

BRIEF DESCRIPTION OF THE DRAWINGS

[0005] Various features of the embodiments can be more fully appreciated, as the same become better understood with reference to the following detailed description of the embodiments when considered in connection with the accompanying figures, in which:

[0006] FIG. 1 illustrates an exemplary mobile device in accordance with an embodiment;

[0007] FIG. 2 illustrates an exemplary system where a mobile device can operate in accordance with another embodiment;

[0008] FIG. 3 illustrates an exemplary flow diagram in accordance with yet another embodiment; and

[0009] FIG. 4 illustrates an exemplary profile in accordance with yet another embodiment.

DETAILED DESCRIPTION

[0010] For simplicity and illustrative purposes, the principles of the present invention are described by referring mainly to exemplary embodiments thereof. However, one of ordinary skill in the art would readily recognize that the same principles are equally applicable to, and can be implemented in, all types of embedded systems, and that any such variations do not depart from the true spirit and scope of the present invention. Moreover, in the following detailed description, references are made to the accompanying figures, which illustrate specific embodiments. Electrical, mechanical, logical and structural changes may be made to the embodiments without departing from the spirit and scope of the present invention. The following detailed description is, therefore, not to be taken in a limiting sense and the scope of the present invention is defined by the appended claims and their equivalents.

[0011] Embodiments generally relate to a methods, systems, and apparatus for predicting power usage for an application. More specifically, an estimate module may be configured to request and/or retrieve key parameters from both the mobile terminal and the service provider of the requested application/service to provide a power usage estimate for the requested application/service.

[0012] An estimate module executing on the mobile terminal may query for a set of parameters or characteristics from the application/service in response to a request to run the application/service. Alternatively, a profile may be associated with the application and stored on the mobile terminal, where the profile includes the set of parameters. Each set of parameters for the respective application/service may be determined by the application/service developer or the service provider. This set of parameters is unique and specific to the targeted application/service.

[0013] The set of parameters may provide the estimate module the information necessary to generate an energy consumption estimate. The set of parameters may comprise a subset of parameters that have to be obtained from the service provider of the requested application/service and a subset of parameters that can be obtained from the mobile terminal or device. For example, the estimate module may request a subset of parameters from a service provider such as program duration, frequency of use of radio resources, data format to decode for a digital video broadcast-handheld (DVB-H) service. The estimate module may also retrieve a subset of parameters from the mobile terminal such as current state of battery charge, current CPU load and memory usage. With the set of parameters, an estimate of the energy consumption is calculated based on mathematical weighting formula. Subsequently, the estimate module may inform the user of the impact of the requested application on the battery level of the mobile terminal.

[0014] The estimate module may be configured to store a set of key parameters for each application/service. Each set of key parameters for the respective application/service may be determined by the application/service

developer or the service provider. This set of key parameters is unique and specific to the targeted application/service.

[0015] FIG. 1 illustrates an exemplary embodiment of a mobile terminal 100 in accordance with an embodiment. It should be readily apparent to those of ordinary skill in the art that the mobile terminal 100 depicted in FIG. 1 represents a generalized schematic illustration and that other components may be added or existing components may be removed or modified. Moreover, the mobile terminal 100 may be implemented using software components, hardware components, or combinations thereof.

[0016] As shown in FIG. 1, the mobile terminal 100 may include a communication interface 105, a processor 110, a user interface 115, a display module 120, and storage 125. The communication interface 105 may be configured to facilitate communication with a base station of a wireless communication network such as a 3G/ Universal Mobile Telecommunications System or other similar data oriented networks. More particularly, the communication interface 105 may transmit and receive digital voice packets through a radio frequency (RF) antenna 107. The communication interface 105 may also be configured to interface with a shared bus 130. Transmitting voice packets may be forwarded from the user interface 115 to the communication interface 105 over the shared bus 130 as well as received voice packets forwarded to the user interface 115 over the shared bus 130.

[0017] Processor 110 may be configured to interface with the shared bus 130. The processor 110 may be configured to implement the software that embodies the functionality of the mobile terminal 100, which may be stored in

processor memory 135. The processor memory 135 may be programmable read only memory, flash memory or similar type of high speed persistent storage. Processor 110 may be an application specific integrated circuit, programmable field gate array, a microprocessor, digital signal processor or similar type of computing platform.

[0018] Storage 125 may be configured to store information for a user of the mobile terminal 100. For example, a contact list, downloaded music, and/or digital images may be stored in storage 125. The storage 125 may be implemented using a persistent storage such as flash memory. In some embodiments, the storage function of the processor memory 135 may be provided by storage 125.

[0019] User interface 115 may be configured to interface with the shared bus 130. The user interface 115 may also be configured to facilitate interaction with a user. As such, the user interface 115 may include media input and output mechanisms. For example, to facilitate voice communications, these mechanisms may include a microphone (not shown) for receiving analog speech signals from a user and a speaker (not shown) for playing out analog speech signals to a user. Further, the mobile terminal 100 may include digital/analog media signals and digital representations of those signals, for example, soft button on a keyless display.

[0020] The user interface 115 may also include a keypad (not shown). The keypad may be a Bell keypad, a QWERTY keyboard or similar mechanisms. In some embodiments, the keypad may be emulated on the display 120. The display 120 may be configured to provide a visual interface to assist in the

access of the mobile terminal 100. For example, the display 120 may display a telephone number as entered by the user of the mobile terminal 100. The display 120 may also be configured to display a battery power level indicator 145, for example, an icon or graphical element, for the power source 150.

[0021] The power source 150 may be configured to provide the power to operate the mobile terminal 100. The power source 150 may be a rechargeable battery such as lithium-ion battery. The power source 150 may also include circuitry to determine the amount of charge in the power source 150 as known to those skilled in the art.

[0022] In accordance with various embodiments, the processor 110 may be configured to execute an estimate module 140. More particularly, the estimate module 140 may be configured to request and/or retrieve parameters to perform a power usage estimate for a requested application/service. In some embodiments, the parameters may be determined in a profile associated with the requested application/service.

[0023] When a user requests to run an application/service on the mobile terminal 100, the estimate module 140 may be configured to query for parameters related to the requested application/service from the requested application. The requested application may return a set of parameters which permit the estimate module 140 to calculate an energy consumption estimate. The set of parameters may include a subset of parameters that may be obtained from the service provider of the request application/service as well as a subset of parameters that may be obtained from the mobile terminal 100. The set of parameters may be determined by the service provider for each provided

application/service. For example, the estimate module 140 may request service provider parameters such as program duration, frequency of use of radio resources, and data format to decode for a DVB-H service. The estimate module 140 may also retrieve values for mobile terminal parameters such as current state of battery charge, current CPU load and memory usage. With a complete set of parameters, an estimate of the energy consumption is calculated based on a mathematical weighting formula that is customized to the requested application/service. For example, an estimation of a video streaming is shown in equation (1)

$$E_c = W_1 \cdot (D_S) \cdot (P_L^2) + W_2 \cdot (V_{fr}) + W_3 \cdot S_l + W_4 \frac{T_{avg}}{v_{bt}} \qquad \textbf{(1)}$$

where, E_c is energy consumption; D_s is the size of the display; P_L is the length of the program; V_{fr} is the video framerate; S_l is the sound level; T_{avg} is the average throughput; v_{bt} is the video bitrate; and W_n are weighting coefficients dependent on architecture and implementation of the network. Subsequently, the estimate module 140 may inform the user of the impact of the requested application on the battery level of the mobile terminal 100.

[0024] In some embodiments, the estimate module 140 may be configured to store a set of parameters for each application/service. More specifically, a profile may be created for each application or service that contains the set of parameters. The profile may then be downloaded and stored in the mobile terminal 100. Thus, the estimate module 140 may access the profile to determine the set of parameters for a requested application/service.

[0025] Accordingly, the estimate module 140 may assist a user in the management of the battery life of the mobile terminal 100. When a user selects

an application or service, the user can be notified of the impact of the requested application/service on the power life of the mobile terminal 100. If the requested application/service drains the power source 150 of the mobile terminal 100, the user may modify or cancel the requested application/service to comply with the remaining battery life. Thus, a user may maximize the operating time of the mobile terminal 100.

[0026] FIG. 2 illustrates an exemplary system 200 in accordance with another embodiment. It should be readily apparent to those of ordinary skill in the art that the system 200 depicted in FIG. 2 represents a generalized schematic illustration and that other components may be added or existing components may be removed or modified. Moreover, the system 200 may be implemented using software components, hardware components, or combinations thereof.

[0027] As shown in FIG. 2, the system 200 includes access cells 205. The access cells 205 may interface with a public switched telephone network ("PSTN") 210. The access cells 205 may also interface with an Internet Protocol ("IP") network 215. The IP network 215 may be the internet, a private local area network, a private wide area network, or combinations thereof.

[0028] Each access cell 205 may include an enhanced base transceiver station ("EBTS") 220. The EBTS 220 may be configured to transmit and receive voice packets from mobile devices 100 within the coverage area of the EBTS 220. The EBTS 220 may also include a service integration module (not shown) that is configured to determine the current state of each mobile device in the coverage area of the EBTS 220.

[0029] The EBTS 220 may interface with an interconnect call module 225 and an IP services module 230. The interconnect call module 225 may include a base site controller ("BSC") 235 coupled with a mobile switching center ("MSC") 240 for handling cellular and circuit switched calls. The MSC 240 may also be interfaced with a home location and visitor location registers (not shown) for providing mobility management as known in the art. The BSC 235 can provide control and concentration functions for one or more EBTS sites and their associated mobile terminals 100.

[0030] The IP services module 230 may be configured to provide Internet protocol services for the mobile terminals 100. For example, push-to-talk communication, internet browsing, video streaming, television broadcasts, email functions, and other similar services may be provided through the IP services module 230.

[0031] Service/application servers 245 may be accessed through the IP network 215 via the access cells 205. The service/application servers 245 may provide respective applications/services for the mobile terminals 100, for example, DVB-H broadcasts, web radio, digital audio broadcasting, audio streaming, etc. The user may access these service/application servers 245 through their mobile terminals as known to those skilled in the art. The service application servers 245 may be interfaced with the service providers 250 to provide the requested application/service to the user.

[0032] Accordingly, when a user requests a selected service or application from a service/application server 245 through the user interface 115 of the

mobile terminal 100, the estimate module 140 may request a set of parameters from the requested application/service residing on service/application server 245. The estimate module 140 may be configured to retrieve values for the received set of parameters. Thus, the estimate module 140 may query the service provider 250 for service provider parameters and the mobile terminal 100 for mobile terminal parameters. Based on the retrieved values of the set of parameters, an energy consumption estimate may be determined. The estimate module 140 may be further configured to indicate the impact of the energy consumption estimate on the current battery level of the mobile terminal.

[0033] FIG. 3 illustrates a process flow diagram 300 executed in the system in accordance with an embodiment. It should be readily apparent to those of ordinary skill in the art that the process flow diagram 300 depicted in FIG. 3 represents a generalized schematic illustration and that other steps may be added or existing steps may be removed or modified.

[0034] As shown in FIG. 3, user 305 may request to execute an application or service on the mobile terminal 100, in step 310. More specifically, a user may select an application or service on the mobile terminal 100 through the user interface 115. Application and/or service may be provided by the provider of network 200 or the user may have downloaded applications into the mobile terminal 100.

[0035] In step 315, the estimate module 140 requests a set of parameters from the selected service/application 245. The selected service/application 245 may return a list of parameters that are to be used by the estimate module 140 to determine an energy consumption estimate, in step 320. In some

embodiments, instead of querying the application for the set of parameters, the mobile terminal 100 may also store an associated profile with an application (or service) which includes the set of parameters. The profile may be provided by the developer or provider of the application/service.

[0036] As an example of a set of parameters, FIG. 4 illustrates a list of parameters for a DVB-H service. As shown in FIG. 4, the list of parameters (or profile) 400 may be data structure such as a table, linked list, or other similar structure. The profile 400 may optionally include a title record 405 which describes the application. The profile 400 may also optionally include a record comprising a parameter field 410a and a source field 410b. The parameter field 410a may define a parameter of the application/service. The source field 410b may define where the value of the respective parameter may be retrieved. Records 415-425 illustrate an exemplary subset of parameters (CPU load, memory usage, current battery level, respectively) that can be retrieved internally, i.e., from the mobile terminal 100. Records 430-440 illustrate an exemplary subset of parameters (program duration, data format, and frequency, respectively) that can be retrieved from the service provider 250.

[0037] Returning to FIG. 3, having received or retrieved the set of parameters, the estimate module 140 may retrieve the mobile terminal parameters from the set of parameters, in step 330. The estimate module 140 may then query the service provider 250 for the service provider of parameters, in step 330.

[0038] In step 335, the service provider 250 may return the requested values for the service provider parameters. In step 340, the estimate module

140 may be configured to calculate the energy consumption estimate based on a mathematical weighted formula or heuristic optimized for the application/service.

[0039] In step 345, the estimate module 140 may be configured to indicate to the user on the user interface 115 the impact that the requested application has on the current battery level. For example, if the requested application/service exceeds the current battery life, the estimate module 140 may display a message that the requested application may induce a power-off within 20 minutes. In step 350, the user may then decide whether or not he wants to execute or modify the selected application or service.

[0040] Certain embodiments may be performed as a computer program. The computer program may exist in a variety of forms both active and inactive. For example, the computer program can exist as software program(s) comprised of program instructions in source code, object code, executable code or other formats; firmware program(s); or hardware description language (HDL) files. Any of the above can be embodied on a computer readable medium, which include storage devices and signals, in compressed or uncompressed form. Exemplary computer readable storage devices include conventional computer system RAM (random access memory), ROM (read-only memory), EPROM (erasable, programmable ROM), EEPROM (electrically erasable, programmable ROM), and magnetic or optical disks or tapes. Exemplary computer readable signals, whether modulated using a carrier or not, are signals that a computer system hosting or running the present invention can be configured to access, including signals downloaded through the Internet or other networks. Concrete examples of the foregoing include

distribution of executable software program(s) of the computer program on a CD-ROM or via Internet download. In a sense, the Internet itself, as an abstract entity, is a computer readable medium. The same is true of computer networks in general.

[0041] While the invention has been described with reference to the exemplary embodiments thereof, those skilled in the art will be able to make various modifications to the described embodiments without departing from the true spirit and scope. The terms and descriptions used herein are set forth by way of illustration only and are not meant as limitations. In particular, although the method has been described by examples, the steps of the method may be performed in a different order than illustrated or simultaneously. Those skilled in the art will recognize that these and other variations are possible within the spirit and scope as defined in the following claims and their equivalents.

[0042] What is claimed is:

CLAIMS

1. A power consumption estimation method in a wireless communication device, the method comprising:

determining at least one key parameter of a set of key parameters associated with an application to be executed on the wireless communication device; and

determining an estimated power consumption based on at least one key parameter for the wireless communication device.

2. The method of claim 1, wherein the determining at least one key parameter of the set of key parameters associated with the application further comprises requesting at least one key parameter of the set of key parameters from a network.

3. The method of claim 2, wherein the set of key parameters includes a program duration, frequency of radio usage, and data format.

4. The method of claim 1, wherein the determining at least one key parameter of the set of key parameters associated with the application further comprises requesting at least one key parameter of the set of key parameters from a mobile terminal.

5. The method of claim 4, wherein the set of key parameters further comprises a current CPU load and memory usage.

6. The method of claim 1, determining the at least one key

parameter of the set of key parameters associated with an application embodies as a digital video broadcast-handheld application.

7. The method of claim 1, wherein the application is one of file download, a web radio, digital audio broadcast, and audio streaming.

8. The method of claim 1, wherein the determination of the estimated power consumption based on at least one key parameter further comprises determining the estimated power consumption based on a mathematical weighting formula.

9. An apparatus for performing the method of claim 1.

10. A computer-readable medium comprising computer-executable instructions for performing the method of claim 1.

11. An apparatus configured to estimate power consumption, the apparatus comprising:

a memory configured to store a plurality of profiles, each profile associated with an application, each profile comprising a set of parameters for the associated application;

a device interface configured to provide a communication channel between the apparatus and a network;

a processor interfaced with the memory; and

an estimate module configured to be stored in the memory and executed by the processor, wherein the estimate module is configured to determine a set of parameters for a selected application and determine an

estimated power consumption based on the set of parameters.

12. The system of claim 11, wherein the estimate module is further configured to execute a mathematical weighting formula to determine the estimated power consumption.

13. The system of claim 11, further comprising a battery configured to provide power to the apparatus and a battery level indicator configured to indicate an amount of power remaining in the battery.

14. The system of claim 13, wherein the estimate module is configured to indicate an effect of the estimated power consumption on a battery level of the apparatus.

15. The system of claim 11, wherein the plurality of profiles are provided by a developer of an application.

16. A system to provide a power consumption estimate, the system comprising:

a network configured to store and provide data;

a mobile device configured to interface with the network through a network interface and powered by a battery, wherein the mobile device further comprises a processor configured to determine a plurality of values, each value associated with a parameter of a selected service, determine an estimated power consumption for the selected service, and indicate an impact of the estimated power consumption on an amount of power stored on the battery.

17. The system of claim 17, wherein the processor is further configured to execute a mathematical weighting formula to determine the estimated power consumption.

18. The system of claim 16, wherein the processor is further configured to query the network for a subset of the plurality of values.

19. The system of claim 16, wherein the processor is further configured to query the mobile device for a subset of the plurality of values.

20. The system of claim 16, wherein the service is one of a download service, a text messaging service, a video broadcast and a mapping service.

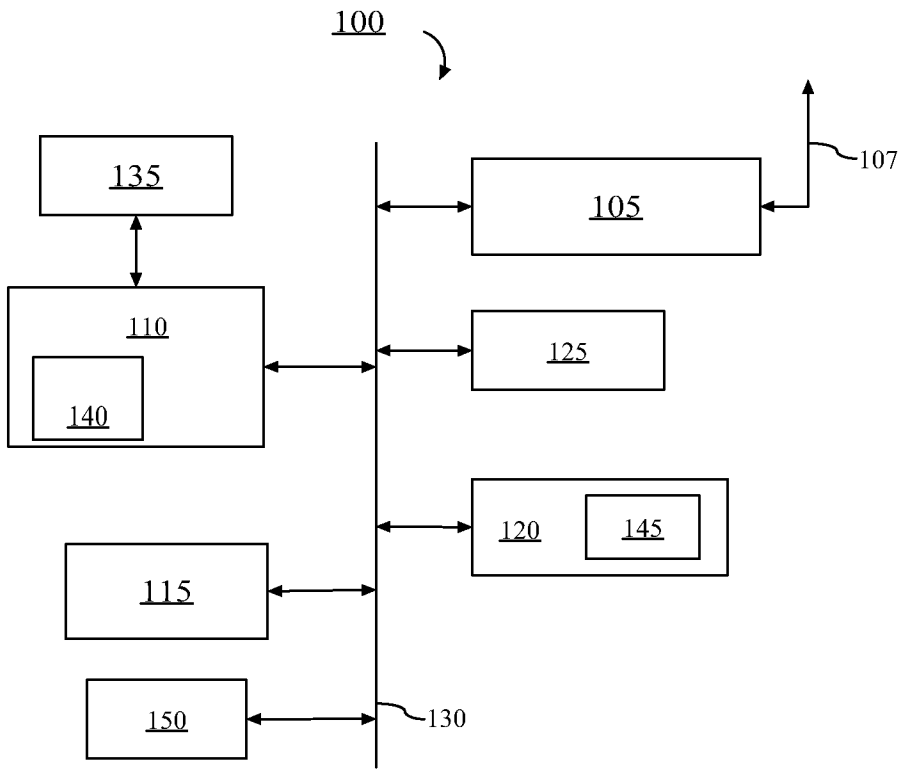


FIG. 1

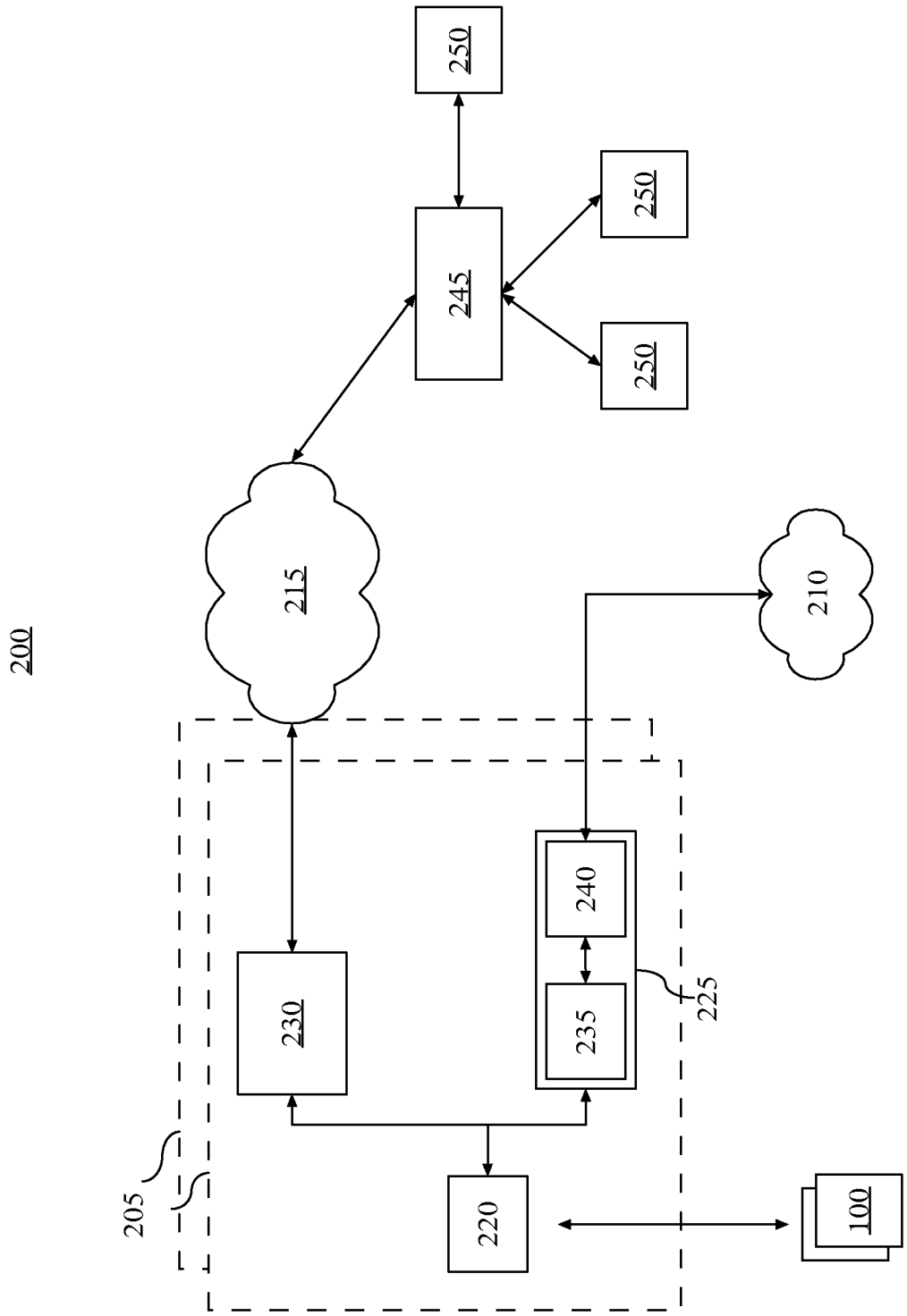


FIG. 2

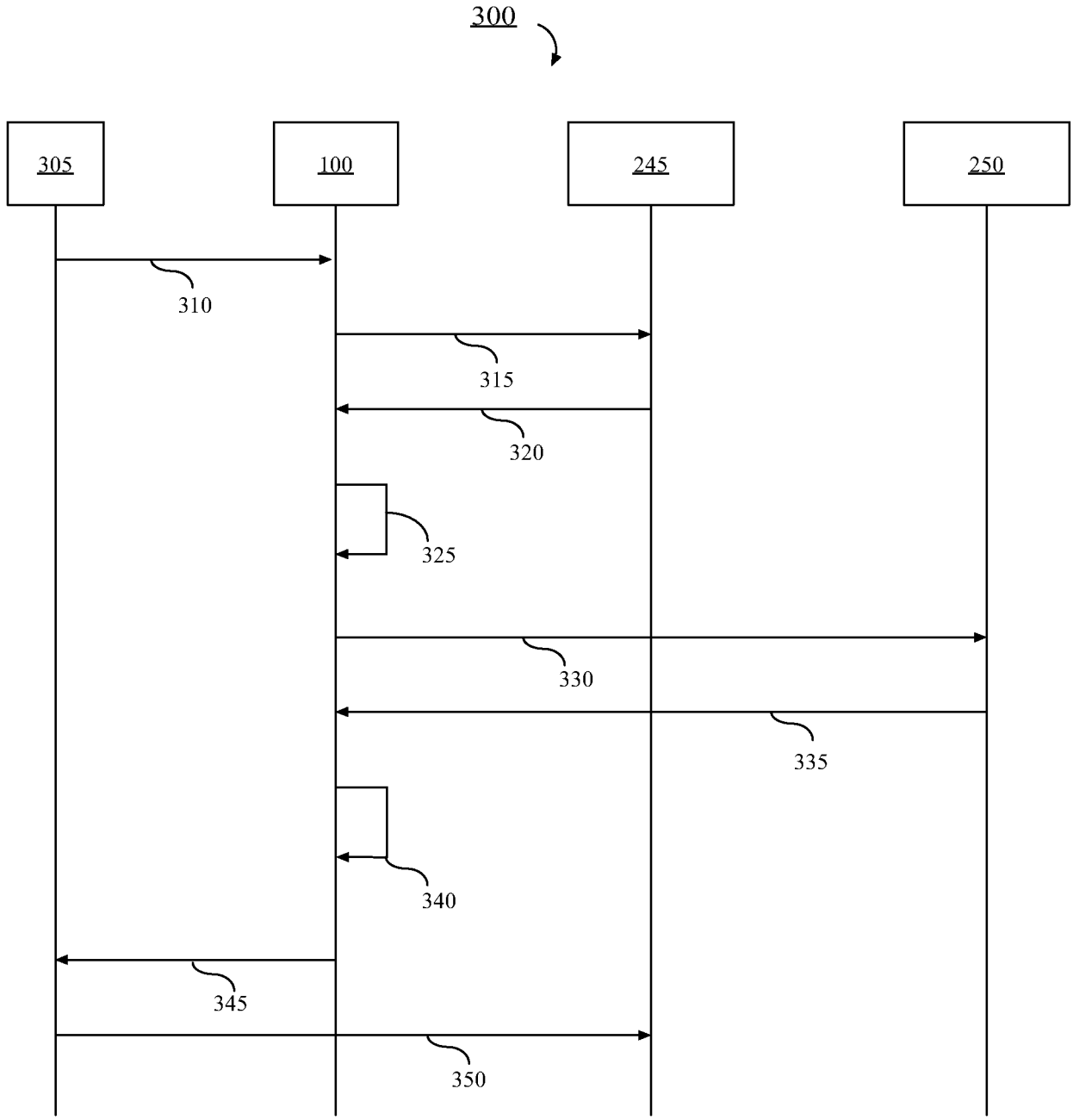


FIG. 3

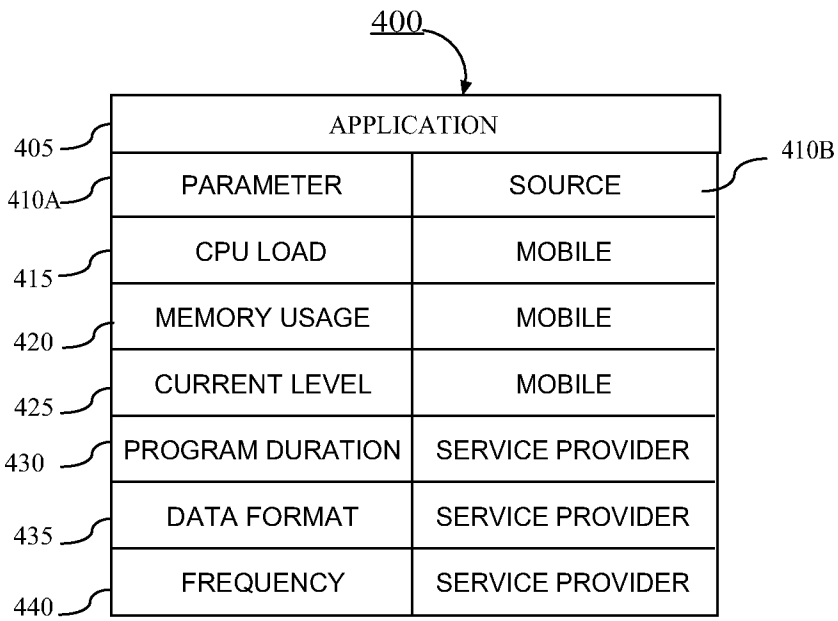

400
APPLICATION
405
410A
410B
PARAMETER
SOURCE
415
CPU LOAD
MOBILE
420
MEMORY USAGE
MOBILE
425
CURRENT LEVEL
MOBILE
430
PROGRAM DURATION
SERVICE PROVIDER
435
DATA FORMAT
SERVICE PROVIDER
440
FREQUENCY
SERVICE PROVIDER

FIG. 4

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2007/073307

A. CLASSIFICATION OF SUBJECT MATTER
INV. H04Q7/32
ADD. H04L12/28

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
H04Q

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2004/021541 A (MOTOROLA INC [US]) 11 March 2004 (2004-03-11)	1-7, 9-11,13, 14,16-20
Y	abstract page 1, line 10 - line 34 page 5, line 10 - line 19 page 4, line 20 - line 36 page 7, line 21 - line 28 page 8, line 27 - line 31 page 9, line 20 - line 29 page 10, line 26 - line 33 page 11, line 28 - line 30 figure 1	8,12

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[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

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"A" document defining the general state of the art which is not considered to be of particular relevance

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
23 November 2007	30/11/2007

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31–70) 340–2040, Tx. 31 651 epo nl, Fax: (+31–70) 340–3016	Rüschmann, Frank

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2007/073307

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2005/069108 A (KONINKL PHILIPS ELECTRONICS NV [NL]; BELL DAVID A [GB]) 28 July 2005 (2005-07-28)	1-11, 13-20
A	abstract page 1, line 17 - line 24 page 3, line 12 - page 4, line 2 page 5, line 27 - line 28 page 6, line 10 - page 7, line 11 page 7, line 21 - line 26 figure 2	8,12
Y	US 2005/048960 A1 (YAMAUCHI MASAHIRO [JP] ET AL) 3 March 2005 (2005-03-03)	8,12
A	paragraphs [0021], [0022] paragraphs [0089] - [0092] paragraphs [0107] - [0109] paragraphs [0143] - [0152] figures 5,9,16,17,29,29	1,9-11, 16

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/US2007/073307

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2004021541 A	11-03-2004	AU 2003261372 A1	19-03-2004
		CN 1679218 A	05-10-2005
		US 2004041538 A1	04-03-2004
WO 2005069108 A	28-07-2005	CN 1910537 A	07-02-2007
		EP 1706807 A1	04-10-2006
		JP 2007527660 T	27-09-2007
		KR 20060129258 A	15-12-2006
		US 2007150592 A1	28-06-2007
US 2005048960 A1	03-03-2005	NONE	