INTEGRATED METHOD AND APPARATUS TO MANAGE MOBILE DEVICES AND SERVICES

TECHNICAL FIELD:

The presently preferred embodiments of this invention relate generally to wireless communications systems and methods and, more specifically, relate to over-the-air (OTA) device management procedures for delivering information to a mobile device such as, but not limited to, a cellular telephone.

BACKGROUND:

As the functionality of mobile devices grows at an increasing rate, configuring and maintaining the services and features on the mobile devices becomes a complex and time-consuming task. For instance, enabling Wireless Application Protocol (WAP), CDMA, and data connectivity requires the configuration of multiple settings. Even with the limited features that are currently available, some users do not know how to configure their mobile devices.

Another use case is OTA provisioning and management of new services to mobile devices. Advanced mobile services such as browsing, multimedia messaging, mobile e-mail and calendar synchronization require accurate mobile device settings. The process of remotely managing device settings and applications is referred to as Device Management.

OTA management is defined in the 3GPP2 OTASP/OTAPA, OMA (Open Mobile Alliance) Device Management (OMA DM), and 3GPP2 IOTA-DM standards (IOTA-DM stands for "IP based over-the-air device management").

There are also currently non-Internet Protocol-based techniques for remotely managing mobile devices. For example, the IS-683 standard (TIA/EIA-683-C, Over-the-Air Service

Provisioning of Mobile Stations in Spread Spectrum Systems, March, 2003) defines a protocol that employs air-interface signaling for remotely managing mobile stations. Another example of the use of non-IP protocols includes the use of proprietary Short Message Service (SMS) based protocols.

Device Management is intended to aid the widespread adoption of mobile services, as it provides a mechanism for users to easily subscribe to new services. For network operators this enables a fast and easy way to introduce new services and manage provisioned services, by dynamically adjusting to changes and ensuring a certain level of quality of service.

In June 2003 the OMA released the OMA Device Management (OMA DM) version 1.1.2 standard based on SyncML DM (Synchronization markup language device management). Reference in this regard may be had to: OMA SyncML HTTP Binding, Version 1.1.2,OMA, June 12, 2003; OMA SyncML OBEX Binding, version 1.1.2, OMA, June 12, 2003; OMA SyncML Device Management Protocol, version 1.1.2, OMA, June 12, 2003. http://www.openmobilealliance.org/ release_program/enabler_releases.html; OMA SyncML Representation Protocol, Device Management usage, version 1.1.2, OMA, June 12, 2003; OMA SyncML Device Management Bootstrap, version 1.1.2, OMA, June 12, 2003; OMA SyncML DM DDF DTD (SyncML_dm_ddf_v111_20021002.dtd), version 1.1.2, OMA, June 12, 2003; OMA SyncML Device Management Tree and Descriptions, version 1.1.2, OMA, June 12, 2003; OMA SyncML Device Management Notification Initiated Session, version 1.1.2, OMA, June 12, 2003; OMA SyncML Device Management Security, version 1.1.2, OMA, June 12, 2003; and OMA SyncML WSP Binding, version 1.1.1, OMA, June 12, 2003.

OMA DM provides an integrated and extensible framework for the OTA management needs of 3G mobile devices and beyond. The standard includes the OMA DM protocol specification, which is based on the SyncML DM protocol. The protocol is optimized for OTA management, wherein a basic consideration is related to the resource and bandwidth limitations of mobile devices.

OMA DM, as a mechanism, is very versatile and can be used to manage different types of data objects. Some of the data objects are simple numeric or textual parameters, while others are binary in nature. Numeric objects may include connectivity parameters, such as access point addresses and proxy configurations. Binary objects may include security keys, blocks of data or software modules.

The protocol leverages the WAP 2.0 bootstrap for initial provisioning, and the set of DM protocol specifications for continuous management after the initial provisioning.

Currently, there is no unified way of managing mobile services over-the-air. What is needed, but was not available prior to this invention, is an integrated method for network service providers to manage mobile devices and services using a single mechanism. The currently available different standards for OTA management, such as OMA DM, IOTA-HCM, IS-683, proprietary OTA, OTA Teleservices, and so forth, do not fulfill this need in a satisfactory manner.

SUMMARY OF THE PREFERRED EMBODIMENTS

The foregoing and other problems are overcome, and other advantages are realized, in accordance with the presently preferred embodiments of this invention.

Disclosed is a method, a system and a computer program executable by a data processor or data processors to accommodate a non-IP OTA protocol using an end-to-end IP protocol. The method includes receiving a message from a non-IP entity; using markup language for message and content representation, where in a markup language message non-IP protocol content is identified using a 'Meta' element, where the Meta element

describes the content type as 'non-IP protocol name', and sending the markup language message. The step of using the markup language preferably includes encapsulating received content in the markup language message and using the Meta element to enable a receiver of the markup language message to extract the content. The message received from the non-IP entity may be, as a non-limiting example, an IS-683 message.

An aspect of this invention is a network node operable to accommodate a non-IP OTA protocol using an end-to-end IP protocol. The network node includes a receiver to receive a message that contains non-IP protocol content and a processor operable with a markup language, such as XML, for message and content representation to encapsulate in an XML message the non-IP protocol content that is identified to a potential receiver of the XML message as such using an XML 'Meta' element. The Meta element describes the Meta content type as 'non-IP protocol name'. The network node further includes a transmitter to transmit the XML message containing the non-IP protocol content towards a recipient, and via a wireless network.

A further aspect of this invention is a mobile station having a non-IP client and a receiver to receive a markup language message that contains a non-IP protocol content message using an end-to-end IP protocol. The mobile station further includes a processor operable with the markup language for message and content representation to extract the non-IP based content message from the received message in response to a presence of a 'Meta' element that describes the Meta content type as 'non-IP protocol name'.

A still further aspect of this invention is a network node operable to accommodate a non-IP Over-the-Air (OTA) protocol using an end-to-end IP protocol. The network node comprises receiver means for receiving a message that contains non-IP protocol content, where the receiver means is coupled to data processor means operable with a markup language, such as Extensible Markup Language (XML), for message and content representation for encapsulating in an XML message the non-IP protocol content that is identified to a potential receiver of the XML message as such using an XML 'Meta' element. The Meta element describes the Meta content type as 'non-IP protocol name'. The network node further includes transmitter means coupled to the data processor means

for transmitting the XML message containing the non-IP protocol content towards a recipient, and via a wireless network.

A still further aspect of this invention provides a method for accommodating a non-IP Over-the-Air (OTA) protocol using an end-to-end IP protocol, and includes a step for receiving a message from a non-IP entity; a step for using markup language for message and content representation, where in a message non-IP protocol content is identified using an 'Meta' element, where the Meta element describes the content type as 'non-IP protocol name'; and a step for sending the message with the "Meta" element.

BRIEF DESCRIPTION OF THE DRAWINGS

The foregoing and other aspects of the presently preferred embodiments of this invention are made more evident in the following Detailed Description of the Preferred Embodiments, when read in conjunction with the attached Drawing Figures, wherein:

Fig. 1 is simplified block diagram of a CDMA-based DM network architecture;

Fig. 2 shows an end-to-end architecture for IOTA-DM;

Fig. 3 shows message flow for accommodating an exemplary non_IP DM message, in this non-limiting case an IS-683 DM message; and

Fig. 4 shows a representation of an end-to-end message format in accordance with the example of Fig. 3.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

By way of introduction, the embodiments of this invention can be used to integrate different OTA protocols, resulting in a unified method for managing mobile devices and services. More specifically, the embodiments of this invention enable the handling of non-Internet Protocol (non-IP) management protocols using an IP-based protocol.

The embodiments of this invention enable the use of an IP-based protocol to achieve an integrated approach for OTA management in different networks and with heterogeneous mobile devices in such networks. The use of the preferred embodiments of this invention ensures that wireless service providers have at their disposal a unified mechanism to manage the mobile devices and services offered in their network(s) or service domain.

The preferred embodiments of this invention use a special Meta type, as well as a specific way of using the DM protocol, to achieve backward compatibility with non-IP protocols used in legacy systems. This enables the markup language-based (i.e., the XML-based) DM protocol to be used in different networks for managing mobile devices of varying features.

The use of the preferred embodiments of this invention may result in cost savings through the re-use of existing components of legacy mobile systems.

The use of the preferred embodiments of this invention also provides an integrated method for service providers to manage mobile services offered in a service domain, and aids in integrating legacy features, as well as third generation (3G) features and future generation features.

The preferred embodiments of this invention can be implemented in mobile devices. Existing software components can be reused to develop an integrated entity in the mobile device to support legacy features. New features for 3G and future generations can then be integrated. Thus, the preferred embodiments of this invention support both legacy features and new features, offering an integrated mechanism to accommodate both. For CDMA mobile devices, the OTASP/OTAPA components can be reused.

To place the embodiments of this invention in a proper technological context, reference is made to Fig. 1 for showing a network architecture for DM in an exemplary CDMA network. Though only the CDMA interface is shown, the OMA DM specifications support as well DM over local access technologies, such as low power RF (e.g.,

Bluetooth™) and infrared (e.g., IrDA). Reference is also made to Fig. 2 for showing the end-to-end architecture for IOTA-DM, and includes a mobile station (MS) 1, such as a cellular telephone, also referred to as a mobile equipment (ME), and a DM server 2 coupled to the MS 1 via a wireless network 22, such as a cellular (e.g., a CDMA) wireless network.

In general, the various embodiments of the MS 1 can include, but are not limited to, cellular telephones, personal digital assistants (PDAs) having wireless communication capabilities, portable computers having wireless communication capabilities, image capture devices such as digital cameras having wireless communication capabilities, gaming devices having wireless communication capabilities, music storage and playback appliances having wireless communication capabilities, Internet appliances permitting wireless Internet access and browsing, as well as portable units or terminals that incorporate combinations of such functions. Non-portable devices are also within the scope of these teachings.

In these figures the MS 1 is assumed to include a DM Client 10 that processes the DM messages and commands, performs authorization, and handles access to a DM management tree. Management Objects 12 include parameters, software objects, configuration data blocks and so forth that are associated with applications and services. Management Objects 12 are organized as logically related groups (or subtrees) in a hierarchical tree. The MS 1 is also assumed to include Applications 14.

The DM Server 2 is an entity in the network for managing the services and applications in the MS 1. The DM Server 2 issues DM commands and correctly interprets responses from the DM client 10. The DM Server 2 includes a DM database 2A in which are stored Device Description Framework (DDF) 16 documents. The DDF 16 document is, in the preferred but non-limiting embodiments of this invention, an XML document (Extensible Markup Language (XML) 1.0 (Second Edition), W3C Recommendation, Version 6-October-2000, World Wide Web Consortium) which describes the properties of management objects in the device.

The OMA DM Protocol (OMA SyncML Device Management Protocol, version 1.1.2, OMA, June 12, 2003) defines a management framework and a set of messages exchanged between the MS 1 and the network entity referred to as the DM server 2.

Also shown for completeness in Fig. 1 are various networks (N/W), including by example an ANSI-41 network 30 and an Internet Protocol (IP) network 32. Coupled to the ANSI-41 network 30 is a messaging center (MC) 34, a home location register (HLR) 36, an over-the-air function (OATF) 38 and a mobile switching center/visitor location register pair (MSC/VLR) 40. The MC 34 is coupled to the DM server 2, while the MSC/VLR 40 is coupled to a base station controller/packet control function (BSC/PCF) 42, as is a packet data support node (PDSN) 44 that is associated with the IP network 32. Also associated with the IP network 32 are various Authentication, Authorization and Accounting (AAA) functions 46, 48, and a home agent (HA) 50. The HA 50 couples the IP network 32 to the DM server 2. Above the DM server 2 are shown a plurality of exemplary management functions 60, including Configuration Management 60A, Service Management 60B, CDMA OTA Service Provisioning (OTASP) and OTA Parameter Administration (OTAPA) Management 60C, Enterprise Management 60D and Software Management 60E functions.

Also shown in Fig. 2, interposed between MS 1 and wireless network 22, and between the DM server 2 and the wireless network 22, is a suitable Hyper Text Transfer Protocol (HTTP), Object Exchange Protocol (OBEX) and Short Message Service (SMS) interface 70A and 70B, respectively.

An aspect of this invention relates to the handling of non-IP management protocols using IP-based protocols. In a non-limiting example the non-IP management protocols are described in the content of IS-683 messages (IS-683 is a TIA/EIA and 3GPP protocol for OTA provisioning and OTA parameter administration in the in cdma2000 systems, also known as C.S0016 in 3GPP).

Fig. 3 shows the message flow between at least one non-IP client 20, the DM client 10, the wireless network 22 (e.g., a CDMA network or a Bluetooth™ network), an IP-based

server 24 and at least one non-IP network entity 26, when handling a typical IS-683 message.

Discussing now more specifically the handling of non-IP management protocols using IP based protocols, it is noted that current IP-based management protocols do not support backwards compatibility with a wide range of non-IP protocols. However, an integrated framework requires handling of non-IP protocols as well as IP protocols.

In accordance with an aspect of this invention, non-IP OTA protocols may be handled using an end-to-end IP protocol that uses XML for message and content representation. In an XML message, the non-IP protocol content is identified using a 'Meta' element of XML.

An embodiment of a method in accordance with this invention is shown in Fig. 3, where the Meta element describes the content type as 'non-IP protocol name'. For example, if the XML protocol used is one based on SyncML, and the non-IP protocol is IS-683, the content type may be expressed as 'syncml-dm:cdma-is683'. For a proprietary protocol, such as one known as, but not limited to, the protocol: Nokia-Ericsson OTA (see for example: http://www.forum.nokis.com/main/1,6566,1_47_50,00.html), it may be 'syncml-dm:nokia-ota'.

The process shown in Fig. 3, which may also be viewed as a logic flow diagram, is as follows.

Step A. An IP-based server 24 intercepts a non-IP protocol message, such as an IS-683 Request Message, and encapsulates the non-IP protocol message in an XML message using a 'Meta' element as described above.

Step B. The XML message having the encapsulated non-IP message is sent as a DM message to the DM client 10 via the wireless network 22.

Step C. The XML-capable DM client 10 receives the DM message and identifies the

Meta type as a non-IP message content and extracts the Meta content. The content encoding may be specified in the 'Meta' element using a format element.

Step D. The XML-capable DM client 10 invokes a non-IP client 20 in the MS 1 and passes the Meta content to the non-IP client 20 in the non-IP protocol format. It should be noted that in a typical case the MS 1 may contain multiple ones of the non-IP clients 20, and in this case the DM client 10 will determine the identity of the destination non-IP client 20 from the received message and route the Meta data to the correct destination non-IP client. Note also that there may also typically be multiple non-IP network entities 26 that send messages (IS-683 and other types of messages) that are intercepted and processed by IP-based server 24, as described above.

Step E. The non-IP client 20 processes the message containing the Meta content and may send a response. The response sequence then follows the same sequence as in Steps A, B, C and D. That is, at Step F the DM client 10 encapsulates the non-IP response in a XML message using the 'Meta' element as described above. In Step G the DM message is sent to the IP-based server 24, which extracts the Meta content (Step H) and formats and sends a suitable IS-683 response message back to the non-IP network entity 26 (Step I).

In Step C above, and when using SyncML DM for XML representation, the non-IP client 20 can be invoked by specifying an 'Exec' command in the XML message and specifying the target of the Exec command as a node in the management tree for the non-IP protocol.

If the non-IP protocol is 3GPP2 IS-683, the node name may specify IS-683. For example the Uniform Resource Indicator (URI) of the node may be './root/...cdma/is-683'.

Fig. 4 is a representation of an exemplary end-to-end message in accordance with the method and system described above.

The various method steps of Fig. 3 can be implemented by suitably programmable data processors located at the nodes of interest in Fig. 3, such as in the MS 1, the IP-based server 24 and the DM client 20.

It can be realized that in embodiments of this invention a message received from the non-IP entity 26 can comprises an IS-683 message, and can include different versions of the IS-683 protocol.

It can be realized that in embodiments of this invention the XML message may include additional information for the processing of Meta content, such as a URI and/or "commands", such as one or more commands to invoke a process in the receiver of the XML message to handle the Meta content, where the Meta data may be base 64 (b64) encoded, or encoded in another format, as specified by a 'Format' element.

It can also be realized that in embodiments of this invention the message received from the non-IP entity 26 can comprise, as an example, a Nokia-Ericsson OTA message (see above).

Further, the XML message may comprise a SyncML DM, or OMA DM message, and the XML protocol may comprise a 3GPP2 IOTA-DM message.

It can be appreciated that the use of the embodiments of this invention can provide significant cost savings through the re-use of software components. For each network there are typically thousands of devices, and instead of re-writing the code for existing functions, developers may instead focus on advanced services and functions, and the carriers may then provision these advanced functions and services to the mobile users using a common integrated provisioning mechanism, as described herein.

The foregoing description has provided by way of exemplary and non-limiting examples a full and informative description of the best method and apparatus presently contemplated by the inventors for carrying out the invention. However, various modifications and adaptations may become apparent to those skilled in the relevant arts in view of the foregoing description, when read in conjunction with the accompanying drawings and the appended claims. As but some examples, the use of other similar or equivalent message formats, content representations and the like may be attempted by

those skilled in the art.

However, all such and similar modifications of the teachings of this invention will still fall within the scope of the embodiments of this invention.

Furthermore, some of the features of the preferred embodiments of this invention may be used to advantage without the corresponding use of other features. As such, the foregoing description should be considered as merely illustrative of the principles, teachings and embodiments of this invention, and not in limitation thereof.

CLAIMS

What is claimed is:

1. A method to accommodate a non-IP Over-the-Air (OTA) protocol using an end-to-end IP protocol, comprising:

receiving a message from a non-IP entity;

using markup language for message and content representation, where in a message non-IP protocol content is identified using an 'Meta' element, where the Meta element describes the content type as 'non-IP protocol name'; and

sending the message with the "Meta" element.

2. A method as in claim 1, where using markup language comprises encapsulating received content in an markup language message by using the Meta element.

3. A method as in claim 1, where the message received from the non-IP entity comprises an IS-683 message, including different versions of the IS-683 protocol.

4. A method as in claim 1, where the markup language message includes additional information for the processing of Meta content comprised of at least one of a URI and one or more commands, where at least one command invokes a process in the receiver of the markup language message to handle the Meta content.

5. A method as in claim 1, where Meta data is encoded by a format specified by a format element.

6. A method as in claim 5, where the format is base 64 (b64) encoded

7. A method as in claim 1, where the message received from the non-IP entity comprises

a Nokia-Ericsson OTA message.

8. The method of claim 1, where the markup language message comprises a SyncML DM message.

9. The method of claim 1, where the markup language message comprises an OMA DM message.

10. A method as in claim 1, where a markup language protocol comprises a 3GPP2 IOTA-DM message.

11. A network node operable to accommodate a non-IP Over-the-Air (OTA) protocol using an end-to-end IP protocol, comprising a receiver to receive a message that contains non-IP protocol content and a processor operable with markup language for message and content representation to encapsulate in a markup language message the non-IP protocol content that is identified to a potential receiver of the markup language message as such using an 'Meta' element, where the Meta element describes the Meta content type as 'non-IP protocol name', and further comprising a transmitter to transmit the markup language message containing the non-IP protocol content towards a recipient and via a wireless network.

12. A network node as in claim 11, where the received message comprises an IS-683 protocol message.

13. A network node as in claim 11, where the markup language message comprises additional information related to processing of the Meta content.

14. A network node as in claim 13, where the additional information comprises a URI.

15. A network node as in claim 13, where the additional information comprises at least one command to invoke a process in the receiver of the markup language message to handle the Meta content.

16. A network node as in claim 11, where the Meta content is base 64 (b64) encoded.

17. A network node as in claim 11, where an encoding of the Meta content is specified by a 'Format' element that comprises part of the markup language message.

18. A network node as in claim 11, where the received message comprises a Nokia-Ericsson OTA message.

19. A network node as in claim 11, where the markup language message comprises a SyncML DM message.

20. A network node as in claim 11, where the markup language message comprises a OMA DM message.

21. A network node as in claim 11, where a markup language protocol comprises a 3GPP2 IOTA-DM message.

22. A mobile station, comprising a non-IP client and a receiver to receive a markup language message that contains a non-IP protocol Over-the-Air (OTA) content message using an end-to-end IP protocol and a processor operable with markup language for message and content representation to extract the non-IP based content message from the received markup language message in response to a presence of an markup language 'Meta' element that describes the Meta content type as 'non-IP protocol name'.

23. A mobile station as in claim 22, and further comprising a transmitter coupled to the processor to transmit an markup language message containing a non-IP protocol content response message towards an originator of the non-IP protocol content message.

24. A mobile station as in claim 23, where said processor is further operable to direct the extracted non-IP based content message to the non-IP client, and where the non-IP protocol content response message is originated by the non-IP client.

25. A mobile station as in claim 22, where the non-IP protocol content message comprises an IS-683 protocol message.

26. A mobile station as in claim 22, where the markup language message comprises additional information related to processing of the Meta content.

27. A mobile station as in claim 26, where the additional information comprises a URI.

28. A mobile station as in claim 26, where the additional information comprises at least one command to invoke a process to handle the Meta content.

29. A mobile station as in claim 22, where the Meta content is base 64 (b64) encoded.

30. A mobile station as in claim 22, where an encoding of the Meta content is specified by a 'Format' element that comprises part of the markup language message.

31. A mobile station as in claim 22, where the non-IP protocol content message comprises a Nokia-Ericsson OTA message.

32. A mobile station as in claim 22, where the markup language message comprises a SyncML DM message.

33. A mobile station as in claim 22, where the markup language message comprises an OMA DM message.

34. A mobile station as in claim 22, where a markup language protocol comprises a 3GPP2 IOTA-DM message.

35. A computer readable data storage medium storing computer program instructions for causing a computer that comprises part of a network node to accommodate a non-IP Over-the-Air (OTA) protocol using an end-to-end IP protocol by performing operations

of receiving a message that contains non-IP protocol content; encapsulating in a markup language message the non-IP protocol content that is identified to a potential receiver of the markup language message as such using an markup language 'Meta' element, where the Meta element describes the Meta content type as 'non-IP protocol name'; and transmitting the markup language message containing the non-IP protocol content towards a recipient.

36. A computer readable data storage medium storing computer program instructions for causing a computer that comprises part of a mobile station having a non-IP client to perform operations of receiving a markup language message that contains a non-IP protocol Over-the-Air (OTA) content message using an end-to-end IP protocol; and extracting the non-IP based content message from the received markup language message in response to a presence of a markup language 'Meta' element that describes the Meta content type as 'non-IP protocol name'.

37. A computer readable data storage medium as in claim 36, and further comprising an operation of transmitting a markup language message containing an encapsulated non-IP protocol content response message towards an originator of the non-IP protocol content message.

38. A computer readable data storage medium as in claim 37, further comprising an operation of directing the extracted non-IP based content message to the non-IP client, where the non-IP protocol content response message is originated by the non-IP client.

39. A network node operable to accommodate a non-IP Over-the-Air (OTA) protocol using an end-to-end IP protocol, comprising receiver means for receiving a message that contains non-IP protocol content, said receiver means coupled to data processor means operable with markup language for message and content representation for encapsulating in a markup language message the non-IP protocol content that is identified to a potential receiver of the markup language message as such using a markup language 'Meta' element, where the Meta element describes the Meta content type as 'non-IP protocol name', and further comprising transmitter means coupled to said data processor means for

transmitting the markup language message containing the non-IP protocol content towards a recipient and via a wireless network.

40. A network node as in claim 39, where the received message comprises an IS-683 protocol message.

41. A network node as in claim 39, where the markup language message comprises additional information related to processing of the Meta content.

42. A network node as in claim 41, where the additional information comprises at least one of a URI and at least one command to invoke a process in the receiver of the markup language message to handle the Meta content.

43. A method for accommodating a non-IP Over-the-Air (OTA) protocol using an end-to-end IP protocol, comprising:
a step for receiving a message from a non-IP entity;
a step for using markup language for message and content representation, where in a message non-IP protocol content is identified using an 'Meta' element, where the Meta element describes the content type as 'non-IP protocol name'; and
a step for sending the message with the "Meta" element.

44. A method as in claim 43, where the step for receiving the message receives an IS-683 protocol message.

45. A method as in claim 43, where the step for using markup language comprises using additional information from the message related to processing of the Meta content.

46. A method as in claim 45, where using the additional information comprises using at least one of a URI and at least one command to invoke a process in the receiver of the markup language message to handle the Meta content.