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Costa-Requena et al.

(54) PROVIDING MOBILE-SPECIFIC SERVICES FOR MOBILE DEVICES VIA AD-HOC NETWORKS

(76) Inventors: **Jose Costa-Requena**, Helsinki (FI); **Inmaculada Espigares**, Helsinki (FI)

Correspondence Address:
Hollingsworth & Funk, LLC
Suite 125
8009 34th Avenue South
Minneapolis, MN 55425 (US)

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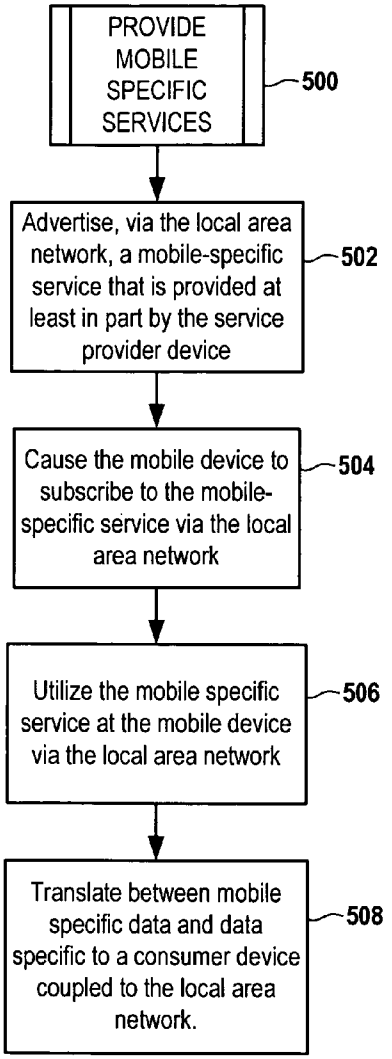
(57) **ABSTRACT**

Mobile-specific services are provided to a mobile device coupled to a local area network. The local area network provides ad-hoc connectivity between consumer electronics devices. A service provider device is coupled to the local area network. A mobile-specific service is provided at least in part by the service provider device. The mobile-specific service is advertised via the local area network. The mobile device subscribes to the mobile-specific service via the local area network in response to advertising of the mobile-specific service. The mobile device utilizes the mobile-specific service via the local area network.



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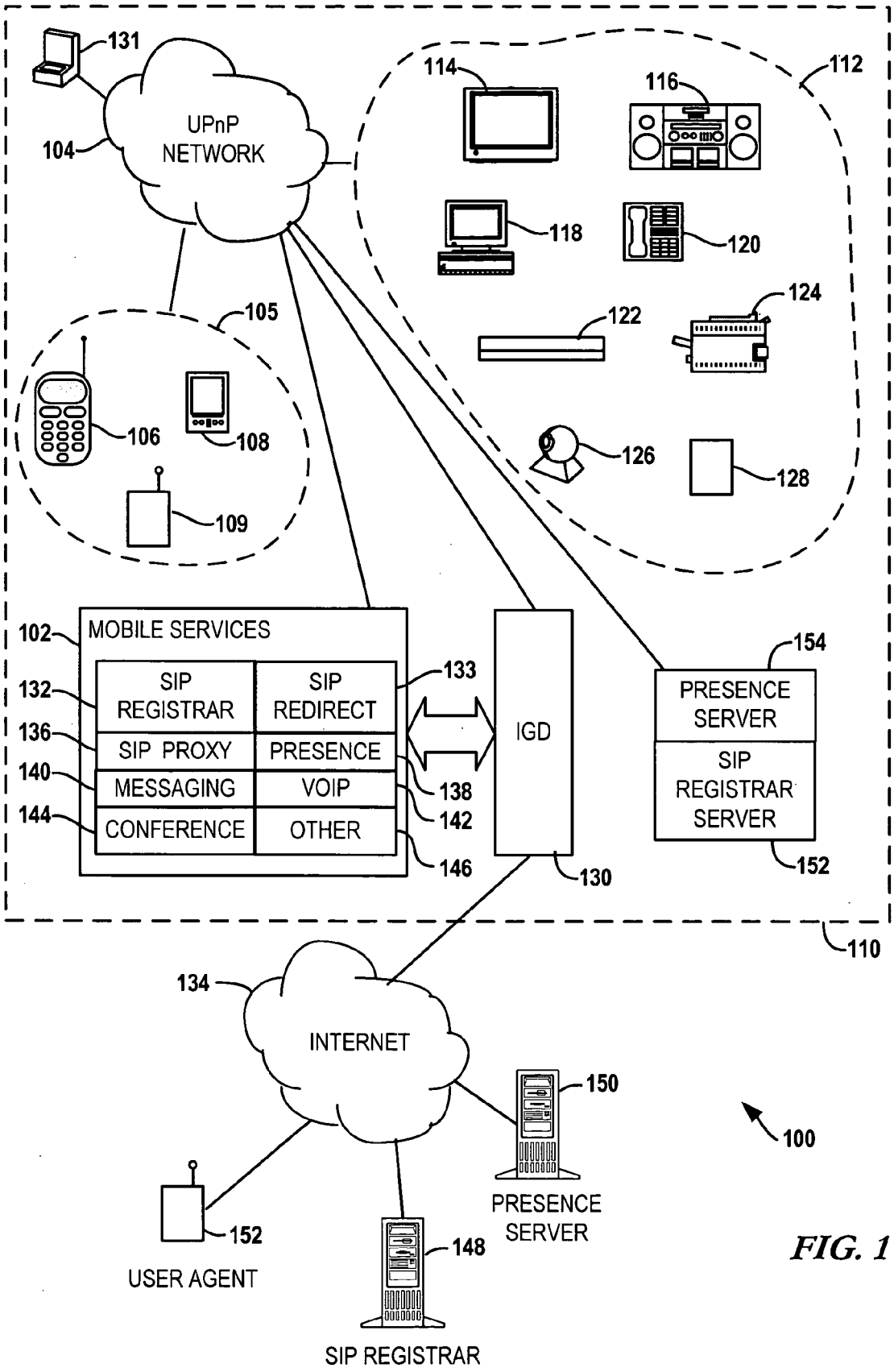
131
UPnP NETWORK
104
114
116
112
118
120
124
122
105
106
108
126
128
109
102
MOBILE SERVICES
SIP REGISTRAR
SIP REDIRECT
SIP PROXY
PRESENCE
MESSAGING
VOIP
CONFERENCE
OTHER
132
136
140
144
133
138
142
146
IGD
130
154
PRESENCE SERVER
SIP REGISTRAR SERVER
152
110
134
INTERNET
150
PRESENCE SERVER
100
152
USER AGENT
148
SIP REGISTRAR

FIG. 1

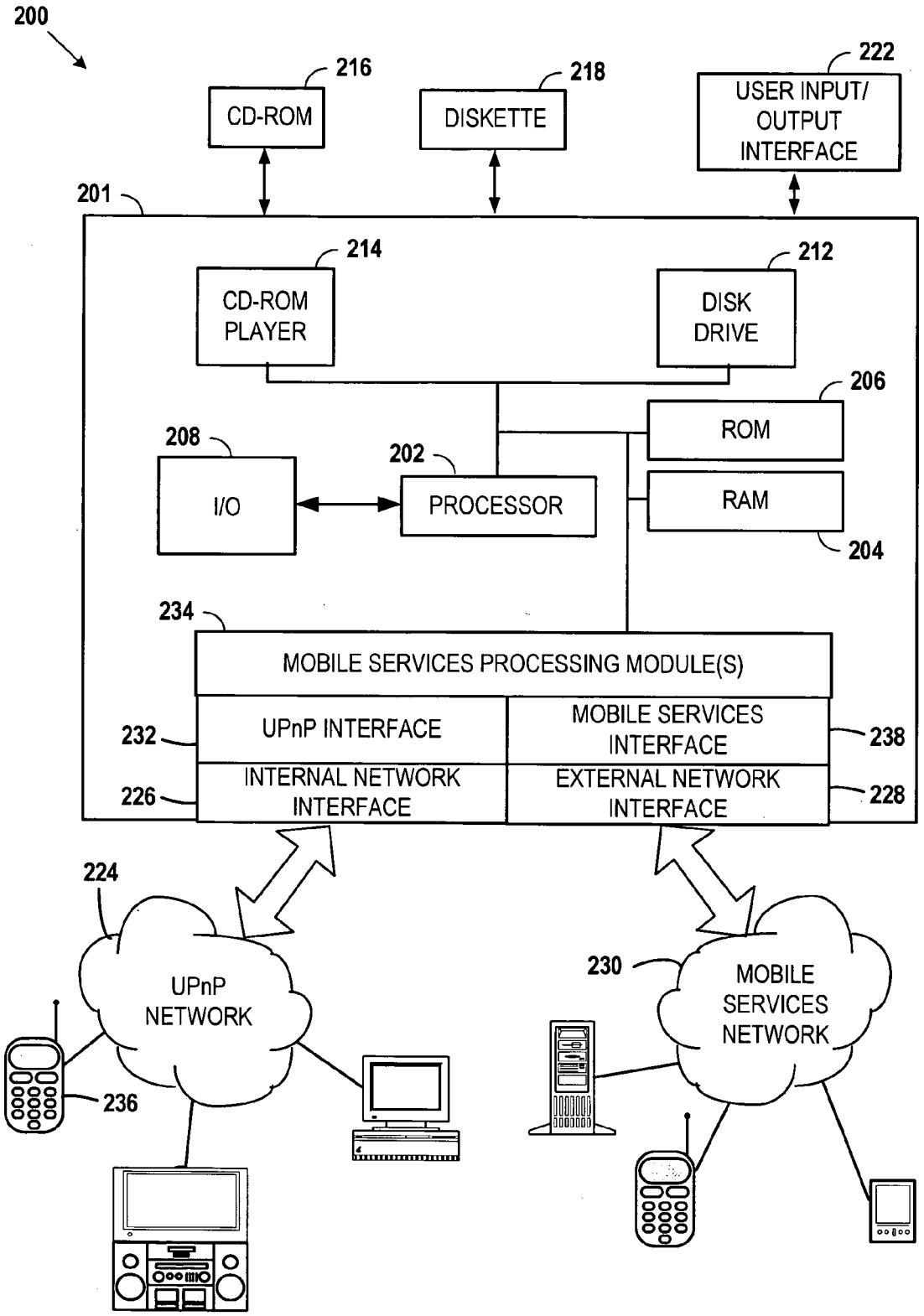
200
216
CD-ROM
218
DISKETTE
222
USER INPUT/ OUTPUT INTERFACE
201
214
CD-ROM PLAYER
212
DISK DRIVE
206
ROM
208
I/O
202
PROCESSOR
RAM
204
234
MOBILE SERVICES PROCESSING MODULE(S)
232
UPnP INTERFACE
MOBILE SERVICES INTERFACE
238
226
INTERNAL NETWORK INTERFACE
EXTERNAL NETWORK INTERFACE
228
224
UPnP NETWORK
230
MOBILE SERVICES NETWORK
236

FIG. 2

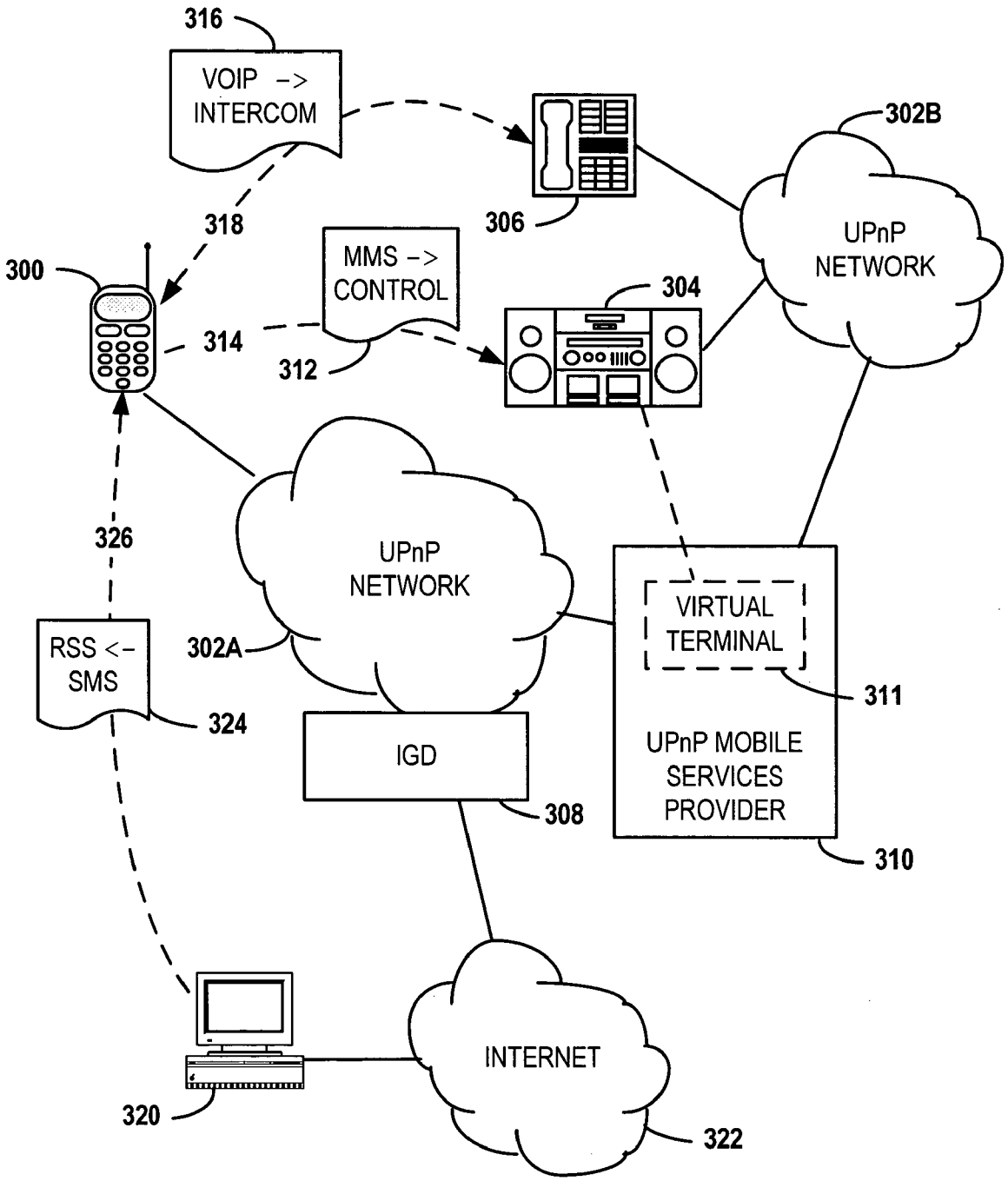
316
VOIP -> INTERCOM
302B
306
UPnP NETWORK
318
300
MMS -> CONTROL
304
314
312
326
UPnP NETWORK
VIRTUAL TERMINAL
RSS <- SMS
302A
311
324
IGD
UPnP MOBILE SERVICES PROVIDER
308
310
INTERNET
320
322

FIG. 3

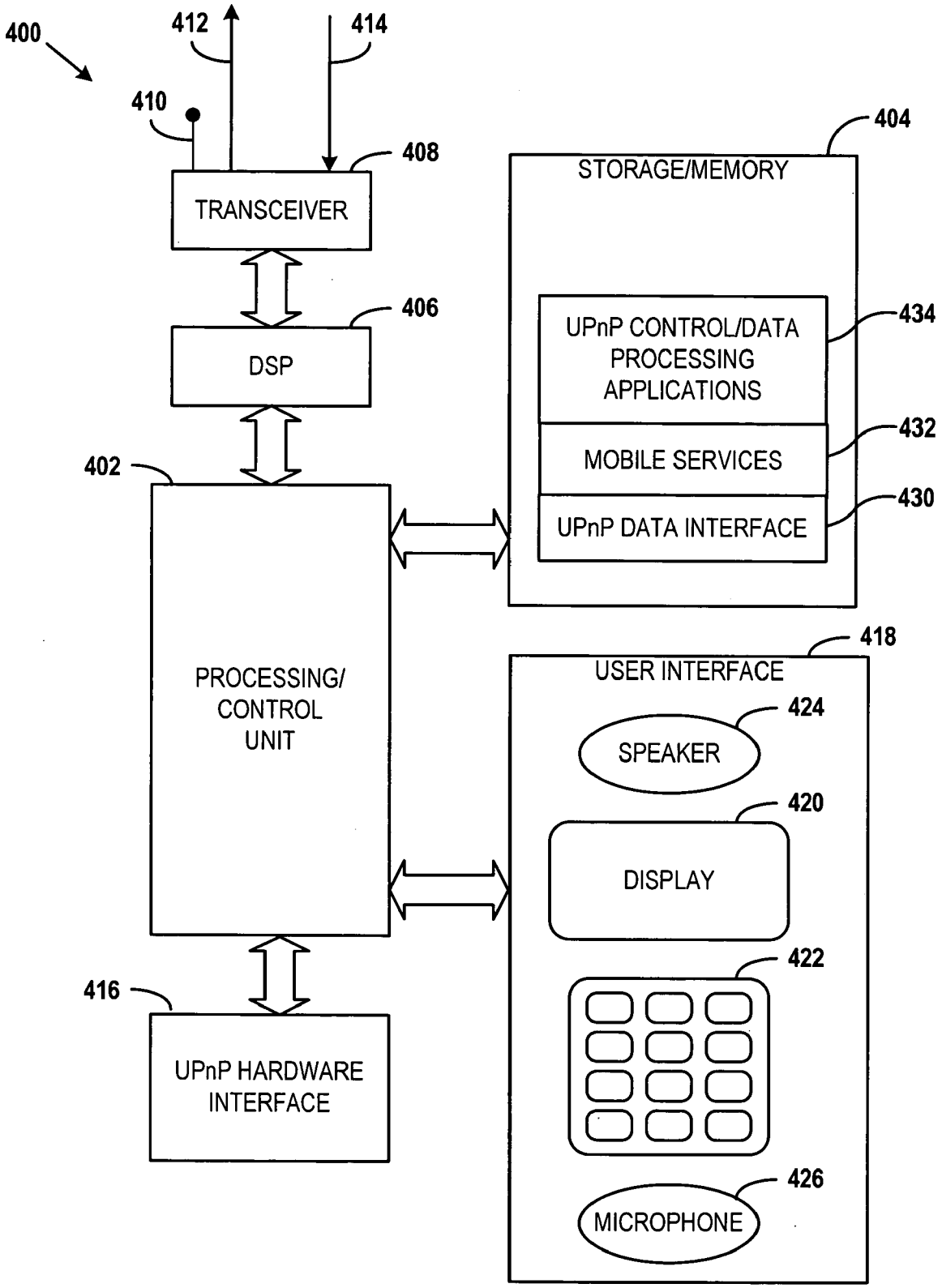
400
412
414
410
408
TRANSCEIVER
406
DSP
402
PROCESSING/
CONTROL
UNIT
416
UPnP HARDWARE
INTERFACE
404
STORAGE/MEMORY
UPnP CONTROL/DATA
PROCESSING
APPLICATIONS
434
MOBILE SERVICES
432
UPnP DATA INTERFACE
430
418
USER INTERFACE
424
SPEAKER
420
DISPLAY
422
426
MICROPHONE

FIG. 4

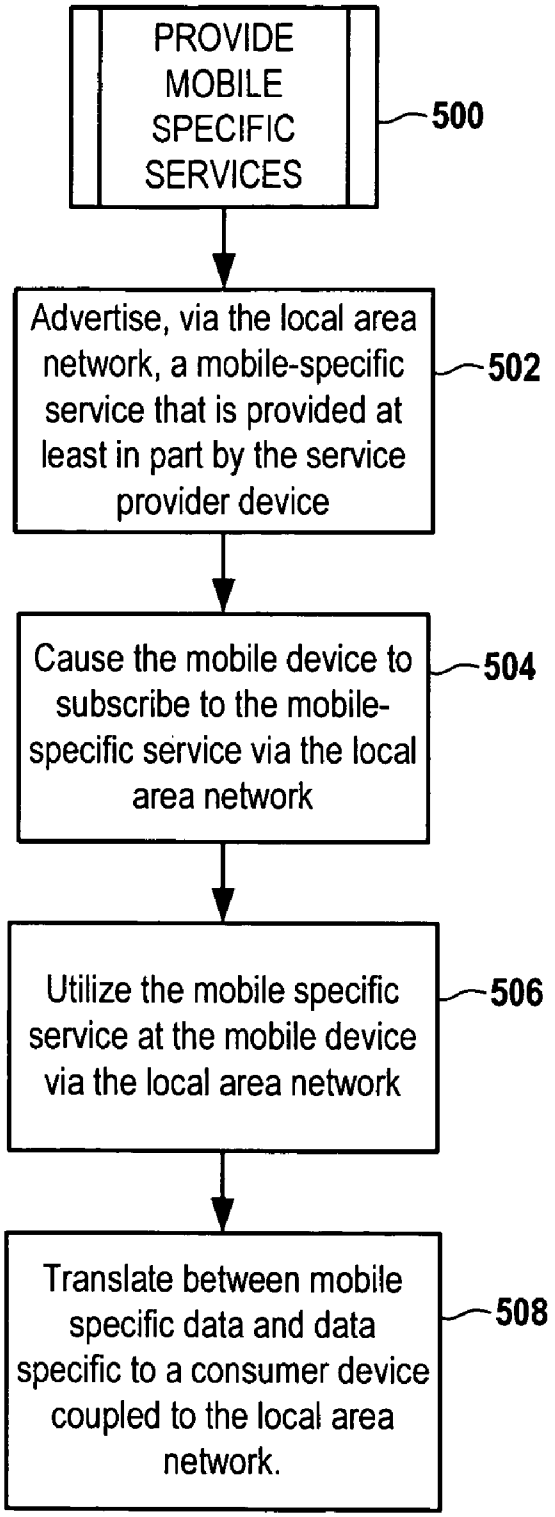
PROVIDE MOBILE SPECIFIC SERVICES
500
Advertise, via the local area network, a mobile-specific service that is provided at least in part by the service provider device
502
Cause the mobile device to subscribe to the mobile-specific service via the local area network
504
Utilize the mobile specific service at the mobile device via the local area network
506
Translate between mobile specific data and data specific to a consumer device coupled to the local area network.
508

FIG. 5

PROVIDING MOBILE-SPECIFIC SERVICES FOR MOBILE DEVICES VIA AD-HOC NETWORKS

FIELD OF THE INVENTION

[0001] This invention relates in general to communications devices, and more particularly to communications devices configured for providing mobile-specific services on an ad hoc network.

BACKGROUND OF THE INVENTION

[0002] Mobile communications devices such as cell phones are becoming more popular due in part to the capabilities being added to such devices. Far from being simple voice communications tools, modern cell phones and related devices have become versatile digital communications and data processing tools. These devices form an important niche in the growing field of personal digital communications.

[0003] One factor that is expected to increase the popularity of mobile devices is the development of third generation (3G) technologies. The designation 3G refers to a collection of standards and technologies that can be used in the near future to enhance performance and increase data speed on cell phone networks. In particular, 3G is an International Telecommunication Union (ITU) specification for the third generation of mobile communications technology. A 3G cell phone would, in theory, be compatible with the 3G languages or standards that support enhanced data speeds.

[0004] The 3G infrastructure aims to provide packet-switched data to a handheld terminal with data bandwidth measured in hundreds of Kbits/sec. It is intended that 3G will work over wireless air interfaces such as Code Division Multiple Access (CDMA), Wideband CDMA (W-CDMA), and the Time Division Multiple Access (TDMA) based General Packet Radio Service (GPRS). The latter interface is included in the Enhanced Data for GSM, Environment (EDGE) air interface that has been developed specifically to meet the bandwidth needs of 3G cell phones. One advantage of 3G networks is that they may allow connectivity with public Internet and with private Internet Service providers. Moreover, 3G networks have inter-networking functions compatible with Wireless Local Area Networks (WLAN) that will allow devices with WLAN cards to connect to 3G infrastructure and access mobile specific services.

[0005] Future 3G devices may include features that allow communication with other consumer electronics devices. For example, a standard known as Universal Plug and Play™ (UPnP) provides a way for disparate processing devices to exchange data. The UPnP standard defines an architecture for peer-to-peer network connectivity utilizing a wide variety of electronic devices. The UPnP standard includes standards for service discovery, and is mainly targeted for proximity or ad hoc networks.

[0006] Various contributors publish UPnP device and service descriptions, thus creating a way to easily connect devices and simplifying the implementation of networks. UPnP is designed to work in many environments, including the home, businesses, public spaces, and on devices attached to the Internet. The UPnP standard is an open architecture that leverages Web technologies and is designed to provide ad-hoc networking and distributed computing.

[0007] The UPnP model is designed to support zero-configuration networking and automatic discovery for a wide variety of device categories. This allows a device to dynamically join a network, obtain an IP address, convey its capabilities, and learn about the presence and capabilities of other devices. Other Internet protocols such as Dynamic Host Configuration Protocol (DHCP) and Domain Name Service (DNS) may optionally included in a UPnP network, although they are not required. A device can leave a UPnP network smoothly and automatically without leaving any unwanted state behind.

[0008] The UPnP architecture includes mechanisms for discovery of devices on the network and mechanisms for describing capabilities of those devices. The UPnP discovery protocol allows a device to advertise its services to control points on the network utilizing multicast messages. Multicasting refers to a sending a single copy of data to multiple recipients on an Internet Protocol (IP) network. Devices can multicast one or more service announcement messages. Each message describes an embedded device and/or service available from the message's originator. Other devices on the network listen on the multicast address for these service announcement messages. This information can be used to by the devices to utilize UPnP services.

[0009] It is the goal of UPnP to allow home electronics to be able to interact in order to further improve the usefulness of such electronics. Since a 3G communications device also has advanced data processing abilities, it is possible for such 3G devices to communicate via UPnP networks. Technology advances will soon produce extremely 3G portable devices that include high-speed data connectivity and advanced data processing. This will make such devices indispensable, both in and away from the user's homes. However, to more effectively allow these devices to communicate in non-mobile environments such as UPnP, adaptations to both the devices and the UPnP architecture may be desirable.

SUMMARY OF THE INVENTION

[0010] The present disclosure relates to a system, apparatus and method for exchanging data between a local network and a wireless device. In accordance with one embodiment of the invention, a method is described for exchanging data between a mobile device and a local area network. The network provides ad-hoc connectivity between consumer electronics devices. The method involves advertising, via the local area network, a mobile-specific service that is provided at least in part by a service provider device that is capable of being coupled to the local area network. The mobile-specific service is provided at least in part by the service provider device. A request from the mobile device to subscribe to the mobile-specific service is received at the service provider device in response to advertising of the mobile-specific service. The mobile-specific service is provided to the mobile device via the service provider device in response to the request

[0011] In more particular embodiments, the method involves providing the mobile-specific service by accessing, via the service provider, a server entity configured to provide the mobile specific service. The server entity may be located within and/or outside of the local area network. In one arrangement, the local area network includes a Universal Plug and Play network. In other arrangements, the mobile-

specific service comprises a mobile messaging service, such as Short Message Service and/or Multimedia Message Service. The mobile-specific service may include a voice communication service, such as Session Initiation Protocol (SIP), Voice Over IP, SIP registrar service, SIP redirect service, and/or SIP proxy service.

[0012] In another configuration, the method may further involve receiving mobile-specific data at the service provider device via the mobile-specific service. Based on the mobile-specific data, translated data is formed that is specific to a consumer electronics device coupled to the local area network. The translated data is sent to the consumer electronics device via the local area network. Forming the translated data may involve forming a command configured to remotely operate the consumer electronics device. Forming the translated data may also involve forming multimedia data that is compatible with a rendering function of the consumer electronics device.

[0013] In other more particular embodiments, the method further involves receiving data at the service provider device via the local area network. The data is specific to a consumer electronics device coupled to the local area network. Based on the data, mobile-specific data that is compatible with the mobile-specific service is formed. The mobile-specific data is sent to the mobile device via the mobile-specific service. The mobile-specific data may include multimedia data that is compatible with a rendering function of the mobile device.

[0014] In another embodiment of the invention, a processor-readable medium includes instructions that are executable by a data processing arrangement capable of being coupled to a local area network. The local area network provides ad-hoc connectivity to consumer electronics devices. The instructions are executable by the data processing arrangement for advertising, via the local area network, a mobile-specific service that is provided at least in part by the data processing arrangement. In response to advertising the mobile-specific service, a request is received for the mobile-specific service from a mobile device that is configured to operate on the local area network. The mobile-specific service is provided to the mobile device via the local area network in response to the request.

[0015] In another embodiment of the invention, a processor-readable medium include instructions which are executable by a mobile data processing arrangement capable of being coupled to a local area network that provides ad-hoc connectivity to consumer electronics devices. The instructions are executable by the data processing arrangement for discovering, via the local area network, a mobile-specific service that is provided at least in part by a provider device coupled to the local area network. A request for the mobile-specific service is sent to the provider device via the local area network. The mobile-specific service is utilized via the provider device.

[0016] In another embodiment of the present invention, a system includes a local area network configured to provide ad-hoc data exchanges between consumer electronics devices capable of being coupled to the local area network. The system also includes: means for advertising, via the local area network, a mobile-specific service that is provided at least in part by a service provider device coupled to the local area network; means for causing a mobile device to subscribe to the mobile-specific service via the local area network; and means for causing the mobile device to utilize the mobile-specific service via the local area network.

[0017] In another embodiment of the present invention, an apparatus includes a network interface capable of being coupled to a local area network that provides ad-hoc connectivity to consumer electronics devices. A processor is coupled to the network interface. A memory is coupled to the processor, the memory contains instructions that cause the processor to advertise, via the local area network, a mobile-specific service that is provided at least in part by the apparatus. The instructions also cause the processor to receive a request for the mobile-specific service from a mobile device that is capable of operating on the local area network in response to advertising the mobile-specific service. The apparatus provides the mobile-specific service to the mobile device via the local area network in response to the request.

[0018] In another embodiment of the present invention, a mobile terminal includes a network interface capable of being coupled to a local area network that provides ad-hoc connectivity to consumer electronics devices. A processor is coupled to the network interface. A memory coupled to the processor. The memory contains instructions that cause the processor to discover, via the local area network, a mobile-specific service that is provided at least in part by a provider device coupled to the local area network. The instructions also cause the processor to send a request for the mobile-specific service to the provider device, and utilize the mobile-specific service via the provider device.

[0019] These and various other advantages and features of novelty which characterize the invention are pointed out with particularity in the claims annexed hereto and form a part hereof. However, for a better understanding of the invention, its advantages, and the objects obtained by its use, reference should be made to the drawings which form a further part hereof, and to accompanying descriptive matter, in which there are illustrated and described specific examples of a system, apparatus, and method in accordance with the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0020] The invention is described in connection with the embodiments illustrated in the following diagrams.

[0021] **FIG. 1** illustrates a system for providing mobile-specific services on an ad-hoc local area network according to embodiments of the present invention;

[0022] **FIG. 2** illustrates a device for providing mobile-specific services on an ad-hoc local area network according to embodiments of the present invention;

[0023] **FIG. 3** illustrates exchanges between mobile devices and consumer electronics devices on an ad-hoc local area network according to embodiments of the present invention;

[0024] **FIG. 4** illustrates a mobile terminal configured for utilizing mobile-specific services on an ad-hoc local area network according to embodiments of the present invention; and

[0025] **FIG. 5** illustrates a procedure for providing mobile-specific services on an ad-hoc local area network according to embodiments of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0026] In the following description of various exemplary embodiments, reference is made to the accompanying drawings that form a part hereof, and in which is shown by way of illustration various embodiments in which the invention may be practiced. It is to be understood that other embodiments may be utilized, as structural and operational changes may be made without departing from the scope of the present invention.

[0027] Generally, the present invention provides a way of providing mobile-specific services over an ad-hoc, consumer electronics-oriented network. The mobile services may include Voice over Internet Protocol (VoIP), Short Messaging Service (SMS), Multimedia Messaging Service (MMS), presence, etc. The mobile services may be implemented in an entity that is actively coupled to the network. In other arrangements, the services may be implemented in an externally located entity (e.g. mobile operator, Internet Service Provider, etc) but virtually represented in the local network by device that announces the services locally in the home network. In one example, the services could be represented and/or provided by a dedicated mobile-services provider device. A mobile device with the capability to connect to the provider device via the home networks can take advantage mobile-specific services that would normally be provided via cellular networks. The provider device may also provide connectivity between the mobile devices and consumer electronics coupled to the networks using the mobile-specific services.

[0028] The present invention is applicable in any type of communication systems and networks, particularly to proximity or ad-hoc networks that are adapted for consumer electronics use. In order to facilitate an understanding of the invention, the present invention is described in the context of a UPnP networking environment. It will be appreciated, however, that the invention may be applicable in any system or application where ad-hoc data communications between devices such as consumer and mobile electronics is desired.

[0029] As previously described, UPnP devices may advertise their capabilities by multicasting service announcement messages on the UPnP network. Entities connecting to a UPnP network are generally divided into two categories, devices and control points. Devices generally refer to any data processing arrangement that is capable of receiving, sending, manipulating, generating, rendering, or otherwise processing data available on a UPnP network. In the UPnP framework, the concept of a device is abstracted into a logical entity known as a logical device. A logical device is a container for both other logical devices and for services. For example, a UPnP television monitor could be considered to be a logical device that contains both a video renderer logical device and a sound renderer logical device. Each of these logical devices may have one or more associated services. The video renderer device, for example, may provide rendering services for both still and moving images. These services may support different input and output formats, resolutions, aspect ratios, etc.

[0030] Control points in a UPnP network enable users to control UPnP devices and their associated services. In particular, control points retrieve device and service descriptions, send actions to services, poll for state variables associated with services, and receive events generated by services. Control points and devices in a UPnP network are intended to have generic interfaces that allow flexible dynamic coupling between control points and devices.

[0031] In UPnP home networks, the available services may be found using service discovery. Service discovery involves utilizing discovery messages that are exchanged via predetermined multicast addresses on the UPnP network. These multicast addresses can be used to advertise services provided by UPnP devices. In addition, control points and other devices can multicast discovery messages to search for devices and services of interest. The search messages contain criteria that may be fulfilled by devices and/or services on the network. Devices that fulfill the criteria will respond to the search message. After the control point and the device have discovered each other, they may engage in a description process to more fully define the details of the available services.

[0032] Some of the services defined in UPnP include printing, remote user interface (UI), audio/video, etc. However, the services currently defined in the UPnP do not include mobile-specific services that are available on cellular phone networks, for example. These mobile-specific services may include VoIP, messaging (e.g., SMS, MMS), presence, multimedia services using Session Initiation Protocol (SIP) and Session Description Protocol (SDP), conferencing applications, whiteboarding, document sharing, etc.

[0033] It will be appreciated that users typically utilize mobile services on mobile devices while away from home. As users become more accustomed to and reliant on these mobile-specific services, it will be beneficial to utilize similar mobile services in the home environment. In some arrangements, the home network may provide services that are identical (at least to the user) to those provided by a cellular network, but utilize a different data pathway. For example, a cellular phone may have the ability to make VoIP calls over mobile networks. When the cellular phone is in the home, a home network may be used to make these VoIP calls via a cable modem connection. When the mobile device is at home it may register in the home VoIP server and the incoming calls to the fixed line can then be forwarded to the mobile device over the local network (e.g. WLAN, Bluetooth, UWB, etc).

[0034] The cellular phone may also utilize mobile services provided entirely with the home on the local network. For example, the home may have a presence server coupled to the local network that provides the same functionality as an external presence server, just in the home domain. In other scenarios, the cellular phone may utilize a mobile-specific service on the home network, but in a way that is unique to devices on that network. For example, the cellular phone may act as a control point for a UPnP device on the local network by sending an SMS message to a specially formed address. The phone may also act as proxy so that incoming data (e.g., a video call) can be forwarded to another UPnP device (e.g., a TV screen).

[0035] Illustrated in **FIG. 1** is an example environment **100** for providing mobile-specific services over a home network according to embodiments of the present invention. A mobile services provider arrangement **102** provides access to mobile-specific services for devices that are capable of

being coupled to a UPnP network **104**. These UPnP-capable devices may include mobile devices **105**, such as cellular phones **106**, Personal Digital Assistants (PDA) **108**, and any other mobile device as represented by generic mobile device **109**.

[**0036**] The UPnP network **104** (or similar networking technology) allows devices to exchange data in a local environment **110**. The local environment **110** typically includes a home or office, although it will be appreciated that other environments may provide UPnP connectivity, including automobiles, airplanes, boats, public wireless hotspots, etc. The UPnP network **104** may couple consumer electronics devices **112**, including televisions **114**, audio systems **116**, computers **118**, telephones **120** (e.g., analog phones, digital phones, cordless phones, SIP phones), digital media centers **122** (e.g., set-top boxes, MP3 jukeboxes, personal video recorders, media hubs), printers **124**, cameras **126**, and other devices, represented by generic UPnP device **128**.

[**0037**] The consumer electronic devices **112** may be coupled to the UPnP network **104** in any manner known in the art. The UPnP network **104** may employ connectivity using any media or format known or later developed. For example, the UPnP network **104** may utilize any combination of wired and wireless networking technologies, such as Ethernet, 802.11 Wi-Fi, X10, powerline networking, infrared, etc. Generally, UPnP networks utilize TCP/IP and other Web technologies to enable proximity networking for transfer of control data and content among networked devices.

[**0038**] The UPnP network **104** may also be configured to provide communications outside the local environment **110**. For example, an Internet Gateway Device (IGD) **130** may provide communications to networks outside the local environment, such as the Internet **134**. The IGD **130** is an IP addressable device typically residing at the edge of a home or small-business network. The IGD **130** includes a WAN interface capable of accessing the Internet **134** and other external networks. The IGD **130** is configured to provide external network access to elements of the UPnP network **104**. The IGD **130** may also provide local addressing and routing services between one or more LAN segments in the local environment **110**. The IGD **130** can be located in a specific home device to provide external connectivity to all devices in the home network. In some cases, a mobile device **105** (e.g., mobile phone **106**) can also act as IGD **130**. Such devices **105** may have access to external wireless networks such as 3G, GPRS, UWB, etc.

[**0039**] The mobile devices **105** and the UPnP mobile services provider **102** may be configured to communicate with the UPnP network **104** in a manner similar to that of the consumer electronics devices **112**. The mobile devices **105** may have direct wired or wireless connections to the network **104**, or may have connections provided by an intermediary device such as a docking station **131**. The mobile devices **105** may advertise certain non-mobile-specific services (e.g., audio rendering) and may utilize non-mobile-specific network services (e.g., file transfer to a storage device). The mobile devices **105** are also configured to utilize mobile-specific services via the UPnP network **104**. The UPnP mobile services provider **102** is configured to provide, at least in part, the mobile-specific services to such mobile devices **105**. It will be appreciated that the provider **102** may also provide and utilize other UPnP services, including those services not specific to mobile environments.

[**0040**] Generally, the UPnP mobile services provider **102** offers a selected set of mobile-specific services that are compatible with cellular and other mobile voice and data technologies. These services may include SIP services such as SIP registrar **132**, SIP redirect **133**, and SIP proxy **136**. Other mobile services offered by the UPnP services provider **102** may include presence **138**, messaging **140**, VoIP **142**, conferencing **144**, and any other service **146** now known or later developed. The mobile devices **105** may be internally configured access these services in the same way as via a mobile/cellular network, except that the data path for these services is via the UPnP network **104**.

[**0041**] The UPnP mobile services provider **102** may act as a proxy device for mobile-specific services. For example, the SIP registrar service **132** and presence service **138** may act as proxies to a SIP registrar server **148** and presence server **150**, respectively, accessible via the Internet **134**. Similarly, the SIP registrar service **132** and presence service **138** may act as proxies to a SIP registrar server **152** and presence server **154** located in the home network **104**. The SIP proxy **136** may be accessed by SIP user agents **152** connected the Internet **134**. The use of the SIP proxy **136** allows routing of SIP messages and multimedia sessions to devices connected to the UPnP network **104**. User agents coupled the home network, such as the mobile devices **105**, may also be able to utilize SIP signaling via the SIP proxy **136**.

[**0042**] The UPnP mobile services provider **102** may be implemented using any combination of hardware and software known in the art. The UPnP mobile services provider **102** may be implemented as a standalone device, a processor-implemented service, or be included as part of other electronic equipment, including computers, routers, wireless access points, set-top boxes, IGDs, etc. **FIG. 2** shows an example computing structure **200** suitable for providing the functionality of a UPnP mobile services provider according to embodiments of the present invention.

[**0043**] The computing structure **200** includes a computing arrangement **201**. The computing arrangement **201** may include custom or general-purpose electronic components. The computing arrangement **201** includes a central processor (CPU) **202** that may be coupled to random access memory (RAM) **204** and/or read-only memory (ROM) **206**. The ROM **206** may include various types of storage media, such as programmable ROM (PROM), erasable PROM (EPROM), etc. The processor **202** may communicate with other internal and external components through input/output (I/O) circuitry **208**. The processor **202** carries out a variety of functions as is known in the art, as dictated by software and/or firmware instructions.

[**0044**] The computing arrangement **201** may include one or more data storage devices, including hard and floppy disk drives **212**, CD-ROM drives **214**, and other hardware capable of reading and/or storing information such as tape, DVD, flash-memory drive, etc. In one embodiment, software for carrying out the operations in accordance with the present invention may be stored and distributed on a CD-ROM **216**, diskette **218** or other form of media capable of portably storing information. These storage media may be

inserted into, and read by, devices such as the CD-ROM drive **214**, the disk drive **212**, etc. The software may also be transmitted to computing arrangement **201** via data signals, such as being downloaded electronically via a network, such as the Internet.

[**0045**] The computing arrangement **201** may be coupled to a user input/output interface **222** for user interaction. The user input/output interface **222** may include apparatus such as a mouse, keyboard, microphone, touch pad, touch screen, voice-recognition system, monitor, LED display, LCD display, etc. The user interface **222** may include physical devices, or may be a pure virtual interface such as provided by Virtual Network Computing (VNC) software and similar technologies.

[**0046**] The computing arrangement **201** may be coupled to other computing devices via networks. In particular, the arrangement **201** may be locally coupled to a UPnP network **224** via an internal network interface **226**. An external network interface **228** may also be included with the computing arrangement **201**. The external interface **228** is generally used to communicate with elements outside the UPnP network **224**, such as a mobile services network **230**.

[**0047**] The network interfaces **226**, **228** may include hardware and software components, including circuitry, firmware, drivers, programs, and protocol modules. It will be appreciated that the network interfaces **226**, **228** may share the same hardware and/or software in providing their respective functions. For example, both interfaces **226**, **228** may communicate via a single interface device coupled to the UPnP network **224**. In such an arrangement, the external interface **228** may communicate externally by utilizing a UPnP IGD (e.g., IGD **130** in **FIG. 1**).

[**0048**] A UPnP interface **232** is coupled to the internal network interface **226** for purposes of dealing with formats and states required by the UPnP standard. The UPnP interface **232** may handle, for example, advertising and description of mobile-specific services on the UPnP network **224**. These mobile-specific services will be of particular interest to UPnP-enabled mobile devices, because such devices are most likely able to exploit these services. The UPnP interface **232** may be a generic module that is adaptable to dynamically add new functionality. The actual mobile services functionality presented at the UPnP interface **232** may be provided by one or more mobile services processing modules **234**.

[**0049**] The mobile services processing modules **234** provide the core functionality of one or more mobile-specific services that are offered via the UPnP interface **232**. For example, the mobile services processing modules **234** may advertise a VoIP service over the UPnP network for use by a UPnP enabled cellular phone **236**. The processing module **234** could be designed to operate much the same as VoIP service available on the mobile services network **230**, except that the processing module **234** handles initiation and communications with the cellular phone **236** using the UPnP interface **232**. The functions provided by a VoIP service module may include establishing and using session and signaling protocols, determining location of VoIP servers and PBX's, etc.

[**0050**] The data processed by the mobile services processing module **234** may be passed to a mobile services interface **238**. The mobile services interface **238** handles the native protocols and formats required of the mobile services network **230**. For example, if the mobile services processing modules **234** is configured for handling VoIP, the external interface may be enabled to connect through a default route (e.g., an IGD) that provides Internet connectivity for routing the voice traffic.

[**0051**] Any UPnP enabled device that is capable of exploiting mobile-specific services via UPnP may utilize the data computing structure **200**. The UPnP enabled device (e.g., the cell phone **236**) may use the mobile-specific services in the normal manner (e.g., voice phone calls, text messages) except that connectivity is provided via UPnP. The device **236** may be enabled to either manually or automatically utilize UPnP in this way for standard mobile services, whether the services are offered inside of or outside of the local network **224**. The data computing structure **200** may also be adapted to allow the mobile device **236** to access entities locally coupled to the UPnP network **224** using the mobile services. In this latter configuration, the mobile device **236** uses existing mobile-specific services to access UPnP devices in way that may be specific to the devices in the local environment. An example of a UPnP enabled mobile device **300** interfacing with local elements of a UPnP network according to the present invention is shown in **FIG. 3**.

[**0052**] The mobile device **300** is capable of communicating via the segments of a UPnP network **302**A-B. The mobile device **300** may be capable of communicating directly with consumer electronics devices on the network **302**A-B, such as an audio system **304**, a telephone **306**, and an IGD **308**. Additionally, the mobile device **300** is configured to utilize a UPnP mobile services provider device **310**. The provider device **310** may act as an intermediary between the mobile device **300** and other elements of the UPnP network **302**A-B.

[**0053**] One function of the UPnP mobile services provider device **310** may be to represent UPnP devices (e.g., the audio system **304**) as devices that are addressable as if the devices were on mobile services network. For example, the provider device **310** can create a virtual mobile terminal **311** representing the audio system **304** for receiving MMS or SMS messages. Before setting up this virtual terminal **311**, the provider device **310** may represent itself as a control point when connecting to the audio system **304**. Through discovery and description, the provider device **310** can determine a set of commands that the audio system **304** can accept (e.g., volume up, next channel, etc). After the provider device **310** has established itself as a control point for the audio system **304**, the provider device **310** can accept commands directed to the audio system **304** via the virtual terminal **311**. The mobile terminal **300** can directly access this virtual terminal **311** through the provider device **310**. The virtual terminal **311** may be represented using a phone number or URL that is only valid on the UPnP network **302**A-B. The provider device **310** may set up any number of virtual terminals to accept data targeted for UPnP devices on the network.

[**0054**] Once the UPnP mobile services provider device **310** is configured, the user of the mobile device **300** may form a simple text message targeted for virtual terminal **311** located on the provider device **310**. For example, the change

a tuner channel on the entertainment center **304**, the user may send an MMS message **312** directed to audio system **304**, as indicated by path **314**. The message may be an MMS message containing the text "c+," or something similarly representative of a channel-changing command. The MMS message **312** may be sent to a specially formed URL such as stereo1@ homenet. The provider device **310** will receive the message **312** and recognize the URL as being directed to the audio system **304**. The provider device **310** will parse the MMS message **312** to create a properly formatted command that is sent to the audio system **304** via the UPnP network **302**A-B.

[**0055**] The mobile device **300** may also utilize the UPnP mobile services provider device **310** for more complex data exchanges on the UPnP network **302**A-B. For example, a home intercom may be formed using UPnP enabled phones/stations such as the phone **306**. The provider device **310** may be enabled to conduct audio communications with the phone **306** via UPnP. These audio communications may be through vendor specific protocols that are not part of any mobile services standard. The mobile device **300** may be able to access the phone **306** via a mobile-specific voice interface of the provider device **310**. Voice communications between the mobile device **300** and phone **306** are represented as the VoIP data **316** and virtual connection path **318**. For example, the provider device **310** may set up a proxy SIP/VoIP interface used by the mobile device **300** to access the phone **306**, even if the phone **306** does not use these protocols.

[**0056**] The UPnP mobile services provider device **310** may also be configured to asynchronously send selected data to the mobile device **300** via a mobile-specific service. For example, a Web server **320** may provide RSS news feeds to subscribers on the Internet **322**. RSS is a format for syndicating news and other regularly updated content on the Web. RSS feeds are created when the originator of the content updates an XML document on the Web server that contains a title, link, and description of a news item. Many browsers support reading RSS feeds, and RSS functionality may be implemented in other programs. In the arrangement of **FIG. 3**, the UPnP mobile services provider device **310** may be configured to read RSS feeds via the IGD **308**. The content of these feeds may be formatted into an SMS message **324** by the provider device **310** and sent to the mobile device **300** using SMS as indicated by path **326**. The SMS message **324** can be read at the mobile device **310** using the device's SMS reader.

[**0057**] Because the mobile device **300** can already communicate via mobile-specific services, the mobile device **300** can communicate with devices on the UPnP network **302**A-B via the provider device **310** without adding any application software. For example, the device **300** may act as a remote control for the audio system **304** by using the text message facilities built into the device **300**. However, there may be advantages to providing application programs that exploit the device's capability to communicate on the UPnP network using mobile-specific services. For example, a remote control program executing on the device **300** may have labeled buttons and the like for easy activation of UPnP devices. Such an application may be easier to write if it can utilize the built-in messaging facilities of the device **300** rather than having to provide special drivers for accessing UPnP devices directly.

[**0058**] An example mobile computing arrangement **400** that is enabled to exploit a UPnP mobile services provider device according to embodiments of the present invention is shown in **FIG. 4**. Those skilled in the art will appreciate that the exemplary mobile computing arrangement **400** is merely representative of general functions that may be associated with such mobile devices, and also that landline computing systems similarly include computing circuitry to perform such operations.

[**0059**] The illustrated mobile computing arrangement **400** may be suitable for performing roles as both UPnP device and a UPnP control point. The mobile computing arrangement **400** includes a processing/control unit **402**, such as a microprocessor, reduced instruction set computer (RISC), or other central processing module. The processing unit **402** need not be a single device, and may include one or more processors. For example, the processing unit may include a master processor and associated slave processors coupled to communicate with the master processor.

[**0060**] The processing unit **402** controls the basic functions of the arrangement **400**. Those functions may be included as instructions stored in a program storage/memory **404**. In one embodiment of the invention, the program modules associated with the storage/memory **404** are stored in non-volatile electrically-erasable, programmable read-only memory (EEPROM), flash read-only memory (ROM), etc. so that the information is not lost upon power down of the mobile terminal. The relevant software for carrying out conventional mobile terminal operations and operations in accordance with the present invention may also be transmitted to the mobile computing arrangement **400** via data signals, such as being downloaded electronically via one or more networks, such as the Internet and an intermediate wireless network(s).

[**0061**] The program storage/memory **404** may also include operating systems for carrying out functions and applications associated with functions on the mobile computing arrangement **400**. The program storage **404** may include one or more of read-only memory (ROM), flash ROM, programmable and/or erasable ROM, random access memory (RAM), subscriber interface module (SIM), wireless interface module (WIM), smart card, hard drive, or other removable memory device.

[**0062**] The mobile computing arrangement **400** also includes hardware and software components coupled to the processing/control unit **402** for performing network data exchanges. The mobile computing arrangement **400** may include multiple network interfaces for maintaining any combination of wired or wireless data connections. In particular, the illustrated mobile computing arrangement **400** includes wireless data transmission circuitry for performing mobile service network data exchanges.

[**0063**] This wireless circuitry includes a digital signal processor (DSP) **406** employed to perform a variety of functions, including analog-to-digital (A/D) conversion, digital-to-analog (D/A) conversion, speech coding/decoding, encryption/decryption, error detection and correction, bit stream translation, filtering, etc. A transceiver **408**, generally coupled to an antenna **410**, transmits the outgoing radio signals **412** and receives the incoming radio signals **414** associated with the wireless device.

[**0064**] The mobile computing arrangement **400** may also include a separate data interface **416** coupled to the proces-

sor **402** and adapted for communicating over a UPnP network. The UPnP interface **416** may include any combination of wired or wireless physical data transmission hardware. The circuitry of the UPnP interface **416** may be integrated with the circuitry of the DSP **406** and transceiver **408**, or may be separately provided. The UPnP hardware interface **416** may be integrated into the mobile arrangement **400** or may be provided as an add-on peripheral device.

[**0065**] The mobile computing arrangement **400** also includes user-interface **418** elements coupled to the processor **402**. The user-interface **418** of the arrangement **400** may include, for example, a display **420** such as a liquid crystal display, a keypad **422**, speaker **424**, and microphone **426**. Other user-interface mechanisms may also be employed, such as voice commands, switches, touch pad/screen, graphical user interface using a pointing device, trackball, joystick, or any other user interface mechanism. These and other user-interface components are coupled to the processor **402** as is known in the art.

[**0066**] The program storage/memory **404** contains software used to operate the mobile computing arrangement **400**. This software may include a UPnP interface module **430** which is coupled to the UPnP hardware interface **416**. The UPnP interface module **430** allows connecting to and sharing data with elements of a UPnP network. Generally, interfacing with UPnP networks involves advertising services available via the mobile computing arrangement **400** and discovering and using advertised services of other devices.

[**0067**] The mobile computing arrangement **400** is typically able to utilize a number of mobile-specific services available on primary wireless service networks, including voice, text messaging, etc. These mobile-specific functions may be provided by one or more mobile services modules **432**. The mobile services modules **432** may also be configured to access these services using any combination of hardware interfaces, including via the transceiver **408** and/or the UPnP hardware interface **416**.

[**0068**] The mobile services module **432** may use the UPnP interfaces **416**, **430** to access mobile-specific services from a locally situated UPnP mobile services provider (e.g., UPnP mobile services provider device **310** in **FIG. 3**). The local UPnP service provider may allow accessing UPnP functions of any devices via mobile-specific formats and protocols. To better utilize these UPnP services, the storage/memory **404** of the mobile arrangement **400** may include UPnP control and data processing applications **434**. These applications **434** may act as a "wrapper" for accessing UPnP functionality via mobile services.

[**0069**] The UPnP applications **434** may present a user interface that is tailored for controlling and/or interfacing with specific UPnP devices. However, existing mobile services protocols are used instead of using the UPnP drivers to interface with these devices. A customized UPnP user interface that runs on top of existing mobile functionality can be easy to implement, memory efficient, and reliable. Ordinarily, implementing these UPnP features would require the application to include an entirely new stack of protocols specific to communicating with a particular UPnP device. However, the arrangement **400** already includes a sophisticated stack of data transfer protocols optimized for the mobile environment. By adapting the existing mobile services protocols provided by the mobile services module **432**, there is no need to implement this additional stack of UPnP protocols. The logic used to translate between mobile-specific protocols and non-mobile-specific functions can be situated in an external device, such as a UPnP mobile services provider device.

[**0070**] For example, the arrangement **400** may include the ability to send, receive, and view images via MMS. However, arrangement **400** may not include the ability to access and control an external data store (e.g., a home media server) containing pictures that are stored in a wide variety of formats. To include an entire media server access protocol stack on the arrangement **400** would require significant amounts of memory. However, if the existing MMS protocol was used to access the media server, then a much more compact application **434** could be used. This compact application **434** would only need to contain the requisite user interface elements and some code to embed media server commands into MMS text messages (or other mobile-specific services and formats). Additional transformations, such as dealing with vendor specific commands and/or formatting images, can be performed externally by the local provider device. Performing transformations on the provider device provides performance benefits, because equivalent transformations performed on the mobile arrangement **400** would be much slower due to the relatively slower mobile processor **402**.

[**0071**] The mobile computing arrangement **400** of **FIG. 4** is provided as a representative example of a computing environment in which the principles of the present invention may be applied. From the description provided herein, those skilled in the art will appreciate that the present invention is equally applicable in a variety of other currently known and future mobile and landline computing environments. For example, desktop computing devices similarly include a processor, memory, a user interface, and data communication circuitry. Thus, the present invention is applicable in any known computing structure where data may be communicated via a network.

[**0072**] Turning now to **FIG. 5**, a procedure **500** is illustrated for providing mobile-specific services on an ad-hoc local area network in accordance with embodiments of the present invention. Mobile-specific services are advertised **502** via the network. The mobile-specific services are provided, at least in part, by a service provider device coupled to the network. A mobile device subscribes **504** to the mobile-specific service via the local area network. The mobile device may then utilize **506** the mobile-specific services via the local area network. Optionally, the service provider may translate **508** between mobile-specific data and data that is specific to consumer devices coupled to the local area network.

[**0073**] Hardware, firmware, software or a combination thereof may be used to perform the various functions and operations described herein of a distributed-computation program. Articles of manufacture encompassing code to carry out functions associated with the present invention are intended to encompass a computer program that exists permanently or temporarily on any computer-usable medium or in any transmitting medium that transmits such a program. Transmitting mediums include, but are not limited to, transmissions via wireless/radio wave communi-

cation networks, the Internet, intranets, telephone/modem-based network communication, hard-wired/cabled communication network, satellite communication, and other stationary or mobile network systems/communication links. From the description provided herein, those skilled in the art will be readily able to combine software created as described with appropriate general purpose or special purpose computer hardware to create a distributed-computation system, apparatus, and method in accordance with the present invention.

[0074] The foregoing description of the exemplary embodiments of the invention has been presented for the purposes of illustration and description. It is not intended to be exhaustive or to limit the invention to the precise form disclosed. Many modifications and variations are possible in light of the above teaching. It is intended that the scope of the invention be limited not with this detailed description, but rather defined by the claims appended hereto.

What is claimed is:

1. A method of exchanging data between a mobile device and a local area network that provides ad-hoc connectivity between consumer electronics devices, comprising:

advertising, via the local area network, a mobile-specific service that is provided at least in part by a service provider device that is capable of being coupled to the network;

receiving at the service provider device, a request from the mobile device to subscribe to the mobile-specific service in response to advertising of the mobile-specific service; and

providing the mobile-specific service to the mobile device via the service provider device in response to the request.

2. The method of claim 1, wherein providing the mobile-specific service to the mobile device comprises accessing, via the service provider device, a server entity located outside the local area network that is configured to provide at least part of the mobile specific service.

3. The method of claim 1, wherein providing the mobile-specific service to the mobile device comprises accessing, via the service provider device, a server entity located within the local area network that is configured to provide at least part of the mobile specific service.

4. The method of claim 1, further comprising:

receiving mobile-specific data at the service provider device via the mobile-specific service;

forming, based on the mobile-specific data, translated data that is specific to a consumer electronics device coupled to the local area network; and

sending the translated data to the consumer electronics device via the local area network.

5. The method of claim 4, wherein forming the translated data comprises forming a command configured to remotely operate the consumer electronics device.

6. The method of claim 4, wherein forming the translated data comprises forming multimedia data that is compatible with a rendering function of the consumer electronics device.

7. The method of claim 1, further comprising:

receiving data at the service provider device via the local area network, wherein the data is specific to a consumer electronics device coupled to the local area network;

forming, based on the data, mobile-specific data that is compatible with the mobile-specific service; and

sending the mobile-specific data to the mobile device via the mobile-specific service.

8. The method of claim 7, wherein forming the mobile-specific data comprises forming multimedia data that is compatible with a rendering function of the mobile device.

9. The method of claim 1, wherein the local area network comprises a Universal Plug and Play network.

10. The method of claim 1, wherein the mobile device comprises a cellular phone.

11. The method of claim 1, wherein the mobile-specific service comprises a mobile messaging service.

12. The method of claim 12, wherein the mobile messaging service comprises at least one of Short Message Service and Multimedia Message Service.

13. The method of claim 1, wherein the mobile-specific service comprises a voice communication service.

14. The method of claim 13, wherein the voice communication service comprises any combination of Session Initiation Protocol (SIP) and Voice Over IP.

15. The method of claim 1, wherein the mobile-specific service comprises at least one of a SIP registrar service, a SIP redirect service, and a SIP proxy service.

16. A processor-readable medium having instructions stored thereon which are executable by a data processing arrangement capable of being coupled to a local area network that provides ad-hoc connectivity to consumer electronics devices, the instructions executable by the data processing arrangement for performing steps comprising:

advertising, via the local area network, a mobile-specific service that is provided at least in part by the data processing arrangement;

receiving, in response to advertising the mobile-specific service, a request for the mobile-specific service from a mobile device that is configured to operate on the local area network; and

providing the mobile-specific service to the mobile device via the local area network in response to the request.

17. The processor-readable medium of claim 16, wherein the steps further comprise:

receiving, from the mobile device, mobile-specific data that is transferred via the mobile-specific service;

forming, based on the mobile-specific data, translated data that is specific to a consumer electronics device coupled to the local area network; and

sending the translated data to the consumer electronics device via the local area network.

18. The processor-readable medium of claim 16, wherein the local area network comprises a Universal Plug and Play network.

19. The processor-readable medium of claim 16, wherein the mobile-specific service comprises any combination of a Short Message Service, a Multimedia Message Service, a

Session Initiation Protocol (SIP), a Voice Over IP service, a SIP registrar service, a SIP redirect service, and a SIP proxy service.

20. A processor-readable medium having instructions stored thereon which are executable by a mobile data processing arrangement capable of being coupled to a local area network that provides ad-hoc connectivity to consumer electronics devices, the instructions executable by the mobile data processing arrangement for performing steps comprising:

discovering, via the local area network, a mobile-specific service that is provided at least in part by a provider device coupled to the local area network;

sending a request for the mobile-specific service to the provider device via the local area network; and

utilizing the mobile-specific service via the provider device.

21. The processor-readable medium of claim 20, wherein the steps further comprise sending, via the provider device, data targeted for a consumer electronics device coupled to the local area network.

22. The processor-readable medium of claim 20, wherein the local area network comprises a Universal Plug and Play network.

23. The processor-readable medium of claim 20, wherein the mobile-specific service comprises any combination of a Short Message Service, a Multimedia Message Service, a Session Initiation Protocol (SIP), a Voice Over IP service, a SIP registrar service, a SIP redirect service, and a SIP proxy service.

24. The processor-readable medium of claim 20, wherein the mobile data processing arrangement comprises a cellular phone.

25. A system comprising:

a local area network configured to provide ad-hoc data exchanges between consumer electronics devices capable of being coupled to the local area network;

means for advertising, via the local area network, a mobile-specific service that is provided at least in part by a service provider device coupled to the local area network;

means for causing a mobile device to subscribe to the mobile-specific service via the local area network; and

means for causing the mobile device to utilize the mobile-specific service via the local area network.

26. The system of claim 25, further comprising:

means for receiving mobile-specific data at the service provider device;

means for translating the mobile-specific data to data that is specific to at least one of the consumer electronics devices; and

means for sending to the at least one consumer electronics devices the data that is specific to the at least one consumer electronics devices.

27. The system of claim 25, further comprising:

means for receiving data at the service provider device via the mobile-specific service, wherein the data is specific to a consumer electronics device that is coupled to the local area network;

means for forming, based on the data, mobile-specific data that is compatible with the mobile-specific service; and

means for sending the mobile-specific data to the mobile device.

28. An apparatus comprising:

a network interface capable of being coupled to a local area network that provides ad-hoc connectivity to consumer electronics devices;

a processor coupled to the network interface; and

a memory coupled to the processor, the memory containing instructions that cause the processor to,

advertise, via the local area network, a mobile-specific service that is provided at least in part by the apparatus;

receive a request for the mobile-specific service from a mobile device that is capable of operating on the local area network in response to advertising the mobile-specific service; and

provide the mobile-specific service to the mobile device via the local area network in response to the request.

29. The apparatus of claim 28, wherein the instructions further cause the processor to,

receive, from the mobile device, mobile-specific data that is transferred via the mobile-specific service;

form, based on the mobile-specific data, translated data that is specific to a consumer electronics device coupled to the local area network; and

send the translated data to the consumer electronics device.

30. The apparatus of claim 28, wherein the local area network comprises a Universal Plug and Play network.

31. The apparatus of claim 28, wherein the mobile-specific service comprises any combination of a Short Message Service, a Multimedia Message Service, a Session Initiation Protocol (SIP), a Voice Over IP service, a SIP registrar service, a SIP redirect service, and a SIP proxy service.

32. The apparatus of claim 28, wherein the mobile-specific service is provided by a server entity located outside of the local area network.

33. The apparatus of claim 28, wherein the mobile-specific service is provided by a server entity located within the local area network.

34. A mobile terminal comprising:

a network interface capable of being coupled to a local area network that provides ad-hoc connectivity to consumer electronics devices;

a processor coupled to the network interface; and

a memory coupled to the processor, the memory containing instructions that cause the processor to,

discover, via the local area network, a mobile-specific service that is provided at least in part by a provider device coupled to the local area network;

send a request for the mobile-specific service to the provider device; and

utilize the mobile-specific service via the provider device.

35. The mobile terminal of claim 34, wherein the instructions further cause the processor to, send, via the mobile-specific service, data targeted for a consumer electronics device coupled to the local area network.

36. The mobile terminal of claim 34, wherein the local area network comprises a Universal Plug and Play network.

37. The mobile terminal of claim 34, wherein the mobile-specific service comprises any combination of a Short Message Service, a Multimedia Message Service, a Session Initiation Protocol (SIP), a Voice Over IP service, a SIP registrar service, a SIP redirect service, and a SIP proxy service.

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