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(54) SYSTEM AND METHOD FOR PROVISIONING DEVICE MANAGEMENT TREE PARAMETERS OVER A CLIENT PROVISIONING PROTOCOL

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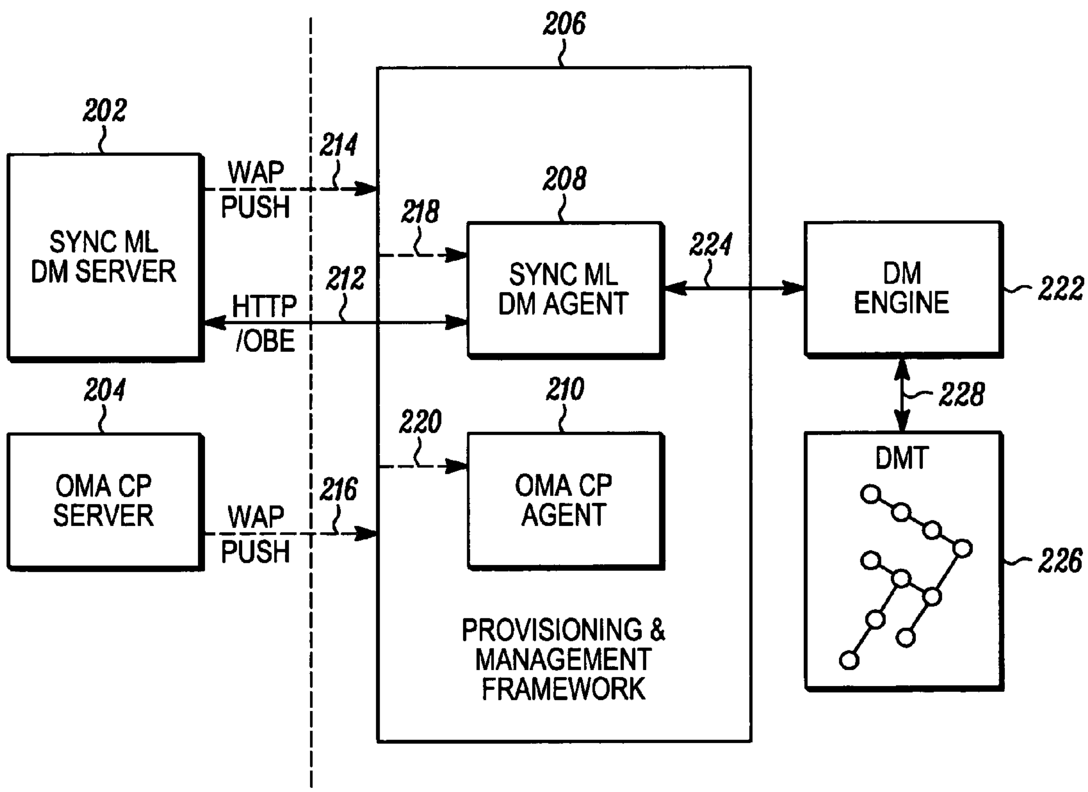
(57) ABSTRACT

A client device (**102**) of a communication system (**100**) comprising a provisioning and management framework (**206**). The framework (**206**) receives (**404**) a client provisioning document from a source (**110**), and the client provisioning document includes a device management characteristic. The client device (**102**) then identifies (**408**) a device management characteristic from the client provisioning document. Thereafter, the client device (**102**) provides (**424**) data based on the device management characteristic of the client provisioning document to a device management tree (**226**, **426**).



200

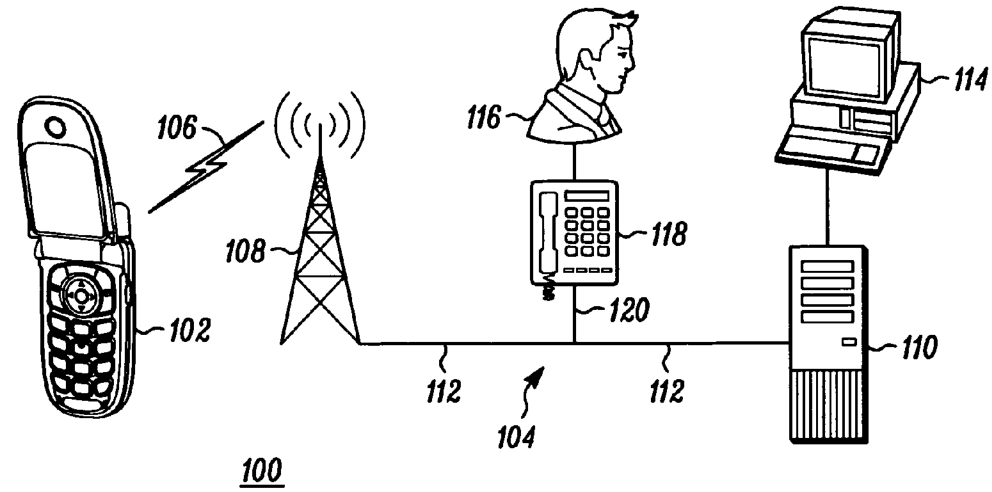

106
116
114
118
108
120
102
110
112
112
104
100

FIG. 1

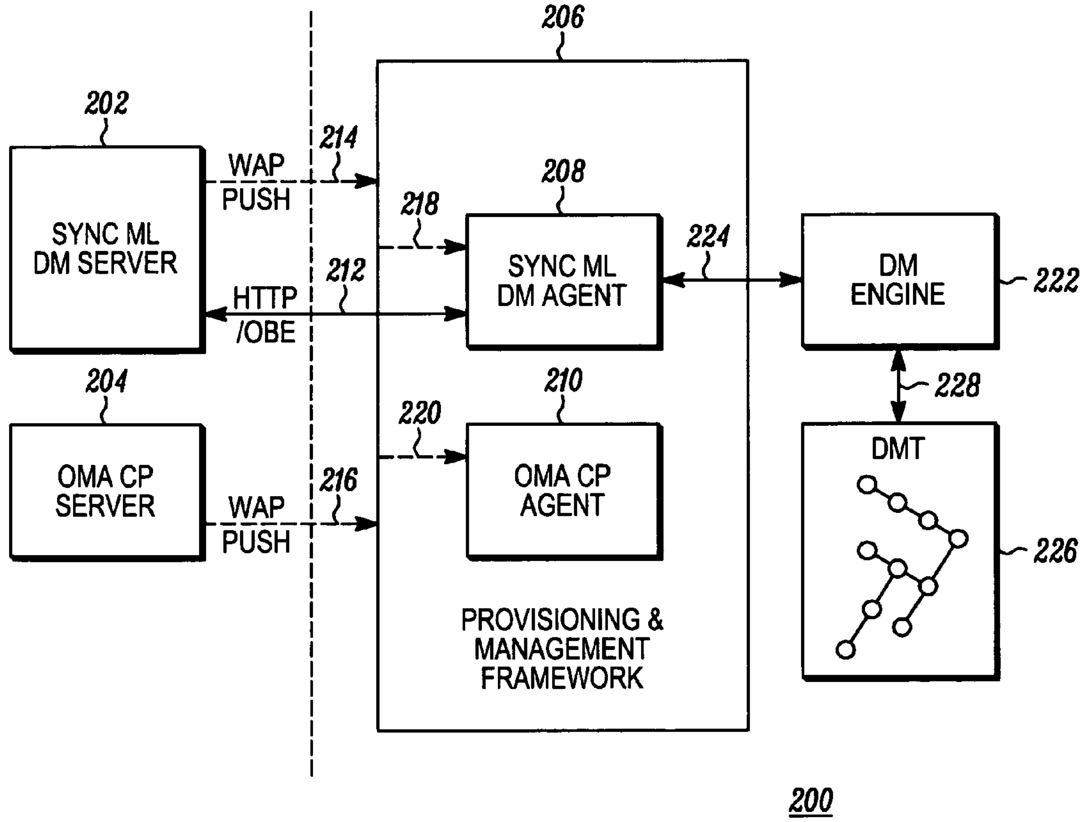

206
202
214
WAP
PUSH
208
218
SYNC ML
DM SERVER
224
HTTP
/OBE
212
SYNC ML
DM AGENT
DM
ENGINE
222
228
204
210
220
OMA CP
SERVER
216
WAP
PUSH
OMA CP
AGENT
DMT
226
PROVISIONING &
MANAGEMENT
FRAMEWORK
200

FIG. 2

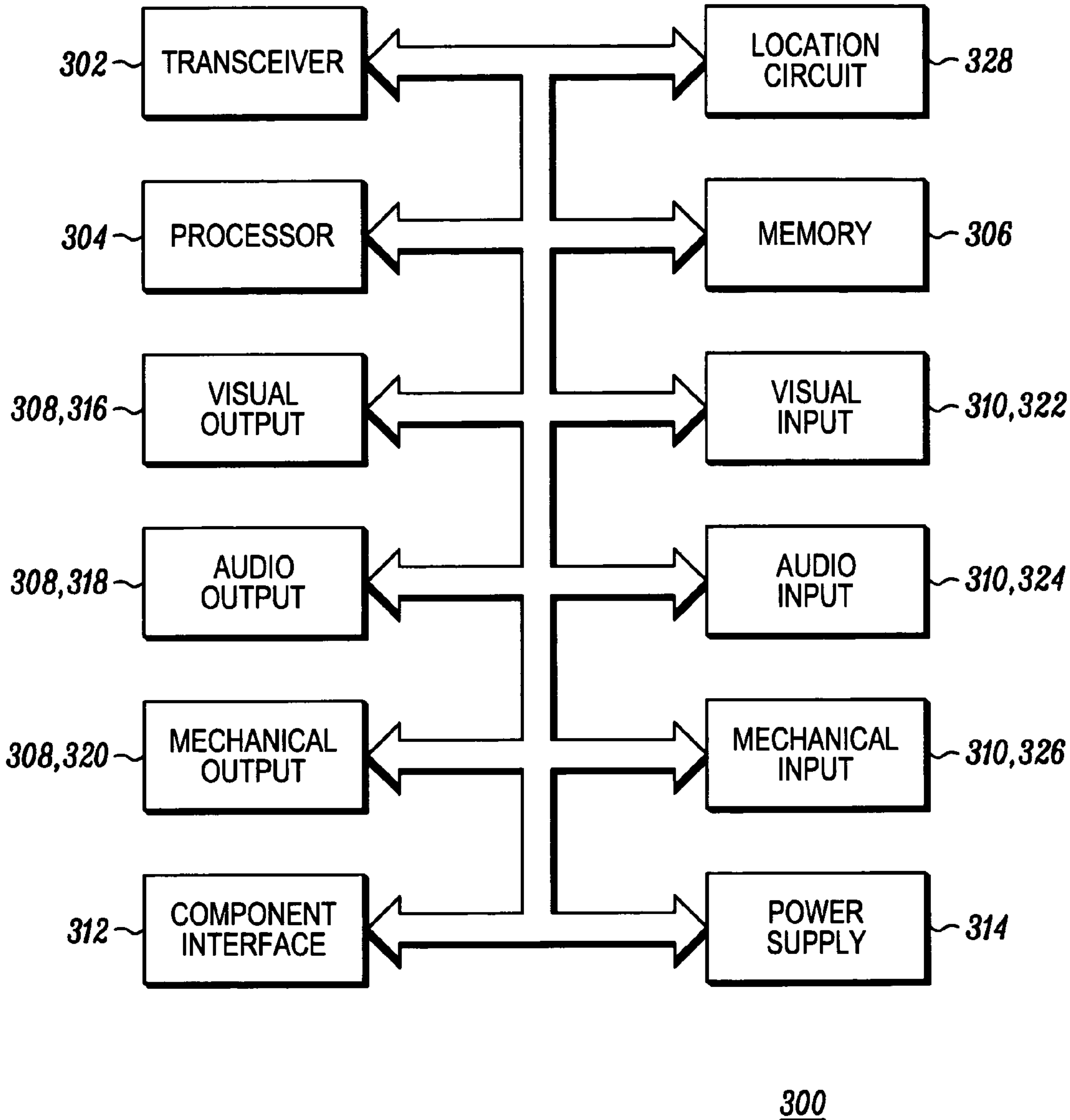

302
TRANSCEIVER
304
PROCESSOR
308,316
VISUAL OUTPUT
308,318
AUDIO OUTPUT
308,320
MECHANICAL OUTPUT
312
COMPONENT INTERFACE
LOCATION CIRCUIT
328
MEMORY
306
VISUAL INPUT
310,322
AUDIO INPUT
310,324
MECHANICAL INPUT
310,326
POWER SUPPLY
314
300

FIG. 3

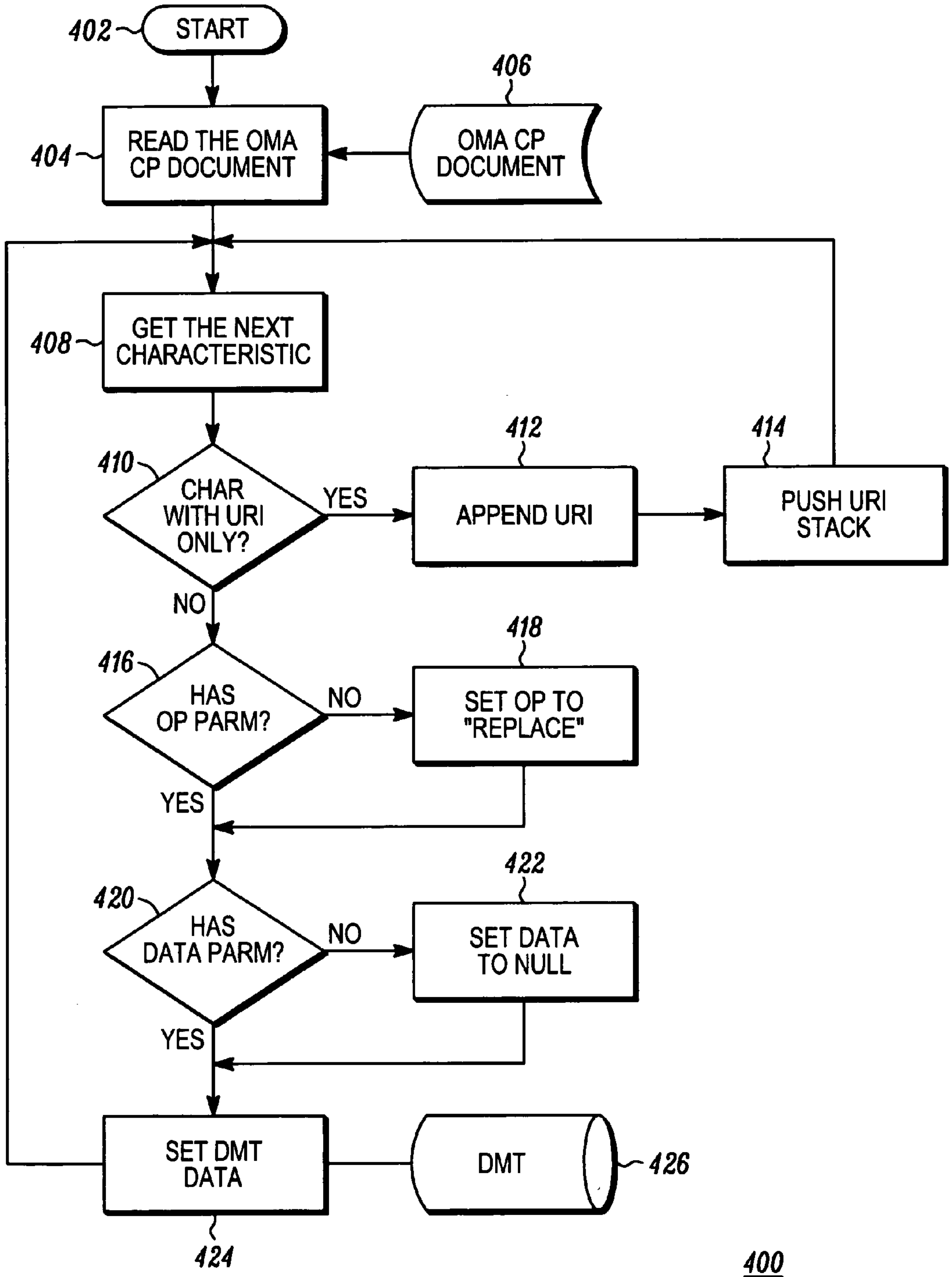

402
START
406
404
READ THE OMA CP DOCUMENT
OMA CP DOCUMENT
408
GET THE NEXT CHARACTERISTIC
410
CHAR WITH URI ONLY?
YES
412
APPEND URI
414
PUSH URI STACK
NO
416
HAS OP PARM?
NO
418
SET OP TO "REPLACE"
YES
420
HAS DATA PARM?
NO
422
SET DATA TO NULL
YES
SET DMT DATA
DMT
426
424
400

FIG. 4

```
502 ~ <characteristic type="SYNCML-DM">
    504 ~ <parm name="URI" value="./DevDetail/Ext/Conf/Log"/>
    506 ~ <characteristic type="SYNCML-DM">
        508 ~ <parm name"URI" value="FileName"/>
        510 ~ <parm name"OP" value="REPLACE"/>
        512 ~ <parm name"DATA" value="log.txt"/>
    514 ~ </characteristic>
    516 ~ <characteristic type="SYNCML-DM">
        518 ~ <parm name"URI" value="Level"/>
        520 ~ <parm name"OP" value="REPLACE"/>
        522 ~ <parm name="DATA" value="3"/>
    524 ~ </characteristic>
526 ~ </characteristic>
```

500

FIG. 5

SYSTEM AND METHOD FOR PROVISIONING DEVICE MANAGEMENT TREE PARAMETERS OVER A CLIENT PROVISIONING PROTOCOL

FIELD OF THE INVENTION

[0001] The present invention relates generally to the field of systems and methods for managing mobile electronic devices from a remote location. More particularly, the present invention relates to a system and method for updating applications and files of a client device via a wireless communication network.

BACKGROUND OF THE INVENTION

[0002] Computing devices may have different capabilities and features based on the applications installed in their memory. The applications may be pre-installed to a computing device before purchase by a customer or installed after purchase by a customer or service technician via a storage media, such as a magnetic or optical disk. For computing devices that communicate with a computer network, applications may be installed after a customer or service technician downloads the applications to the computing device.

[0003] Installations of applications and updates on client devices present other issues that are not a concern for wired devices. Users of client devices frequently need access to a variety of information, but such information is not as readily available as wired connections due to the limited bandwidth of wireless connections. Also, the traffic experienced by a client device should be minimized in order to minimize power drain on the device's power source. Thus, communications are challenged to maximize the quality of information provided to client devices while minimizing the traffic imposed on the wireless connections to the devices.

[0004] A communication that utilizes a large number of applications must have the capability of managing the applications efficiently and proficiently. Two of the more important functions of these systems are client provisioning and device management. Generally, these functions operate independently (with the exception of the WAP profile used in SyncML device management bootstrapping). On the other hand, there are advantages for client provisioning and device management to converge. As application data protocols, both functions are typically generic and, thus, they are quite similar. The major difference between client provisioning and device management is at the level of transport protocols, where client provisioning is confined to a certain type. Thus, the amount and complexity of data that can be provisioned is limited. Accordingly, there is need for a system and method for converging and managing client provisioning and device management to provide significant benefit to communication service providers. There is further need for a system and method that would provide communication service providers with the ability to perform provisioning while in-call and without opening a data connection.

BRIEF DESCRIPTION OF THE DRAWINGS

[0005] **FIG. 1** is a schematic view illustrating an embodiment of a communication system in accordance with the present invention.

[0006] **FIG. 2** is a schematic view illustrating another embodiment of the communication system in accordance with the present invention.

[0007] **FIG. 3** is a block diagram illustrating exemplary internal components of various servers, controllers and devices that may utilize the present invention.

[0008] **FIG. 4** is a flow diagram representing an exemplary operation of a client device in accordance with the present invention.

[0009] **FIG. 5** is a code diagram illustrating an exemplary data format that may be processed by the client device in accordance with the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0010] Client provisioning and device management functions may be combined by defining client provisioning characteristics and parameters that would operate over a device management tree (DMT). For example, Open Mobile Alliance Client Provisioning (OMA CP) characteristics and parameters may be mapped to a DMT to create a new characteristic, namely synchronized markup language-device management (SYNCML-DM), which is recursive. Thus, communication service providers may have a generic and simple parameter provisioning mechanism using existing communication infrastructure. The mechanism would enable the communication service provider to perform provisioning while a user of a client device is communicating with a customer care representative of the communication service provider. The customer care representative would be able to address the user's problems efficiently and provide maximum satisfaction of user experience to the user.

[0011] One aspect of the present invention is a method for a client device of a communication system. The client device receives a client provisioning document from a source. The client device then identifies a device management characteristic from the client provisioning document. Thereafter, the client device stores data based on the device management characteristic of the client provisioning document to a device management tree.

[0012] Another aspect of the present invention is a client device of a communication system comprising a provisioning and management framework. The framework receives a client provisioning document from a source, and the client provisioning document includes a device management characteristic.

[0013] Referring to **FIG. 1**, there is provided a schematic view illustrating a first embodiment **100** of a communication system. The first embodiment **100** includes a client device **102** communicating with a wireless communication network **104** through a wireless link **106**. Any type of wireless link **106** may be utilized for the present invention, but it is to be understood that a high speed wireless data connection is preferred. For example, the wireless communication network **104** may communicate with a plurality of client devices, including the client device **102**, via a cellular-based communication infrastructure that utilizes a cellular-based communication protocols such as Advanced Mobile Phone System (AMPS), Code Division Multiple Access (CDMA), Time Division Multiple Access (TDMA), Global System For Mobile Communications (GSM), Integrated Digital Enhanced Network (iDEN), General Packet Radio Service (GPRS), Enhanced Data for GSM Evolution (EDGE), Universal Mobile Telecommunications System (UMTS), Wideband Code Division Multiple Access (WCDMA) and their variants. The wireless communication network **104** may also communicate with the plurality of client devices via a peer-to-peer or ad hoc system utilizing appropriate communication protocols such as Bluetooth, IEEE 802.11, IEEE 802.16, and the like.

[0014] The wireless communication network **104** may include a variety of components for proper operation and communication with the client device **102**. For example, for the cellular-based communication infrastructure shown in **FIG. 1**, the wireless communication network **104** includes at least one base station **108** and a server **110**. Although a variety of components may be coupled between one or more base stations **108** and the server **110**, the base station and server shown in **FIG. 1** is connected by a single wired line **112** to simplify this example.

[0015] The server **110** is capable of providing services requested by the client device **102**. For example, a user of the device **102** may send a request for assistance, in the form of a data signal (such as text messaging), to the wireless communication network **104**, which directs the data signal to the server **110**. In response, the server **110** may interrogate the device and/or network state and identify one or more solutions. For those solutions that require change or correction of a programmable module of the device **102**, the server **110** may send update data to the device via the wireless link **106** so that the programmable module may be updated to fulfill the request. If multiple solutions are available, then the server **110** may send these options to the device **102** and await a response from the device before proceeding.

[0016] The first embodiment **100** may also include an operator terminal **114**, managed by a service person **116**, which controls the server **110** and communicates with the device **102** through the server. When the server **110** receives the request for assistance, the service person may interrogate the device and/or network state to identify solution(s) and/or select the best solution if multiple solutions are available. The service person **116** may also correspond with the device **102** via data signals (such as text messaging) to explain any issues, solutions and/or other issues that may be of interest the user of the device.

[0017] The first embodiment **100** may further include a voice client device **118** connected to the rest of the wireless communication network **104** via a wired or wireless connection, such as wired line **118**, and is available for use by the service person **116**. The voice client device **118** may also connect to the network via the server **110** or the operator terminal **114**. Thus, in reference to the above examples, a user of the device **102** may send a request for assistance, in the form of a voice signal, to the wireless communication network **106**, which directs the data signal to the server **110**. While the server **110** and or the service person **116** is interrogating the device and/or network state, identifying one or more solutions, and/or selecting an appropriate solution, the service person may correspond with the device **102** via voice signals to explain any issues, solutions and/or other issues that may be of interest the user of the device.

[0018] Referring to **FIG. 2**, there is provided a schematic view illustrating a second embodiment **200** of the communication system. For this system, client provisioning and device management are converged. An example of client provisioning is OMA CP, and an example of device management is SyncML DM. As application data protocols, they are similarly generic, though device management tends to have a meta-data model that is missing from client provisioning.

[0019] The major difference comes at the level of transport protocols. For the example shown in **FIG. 2**, the OMA CP is confined to Wireless Application Protocol Push (WAP Push), which may limit the amount and complexity of data that may be provisioned. On the other hand, the ability to perform provisioning while in-call, and without opening a data connection, may be a significant benefit for the communication service provider. The present invention is not limited to the embodiments shown. For example, SyncML DM binding over short message service (SMS) may be implemented. Preferably, to minimize additional cost, the device management may be implemented on existing infrastructure commonly used by communication service providers, such as OMA CP.

[0020] The client provisioning characteristics and parameters may be defined so that they may operate over the device management tree. A single new characteristic which is recursive may be utilized and is referenced herein as SYNCML-DM. The parameter names include, but are not limited to, a uniform resource identifier (URI) parameter, an operational (OP) parameter and a DATA parameter. The URI parameter is a sync node device management URI. An actual URI may be calculated as concatenation of URI's of nested characteristics and is the only parameter appearing in non-inner-most characteristics. The OP parameter is a node operation, with possible values such as ADD, REPLACE, DELETE and EXECUTE. The DATA parameter is data that may be applied by the operation, if any.

[0021] As shown in **FIG. 2**, the second embodiment **200** includes components at the network **104** and components at one or more client devices **102**. Each component may be a separate device, controller or server, or two or more components may be combined within the same device, controller or server. The components at the network **104** include a device management server **202**, such as a SyncML DM server, and a client provisioning server **204**, such as an OMA CP server. The components at the client device **102** include a provisioning and management framework **206**, which includes a device management agent **208** and a client provisioning agent **210**. For one embodiment, the device management agent **208** and the client provisioning agent **210** are managed by a parameter management frame of the provisioning and management framework **206**.

[0022] The device management server **202** of the network **104** communicates with the device management agent **208** of the client device via communication link **212**. For one embodiment, the signal protocol between the servers **202**, **204** and the agents **208**, **210** is a Hyper Text Transfer Protocol/Open Business Engine (HTTP/OBE). The Open Business Engine is an open source workflow engine written in JAVA, and OBE workflow definitions are written in XML and are typically executed by a J2EE container. The provisioning and management framework **206** also receives sync signals, in the form of WAP Push, from the device management server **202** via connection link **214** and provides the incoming device management signals to the device management agent **208** via connection link **218**. Likewise, the provisioning and management framework **206** further receives provisioning signals, in the form of WAP Push, from the client provisioning server **204** via connection link **216** and provide the incoming provisioning signals to the client provisioning agent **210** via connection link **220**.

[**0023**] The client device further includes a device management engine **222** communicating with the device management agent **208** via connection link **224** and a device management tree **226** communicating with the device management engine via communication link **228**.

[**0024**] Referring to **FIG. 3**, there is provided a block diagram illustrating exemplary internal components of various servers, controllers and devices that may utilize the present invention, such as the client device **102** and the server **110** of **FIG. 1**. The exemplary embodiment includes one or more transceivers **302**, a processor **304**, a memory portion **306**, one or more output devices **308**, and one or more input devices **310**. Each embodiment may include a user interface that comprises at least one input device **310** and may include one or more output devices **308**. Each transceiver **302** may be a wired transceiver, such as an Ethernet connection, or a wireless connection such as an RF transceiver. The internal components **300** may further include a component interface **312** to provide a direct connection to auxiliary components or accessories for additional or enhanced functionality. The internal components **300** preferably include a power supply **314**, such as a battery, for providing power to the other internal components while enabling the server, controller and/or device to be portable.

[**0025**] Referring to the client device **102** and the server **110** of **FIG. 1**, each machine may have a different set of internal components. Each server **110** may include a transceiver **302**, a processor **304**, a memory **306** and a power supply **314** but may optionally include the other internal components **300** shown in **FIG. 2**. The memory **306** of the servers **110** should include high capacity storage in order to handle large volumes of media content. Each client device **102** must include a transceiver **302**, a processor **304**, a memory **306**, one or more output devices **308**, one or more input devices **310** and a power supply **314**. Due to the mobile nature of the client device **102**, the transceiver **302** should be wireless and the power supply should be portable, such as a battery. The component interface **312** is an optional component of the client device **102**.

[**0026**] The input and output devices **308**, **310** of the internal components **300** may include a variety of visual, audio and/or mechanical outputs. For example, the output device(s) **308** may include a visual output device **316** such as a liquid crystal display and light emitting diode indicator, an audio output device **318** such as a speaker, alarm and/or buzzer, and/or a mechanical output device **320** such as a vibrating mechanism. Likewise, by example, the input devices **310** may include a visual input device **322** such as an optical sensor (for example, a camera), an audio input device **324** such as a microphone, and a mechanical input device **326** such as a flip sensor, keyboard, keypad, selection button, touch pad, touch screen, capacitive sensor, motion sensor, and switch.

[**0027**] The internal components **300** may include a location circuit **328**. Examples of the location circuit **328** include, but are not limited to, a Global Positioning System (GPS) receiver, a triangulation receiver, an accelerometer, a gyroscope, or any other information collecting device that may identify a current location of the device.

[**0028**] The memory portion **306** of the internal components **300** may be used by the processor **304** to store and retrieve data. The data that may be stored by the memory portion **306** include, but is not limited to, operating systems, applications, and data. Each operating system includes executable code that controls basic functions of the client device, such as interaction among the components of the internal components **300**, communication with external devices via the transceiver **302** and/or the component interface **312**, and storage and retrieval of applications and data to and from the memory portion **306**. Each application includes executable code utilizes an operating system to provide more specific functionality for the client device, such as file system service and handling of protected and unprotected data stored in the memory portion **306**. Data is non-executable code or information that may be referenced and/or manipulated by an operating system or application for performing functions of the client device.

[**0029**] The processor **304** may perform various operations to store, manipulate and retrieve information in the memory portion **306**. Each component of the internal components **300** is not limited to a single component but represents functions that may be performed by a single component or multiple cooperative components, such as a central processing unit operating in conjunction with a digital signal processor and one or more input/output processors. Likewise, two or more components of the internal components **300** may be combined or integrated so long as the functions of these components may be performed by the client device.

[**0030**] Referring to **FIG. 4**, there is provided a flow diagram representing an exemplary operation **400** of a client device. The exemplary operation **400** begins at step **402**. Next, the client device receives a client provisioning document, such as an OMA CP document, from a source **406**, such as the OMA CP server **204**, and reads the client provisioning document at step **404**. The client device then identifies a characteristic from the client provisioning document at step **408**.

[**0031**] After identifying a characteristic at step **408**, the client device determines whether the characteristic includes a URI parameter but does not include an OP parameter or a DATA parameter at step **410**. If the characteristic only includes a URI parameter, then the client device appends the URI parameter at step **412**, stores the URI parameter by pushing it down on a URI stack at step **414**, and returns to step **408** where the client device identifies the next characteristic from the client provisioning document.

[**0032**] If the client device determines that the characteristic does not only include a URI parameter at step **410**, then the client device determines whether the characteristic includes an OP parameter at step **416**. If not, then the client device sets the OP parameter to "REPLACE" at step **418** and thereafter determines whether the characteristic includes a DATA parameter step **420**. If the characteristic does include an OP parameter, then the client device proceeds directly to step **420** without updating the OP parameter.

[**0033**] The client device determines whether the characteristic includes a DATA parameter at step **420**. If not, then the client device sets the DATA parameter to a NULL value at step **422** and sets device management tree (DMT) data at step **424**. If the characteristic does include a DATA parameter, then the client device proceeds directly to step **424** to set the DMT data. To set the DMT data at step **424**, the client device provides the data to the device management tree **226** (shown in **FIG. 2**). Thereafter, the client device returns to step **408** where the client device identifies the next characteristic from the client provisioning document. The exemplary operation continues until all characteristics of the client provisioning document have been reviewed.

[**0034**] Referring to **FIG. 5**, there is provided a code diagram illustrating an exemplary data format **500** that may be processed by the client device. It is to be understood that **FIG. 5** merely represents an example of the type of data format that may be utilized by the embodiments shown and described herein, and the type of data format is not limited to the one shown in **FIG. 5**. **FIG. 5** shows an example of package setting log parameters which may be encoded in accordance with the present invention. The first line **502** of the exemplary data format **500** identifies the characteristic type of a first node to be SYNCML-DM. The second line **504** of the exemplary data format **500** sets the URI parameter of the first node to be "./DevDetail/Ext/Conf/Log".

[**0035**] The third line **506** of the exemplary data format **500** identifies a second node, nested within the first node, having a characteristic type of SYNCML-DM. The fourth line **508** sets the URI parameter of the second node to be "FileName", the fifth line **510** sets the OP parameter of the second node to be "REPLACE", and the sixth line **512** sets the DATA parameter of the second node to be "log.txt". The seventh line **514** refers back to line **506** and indicates the end of all descriptions of the second node.

[**0036**] The eighth line **516** of the exemplary data format **500** identifies a third node, nested within the first node along with the second node, having a characteristic type of SYNCML-DM. The ninth line **518** sets the URI parameter of the third node to be "Level", the tenth line **520** sets the OP parameter of the third node to be "REPLACE", and the eleventh line **522** sets the DATA parameter of the second node to be "3". The twelfth line **524** refers back to line **516** and indicates the end of all descriptions of the third node. Likewise, the thirteenth line **526** refers back to line **502** and indicates the end of all descriptions of the first node and its nested sub-nodes.

[**0037**] While the preferred embodiments of the invention have been illustrated and described, it is to be understood that the invention is not so limited. Numerous modifications, changes, variations, substitutions and equivalents will occur to those skilled in the art without departing from the spirit and scope of the present invention as defined by the appended claims.

What is claimed is:

1. A method for a client device of a communication system comprising:

receiving a client provisioning document from a source;

identifying a device management characteristic from the client provisioning document; and

storing data based on the device management characteristic of the client provisioning document to a device management tree.

2. The method of claim 1, wherein receiving a client provisioning document from a source includes receiving the client provisioning document from a remote server over a wireless communication link.

3. The method of claim 1, wherein identifying a device management characteristic from the client provisioning document includes identifying at least one of a URI parameter, an OP parameter and a DATA parameter corresponding to the device management characteristic.

4. The method of claim 3, further comprising appending the URI parameter if the client provisioning document only includes the URI parameter.

5. The method of claim 3, further comprising setting the OP parameter to a REPLACE status if the device management characteristic does not include the OP parameter.

6. The method of claim 3, further comprising resetting the DATA parameter to a default value if the device management characteristic does not include the DATA parameter.

7. A client device of a communication system comprising:

a provisioning and management framework configured to receive a client provisioning document, the client provisioning document includes a device management characteristic.

8. The client device of claim 7, wherein the provisioning and management framework receives the client provisioning device from a remote server over a wireless communication link.

9. The client device of claim 7, wherein the device management characteristic corresponds to at least one of a URI parameter, an OP parameter and a DATA parameter.

10. The client device of claim 9, wherein the provisioning and management framework appends the URI parameter if the client provisioning document only includes the URI parameter.

11. The client device of claim 9, wherein the provisioning and management framework sets the OP parameter to a REPLACE status if the device management characteristic does not include the OP parameter.

12. The client device of claim 9, wherein the provisioning and management framework resets the DATA parameter to a default value if the device management characteristic does not include the DATA parameter.

13. The client device of claim 7, further comprising a device management engine communicating with the provisioning and management framework, the device management engine being configured to update a device management tree based on the device management characteristic of the client provisioning document.

* * * * *