Device Management Scheduling Requirements

Candidate Version 1.0 – 28 Mar 2006

Open Mobile Alliance

OMA-RD-DM_Scheduling-V1_0-20060328-C

Contents

1. SCOPE (INFORMATIVE) 5

2. REFERENCES 6
2.1 NORMATIVE REFERENCES 6
2.2 INFORMATIVE REFERENCES 6

3. TERMINOLOGY AND CONVENTIONS 7
3.1 CONVENTIONS 7
3.2 DEFINITIONS 8
3.3 ABBREVIATIONS 9

4. INTRODUCTION (INFORMATIVE) 10

5. USE CASES (INFORMATIVE) 11
5.1 POWER ON SELF TEST 11
5.1.1 Short Description 11
5.1.2 Actors 11
5.1.3 Pre-conditions 11
5.1.4 Post-conditions 11
5.1.5 Normal Flow 11
5.1.6 Alternative Flow 12
5.2 DEFERRED MANAGEMENT TASKS 12
5.2.1 Short Description 12
5.2.2 Actors 12
5.2.3 Pre-conditions 13
5.2.4 Post-conditions 13
5.2.5 Normal Flow 13
5.2.6 Alternative Flow 13
5.3 SCHEDULED DATA COLLECTION 14
5.3.1 Short Description 14
5.3.2 Actors 14
5.3.3 Pre-conditions 15
5.3.4 Post-conditions 15
5.3.5 Normal Flow 15
5.3.6 Alternative Flow 15
5.4 SCHEDULING WHEN SWITCHED OFF 16
5.4.1 Short Description 16
5.4.2 Actors 16
5.4.3 Pre-conditions 16
5.4.4 Post-conditions 16
5.4.5 Normal Flow 16
5.4.6 Alternative Flow 17
5.4.7 Operational and Quality of Experience Requirements 17
5.5 RECONFIGURATION OF PARAMETERS 17
5.5.1 Short Description 17
5.5.2 Actors 17
5.5.3 Pre-conditions 18
5.5.4 Post-conditions 18
5.5.5 Normal Flow 18
5.5.6 Alternative Flow 18
5.6 COMMON SCHEDULING FUNCTIONALITY 18
5.6.1 Short Description 18
5.6.2 Actors 19
5.6.3 Pre-conditions 19
5.6.4 Post-conditions 19

5.6.5 Normal Flow 19
5.6.6 Alternative Flow 20
6. REQUIREMENTS (NORMATIVE) 21
6.1 HIGH-LEVEL FUNCTIONAL REQUIREMENTS 21
6.1.1 Security 21
6.1.2 Charging 21
6.1.3 Administration and Configuration 22
6.1.4 Usability 22
6.1.5 Interoperability 22
6.1.6 Privacy 22
6.2 OVERALL SYSTEM REQUIREMENTS 23
6.2.1 Schedule 23
6.2.2 Executing Schedules 23
6.2.3 Reporting 24
6.2.4 User Interaction 24
6.2.5 Interface 24
6.2.6 Device 24
6.2.7 Device Management System 25
APPENDIX A. CHANGE HISTORY (INFORMATIVE) 27
A.1 APPROVED VERSION HISTORY 27
A.2 DRAFT/CANDIDATE VERSION 1.0 HISTORY 27

Tables

Table 1: High-Level Functional Requirements 21
Table 2: High-Level Functional Requirements – Security Items 21
Table 3: High-Level Functional Requirements – Charging Items 21
Table 4: High-Level Functional Requirements – Administration and Configuration Items 22
Table 5: High-Level Functional Requirements – Usability Items 22
Table 6: High-Level Functional Requirements – Interoperability Items 22
Table 7: High-Level Functional Requirements – Privacy Items 22
Table 8: High-Level System Requirements 23
Table 9: High-Level System Requirements - Schedule 23
Table 10: High-Level System Requirements – Executing Schedules 23
Table 11: High-Level System Requirements – Reporting 24
Table 12: High-Level System Requirements – User Interaction 24
Table 13: High-Level System Requirements – Interface 24
Table 14: High-Level System Requirements – Device 25
Table 15: High-Level System Requirements – Device Management System 26

1. Scope (Informative)

A number of Device Management specifications have been defined within OMA. See [DMBOOT], [DMDDFDTD], [DMNOTI], [DMPRO], [DMREPU], [DMRD], [DMSEC], [DMSTDOBJ], [DMTND], and [DMTNDS]. These specifications, in its entirety referred to as OMA DM v1.2 specifications in [ERELDDM], define protocol and mechanism to be used between a Device Management Server and a mobile device, data model made available for remote manipulation of a mobile device, security and policy to control the access to a particular resource in the mobile device.

This document defines the requirements for Device Management Scheduling functionality, which is based on OMA DM v1.2 specifications and makes use of the functionalities provided by OMA DM v1.2 specifications to define special capabilities of processing management actions and/or other types of actions in given times and conditions according to the schedule set by the management systems in advance.

2. References

2.1 Normative References

[RFC2119] "Key words for use in RFCs to Indicate Requirement Levels", S. Bradner, March 1997, URL:http://www.ietf.org/rfc/rfc2119.txt

[DMRD] "OMA Device Management Requirements Document, Version 1.2". Open Mobile Alliance™. OMA-RD-DM-V1_2. URL:http://www.openmobilealliance.org

2.2 Informative References

[DMBOOT] "OMA Device Management Bootstrap, Version 1.2". Open Mobile Alliance™. OMA-TS-DM-Bootstrap-V1_2. URL:http://www.openmobilealliance.org

[DMDDFDTD] "OMA DM Device Description Framework, Version 1.2". Open Mobile Alliance™. OMA-TS-DM-DDF-V1_2. URL:http://www.openmobilealliance.org

[DMNOTI] "OMA Device Management Notification Initiated Session, Version 1.2". Open Mobile Alliance™. OMA-DM-Notification-V1_2. URL:http://www.openmobilealliance.org

[DMPRO] "OMA Device Management Protocol, Version 1.2". Open Mobile Alliance™. OMA-TS-DM-Protocol-V1_2. URL:http://www.openmobilealliance.org

[DMREPU] "OMA Device Management Representation Protocol, Version 1.2". Open Mobile Alliance™. OMA-TS-DM-RepPro-V1_2. URL:http://www.openmobilealliance.org

[DMSEC] "OMA Device Management Security, Version 1.2". Open Mobile Alliance™. OMA-TS-DM-Security-V1_2. URL:http://www.openmobilealliance.org

[DMSTDOBJ] "OMA Device Management Standardized Objects, Version 1.2". Open Mobile Alliance™. OMA-TS-DM-StdObj-V1_2. URL:http://www.openmobilealliance.org

[DMTND] "OMA Device Management Tree and Description, Version 1.2". Open Mobile Alliance™. OMA-TS-DM-TND-V1_2. URL:http://www.openmobilealliance.org

[DMTNDS] "OMA Device Management Tree and Description Serialization, Version 1.2". Open Mobile Alliance™. OMA-TS-DM-TNDS-V1_2. URL:http://www.openmobilealliance.org

[ERELDDM] "Enabler Release Definition for OMA Device Management Specifications, version 1.2". Open Mobile Alliance™. OMA-ERELD-DM-V1_2. URL:http//:www.openmobilealliance.org

3. Terminology and Conventions

3.1 Conventions

The key words “MUST”, “MUST NOT”, “REQUIRED”, “SHALL”, “SHALL NOT”, “SHOULD”, “SHOULD NOT”, “RECOMMENDED”, “MAY”, and “OPTIONAL” in this document are to be interpreted as described in [RFC2119].

All sections and appendixes, except “Scope” and “Introduction”, are normative, unless they are explicitly indicated to be informative.

3.2 Definitions

Condition A part of the Schedule used to specify when the scheduled management tasks should be executed. The Device is obliged to monitor if there are Condition matches as specified in the Schedule. Examples for the Condition are the points in time, a certain status of the Device, or the occurrence of some events in the Device.

Device In this context, a Device is a voice and/or data terminal that uses a Wireless Bearer for data transfer. Device types may include (but are not limited to): mobile phones (GSM, CDMA, 3GSM, etc.), data-only terminals, PDAs, laptop computers, PCMCIA cards for data communication, unattended data-only Devices (e.g., vending machines), and smart cards if associated with these Devices. If within a particular context an associated smart card should not be regarded as part of a Device this is marked explicitly.

Device Management Management of the Device configuration and other managed objects of Devices from the point of view of the various Management Authorities. Device Management includes:

- Setting initial configuration information in Devices
- Subsequent updates of persistent information in Devices
- Retrieval of management information from Devices
- Processing events and alarms generated by Devices

Device Management Server (or DM Server) The Device Management Server is an entity that is responsible for maintaining one or more Devices, in whole or in part. Its role is to facilitate the easy maintenance of a Device.

Device Management System A background system capable to interact with a (set of) Device(s) for the purpose of Device Management.

Local Wired Bearer Serial, USB, Ethernet

Management Authority An entity that has the right to perform a specific Device Management function on a Device or manipulate a given data element or parameter. For example, the Network Operator, handset manufacturer, enterprise, or Device owner may be the authority or share authority for managing the Device. One Management Authority may own all Device resources or may share or delegate all or parts of these with/to other Management Authorities

Management Object A logical element that can contain or represent and manage configurable data and software within a Device. The data and/or software includes but is not limited to

- Parameters such as connectivity address, User preferences, proxy settings, User Identity, etc.
- Software such as applications, applets, drivers, modules, firmware and their updates.

A management object may represent the complete device configuration or a portion of a device configuration. There may be multiple Management Objects on a Device with a pre-specified relationship between them. Each Management Object will support the following operations.

- Add/Install – insert new elements into a Management Object.
- Replace/Update – modify existing and/or insert new elements into a Management Object.
- Delete/Uninstall – remove existing elements from a Management Object.
- Query/Enumerate – List all or part of a Management Object.

Network Bearers Wireless Bearer and Local Wired Bearers

Network Operator An entity that is licensed and allocated frequency to operate a public mobile wireless telecommunications network for the purpose of providing publicly available commercial services.

On-Device Tool An application or process that runs on the Device either embedded or installed.

Parameters In this context, parameters are service-related data elements that are stored in the Device and can be manipulated (i.e., changed, added, or deleted) over Network Bearers. For example, system parameters can be used to establish or maintain a bearer session, and application parameters can be used to specify the profile of a particular service, or some parameters may be related with performance characteristics.

Policy The set of Service configuration settings and installed applications which are mandated by the Management Authority.

Radio Software The software within a Device that is coupled with the radio hardware to derive the overall “radio” functionality. Radio software is not to be confused with User applications and content, but has certain

	commonality for functional requirements for device management.
Schedule	A collection of information which contains a list of scheduled management tasks, the condition specifying when those scheduled tasks are supposed to be executed, user interaction specifications, and status reporting specifications.
Scheduling Request	The message received from the DM server that contains the requests to install the new Schedules, reconfigure, terminate, or browse the list of the Schedules on the Device, etc.
Service Provider	An entity that provides and administers a service to a Subscriber and/or User. The Network Operator is often a Service Provider.
Subscriber	The individual or organisation that is paying for service.
Trap	The event that is generated by various sources in the Device which the Device Management System would be interested to know. The Trap source includes for example Radio Software, other OMA Enablers, or device drivers.
User	The individual who is in possession of and operates the Device.
Wireless Bearer	WAN Network Bearers (e.g. GPRS, GSM Data, CDMA), WLAN Bearers (802.1x), Local Wireless Network Bearers (e.g. Bluetooth, IR)

3.3 Abbreviations

CDMA	Code Division Multiple Access
DM	Device Management
DMS	Device Management Server
GPRS	General Packet Radio Service
GSM	Global System for Mobile Communication
IR	InfraRed
MMS	Multimedia Messaging Service
MO	Management Object
OMA	Open Mobile Alliance
OTA	Over The Air
PCMCIA	Personal Computer Memory Card International Association
PDA	Personal Digital Assistant
POST	Power On Self Test
UI	User Interface
USB	Universal Serial Bus
QoS	Quality of Service
WAN	Wide Area Network
WAP	Wireless Application Protocol
WLAN	Wireless Local Access Network

4. Introduction (Informative)

Continually expanding mobile application service gives rise to the growth in the number of Devices with different types and functionalities. Such a growth has made it more difficult and expensive to manage the Device and provide satisfactory customer support. Device administration systems need to be more flexible and cost-effective to address the issue.

Device Management Scheduling aims to further reduce network operation cost by offline processing of the scheduled management commands, and enhance user experience by allowing for example earlier response time to the local events of the device. Device Management Scheduling specifications will provide special capabilities of processing management actions and/or other types of actions in given times and conditions according to the schedule set by the management systems in advance.

In addition, Device Management Scheduling can be also seen as common scheduling platform to be utilized by general applications or other OMA enablers to their specific needs for scheduling capability, which can be managed by the remote server.

A Device is any User terminal which is primarily used in mobile scenarios. They may be equipped with a smart card (where applicable), which is under the sphere of influence of a specific Management Authority. The scope of Device Management includes both the Device itself and smart card. A Device could be, for example, a WAP- or MMS-capable handheld, a smart phone, PDA, or a notebook computer. PDAs, handhelds, smart phones and notebooks can be attached to a wireless modem via hardware integration, cable, IR, and Bluetooth.

Each of the requirements may limit the target Device to the specific subset of capabilities of a Device considering the fact that each of the Devices has different constraints from each other due mainly to capabilities in particular for mobile phone handset. When such requirements or use cases are specified, the capabilities of Device(s) that each requirement or use case is targeting should clearly be described in this specification. *Devices which are under the control of a Management Authority should support transparent forced setting of all parameters covered by the Management Authority Control.*

The actors involved in Device Management include Management Authorities (including Network Operators, Enterprise Managers, Service Providers), Device Management Systems, Subscribers and Users.

The objective of this document is to develop a standardized approach to Device Management Scheduling and its requirements.

5. Use Cases (Informative)

5.1 Power On Self Test

5.1.1 Short Description

The Device performs a scheduled diagnostics task whenever it is powered on. The diagnostics task may include, but not limited to, monitoring configurations or status of the Device or running on-device diagnostics tools. The result of the diagnostics and relevant informations are reported back to the Device Management Server depending on the result.

5.1.2 Actors

- **User**
- **Device**
- **Device Management Server**

5.1.2.1 Actor Specific Issues

- **User:** The User wants to use the Device in its healthiest condition without being bothered by running diagnostics while she/he is doing important jobs using the Device.
- **Device Management Server:** The Device Management Server wants to perform diagnostics of the Device at each power up, but usually it does not know when the Device is switched on or down. From time to time the Device Management Server needs to change the diagnostics procedure. In addition, every time it wants to run the diagnostic in the Device, it needs to establish a session or two with the Device, which may not be cost-efficient sometimes.

5.1.2.2 Actor Specific Benefits

- **User:** User disruption due to running diagnostics is minimal. The Device remains healthy when the User actually uses the Device.
- **Device Management Server:** The Device Management Server can dynamically configure diagnostics procedure. The Device Management Server can make sure that the Device runs diagnostics right after it is switched on. Network operation cost is reduced because most of times establishing sessions is not necessary.

5.1.3 Pre-conditions

There has been a session in advance. The server has scheduled a diagnostics task into the Device during the session.

5.1.4 Post-conditions

The diagnostics is performed at every power on of the Device. The result is reported back to the server and any problem is solved if there is any, through the prompt healing process before the User actually uses the Device.

5.1.5 Normal Flow

1. The User switches on the Device.
2. The Device performs scheduled diagnostics.

3. The Device compares the result of the diagnostics against the reporting criteria to decide if it needs to report the result.
4. If the result of the diagnostics fulfils the reporting criteria, the Device reports the result and/or relevant informations back to the Device Management Server.
5. The Device Management Server analyses the report and initiates corresponding management actions.
6. The problem is solved as a result of the management actions and the Device remains healthy.

5.1.6 Alternative Flow

5.1.6.1 Alternative Flow 1

As the Management Authority gains the experience in customer care, it may find patterns in the problems. In such cases, it is possible to schedule the Device to analyse its status and cure itself if any problem is detected. After curing itself, the Device may also report the result of the self-healing process back to server.

5.1.6.2 Alternative Flow 2

The diagnostics task may also be scheduled to launch in given times or when the value of a certain parameter in the Device falls into specific range.

5.2 Deferred Management Tasks

5.2.1 Short Description

Nicole notices a message box popped up on the display of her phone when she is engaged in an important conversation with her customer using the phone. The message asks her if she would like to upgrade her phone's software. It also contains a short description about the upgrade offer such as the software version, how long it will take, the deadline of the upgrade, and the warning that the phone will reboot automatically during upgrade. After checking the message, she decides to defer it to next available time because she doesn't want to let it disrupt the conversation. Two days later, the same message box appears on her handset. This time, she wants to accept the offer. When she accepts it, her phone is upgraded and result is reported back to the server. The whole process has been scheduled by the server in advance and executed locally by the Nicole's phone.

5.2.2 Actors

- **User**
- **Device**
- **Device Management Server**

5.2.2.1 Actor Specific Issues

- **User:** Since some management tasks such as firmware upgrade or large object download may cause severe inconvenience to the User, there needs to be the way for the User to defer such management tasks as many times as she/he wants. Alternatively, the User may want to proactively initiate the pending or deferred management task rather than wait for the offer to be given repeatedly.

- **Device Management Server:** Device Management Server is going to allow the User to defer the offered management task, but it wants to do it cost-efficiently, therefore it doesn't want to setup sessions every time it presents the offer to the User. The Device Management Server also wants to make sure that the management task will be performed before at certain point in time, the deadline.

5.2.2.2 Actor Specific Benefits

- **User:** The User is given the opportunity to defer and/or choose the best time for the offered management task.
- **Device Management Server:** Device Management Server can provide enhanced customer support cost-effeciently by scheduling the task at once.

5.2.3 Pre-conditions

There has been a session in advance. The server has scheduled a management task into the Device during the session.

5.2.4 Post-conditions

The management task is processed at the time of the User's best convenience. The Device Management Server receives the result of the management task after it is processed.

5.2.5 Normal Flow

1. The Condition matches.
2. The Device prompts the User with offered management task.
3. The User decides if she/he will accept the offer. The process repeats steps 1-3 until the User consents the offer.
4. The Device performs the offered management task.

The Device reports the result back to the Device Management Server.

5.2.6 Alternative Flow

5.2.6.1 Alternative Flow 1

The User repeatedly defers the offered management task that the Management Authority needs to enforce before at a certain point in time, the deadline. Finally, it reaches the deadline and the User is forced to accept the offered management tasks. The Device reports the result back to the Device Management Server after completion of the management task.

5.2.6.2 Alternative Flow 2

When a management task is scheduled, it becomes a pending management task that the User can proactively bring up and initiate whenever the User wants. The Device may provide a UI facility to notice the User about the pending management tasks, for example, a beep or an activated icon in the task bar shown in the corner of the display. By clicking upon the icon the User can browse the list of the pending tasks, among which the User selects one to initiate, or the User may configure one so that it will generate a pop-up message along with an alert signal some time later.

5.2.6.3 Alternative Flow 3

When Nicole is asked if she want to upgrade her phone's software, she may defer the offer and configure the notification process herself for such parameters as the interval between the notifications and the type of notifications. Nicole is allowed to do so when the software upgrade was first scheduled.

5.2.6.4 Alternative Flow 4

When Nicole is asked if she want to defer a management task at her phone she may defer the offer and configure the exact time to perform this operation. Nicole can therefore allow the Device and server to defer a management task at a designated time, such as 3:00 AM, without user's interaction.

5.2.6.5 Alternative Flow 5

When Nicole goes abroad with her mobile device. Her device receives a request to perform a management task that involves additional transfer costs while roaming. But, depending on the Device Management Server's policy settings the request is either deferred to the time when Nicole comes back to her home Network (silently stored in her device) or Nicole is asked explicitly whether she wants the immediate task execution irrespective of costs.

5.3 Scheduled Data Collection

5.3.1 Short Description

A Management Authority received a lot of customer complains regarding bad voice quality, rejected phone calls and low data rate. The Management Authority decided to collect monitoring data from a user's perspective in order to analyze the Quality of Service (QoS) problem. The Management Authority would like to insert a data collection profile in the device to collect several vital indicators for QoS. The selected devices belonged to those who have called and complained about the quality of service and some randomly selected subscribers.

The device prompts to James a text message requesting his permission to enable data collection capability on his cell phone., due to a QoS monitoring activity. He examines the collection items and accepted the profile.

5.3.2 Actors

- **User**
- **Device**
- **Device Management Server**
- **Management Authority**

5.3.2.1 Actor Specific Issues

- **User:** The User wants the Network Operator to solve the problems of his device. However, not all subscribers welcome operators collecting data from their mobile devices. Besides privacy concerns, data collection activities consumes CPU power, battery and network bandwidth. On the other hand, some subscribers may welcome proactive monitoring to ensure quality of service. Some subscribers may be willing to exchange for tariff discount by subjecting their mobile devices as data collection samples. Subscriber's consent is required before setting up monitoring schedules. And the consent also depends on what is collected, what is the effect on the mobile device with collection activities.
- **Device Management Server:** Two variables in the data collection activity. One is the time variable, which includes the time of occurrence and the repetitiveness in time. The other one is the managed objects to be monitored and

collected. It would off-load a Device Management Server's work if a mobile device can remember these two variables and deliver reports without Device Management Server's intervention. Not all mobile devices have all the memory, battery capacity and computing power to continuously maintain these chronic jobs on behalf of a Device Management Server. It is possible that a Device Management Server needs to remember collection profiles on a device basis.

- **Management Authority:** The Management Authority is interested in improving the QoS of the services offered to the subscribers.

5.3.2.2 Actor Specific Benefits

- **User:** The User can use his phone since the QoS problems are solved. (The User is given the choice to participate in exchange of consistent quality of service or tariff discount).
- **Device Management Server:** Device Management Server can provide enhanced customer support cost-efficiently by getting valuable performance data from user's point of view.
- **Management Authority:** The Management Authority is able to collect data from the subscriber's devices to improve the QoS.

5.3.3 Pre-conditions

The device is capable of receiving and executing a Schedule.

5.3.4 Post-conditions

The management task is processed at the time of the User's best convenience. The Device Management Server receives the result of the management task after it is processed.

5.3.5 Normal Flow

1. The Device Management Server requests to the Device the permission to run the schedule for running data collection profile on the Device
2. The Device prompts the User to ask authorisation for inserting and running the data collection profile on the Device.
3. The User accepts the offer.
4. The Schedule is setup on the device.
5. The Device performs the data collection task
7. The Device reports the result back to the Device Management Server from time to time.

5.3.6 Alternative Flow

5.3.6.1 Alternative Flow 1

The User accepted offer of data collection profile and the data collection activity has been in action for a while. The User changes his mind and wants to terminate it. The User disables it and subsequently the Device Management Server is informed about this and removes the schedule from the Device.

5.4 Scheduling When Switched Off

5.4.1 Short Description

Isabel has scheduled a boring SW upgrade action to be done at a time that will not bother her day to day work, so she decides to schedule it at 12:00 am. However this has been a long working day, and decides to go to bed early, at 10:00 pm she decides to switch her phone off, the device is capable of handling the missed Schedules and offers Isabel the possibility to complete the Schedule after the phone is switched on again.

5.4.2 Actors

- **User**
- **Device**
- **Management Authority**

5.4.2.1 Actor Specific Issues

- **User:** The User would like to be able to not be disturbed with management actions.
- **Management Authority:** The Management Authority is interested in making sure some management actions can be done are done within a period of time and with as less disturbance to the user as possible.

5.4.2.2 Actor Specific Benefits

- **User:** The User is provided with the capability to decide, before switching the phone off, to decide whether or not he wants to execute some prescheduled management actions.
- **Management Authority:** The Management Authority is able to offer their customers the possibility to check if they want the device to execute the management actions before letting the device Power Off.

5.4.3 Pre-conditions

The device is capable of receiving and executing a Schedule. And, the Schedule has been correctly installed on the device.

5.4.4 Post-conditions

n/a.

5.4.5 Normal Flow

1. The device is switched off.
2. During the period of time the device is switched off, a schedule was intended to be executed.
3. The Mobile is switched on.
4. The Device detects that a schedule was missed.

5. The user or DM server is informed of the missed schedule(s) and given the option of performing the missed schedule now.

5.4.6 Alternative Flow

5.4.6.1 Alternative Flow 1

When the mobile is switched on the Device invokes the scheduled tasks without prompting the user.

5.4.6.2 Alternative Flow 2

The device may be aware of the schedules that are intended to be executed when the user attempts to switch off the device and may inform the user of the possibility to execute them before the device is switched off.

5.4.7 Operational and Quality of Experience Requirements

5.5 Reconfiguration of Parameters

5.5.1 Short Description

The DM Server creates schedules that include a group of parameters among which some are preferred in one situation and others in another situation. After installation of the schedules, the preferred parameters are selected and used over time based on the schedules.

5.5.2 Actors

- **User**
- **Device**
- **Device Management Server**

5.5.2.1 Actor Specific Issues

- **User:** The User wants to be able to have as much quality of service in the device as possible.
- **Device Management Server:** The Device Management Server wants to be able to send the device a Schedule so that in certain conditions, some parameters of the device can be modified.

5.5.2.2 Actor Specific Benefits

- **User:** The parameters of the device can be modified without user intervention on some specific conditions.
- **Management Authority:** The Device Management Server can make sure some parameters of the device can be modified on certain conditions without having to access the device each time he wants to change the parameters.

5.5.3 Pre-conditions

- The Device has been provisioned and is capable of interacting with the DM server.
- The DM Server has sufficient access right to run the schedules in the Device.
- Device has sufficient resource (e.g. processing power, memory) to run the schedules requested by the DM Server.
- The DM Schedule has been already been installed on the device.

5.5.4 Post-conditions

- The schedules are installed in the Device and, over time, different sets of the parameters are selected and used among the group of parameters that are included in the schedules.
- The device's parameters can be modified based on the scenarios and circustances.

5.5.5 Normal Flow

1. The schedule is triggered.
2. Device selects and uses some of the parameters among the group of parameters that are included in the schedules.
3. Optionally, the device may inform the server about the reconfigured parameters.

5.5.6 Alternative Flow

5.5.6.1 Alternative Flow 1

- Device may ask for User Confirmation before parameters reselection.
- Device may send status report to the DM Server after parameters reselection.

5.6 Common Scheduling Functionality

More and more On-device Tools such as Device Health Diagnostic Tools, Scan Engines, Loggers, and Monitors are becoming in use in mobile environment. One of the integral features of those tools is the ability to schedule their invocations. It is highly desirable to define one common scheduling framework and provide it for those tools.

5.6.1 Short Description

The DM Server creates schedules to control the invocation of an On-Device Tool. The schedule consists of the information such as when to start and stop the tool, which arguments to be used for each invocation, etc. After installation of the schedules, the tool is being invoked automatically with proper arguments based on the schedules, for example on regular basis, after erroneous operation, or any other events.

5.6.2 Actors

- **User**
- **Device**
- **Device Management Server**

  Management Authority

5.6.2.1 Actor Specific Issues

- **User:** Different and inconsistent user experience should be avoided.
- **Device:** Having various tools on the device with different implementation of their own but the similar scheduling functionalities is not desirable with regards to the efficient use of limited resources of the device and the efforts for implementation.
- **Management Authority:** The burden of managing the scheduling functionalities of various tools on large number of devices is high.

5.6.2.2 Actor Specific Benefits

- **User:** The User will be provided with consistent user experience when using scheduling functionalities of the various tools on the device.
- **Device:** By having common scheduling functionality reusable by various tools on the device, the burden on the resources and implementation efforts will be reduced.
- **Management Authority:** The burden of managing the scheduling functionalities of various tools on large number of devices will be reduced because one common logic can be applied for all of them.

5.6.3 Pre-conditions

The Device has been provisioned and is capable of interacting with the DM server. The DM Server has sufficient access right to run the schedules in the Device. Device has sufficient resource (e.g. processing power, memory) to run the schedules requested by the DM Server.

5.6.4 Post-conditions

The schedules are installed in the Device and On-Device Tools are being invoked according to the schedule.

5.6.5 Normal Flow

1. DM Server creates schedules to control the invocation of an On-Device Tool.
2. The schedules are sent to the Device and verified to the extent possible, checked for correctness (form, conflicts, etc).
3. Device asks User Confirmation and User gives authorization to run the schedules or modify the schedule.
4. Device installs the schedules and sends confirmation to the DM Server to indicate that the schedules are accepted.
5. Over time, based on the schedules, Device invokes the tool with proper arguments according to the schedules.

5.6.6 Alternative Flow

- The schedules may be installed silently skipping step 3 in Normal Flow.
- The User may modify the schedules setup by the DM server.

6. Requirements (Normative)

6.1 High-Level Functional Requirements

Label	Description	Enabler Release
DM-SCHED-HLFR-01 Ref: UC 5.6	DM Scheduling enabler SHOULD be capable of providing the common scheduling functionalities for other OMA enablers and general applications.	DM Scheduling xx
DM-SCHED-HLFR-02	DM Scheduling enabler SHALL provide the functionality by which the DM server can schedule management tasks for the Device.	DM Scheduling 1.0
DM-SCHED-HLFR-03	Device Management Client SHALL be able to execute DM Schedules without having an active session to the DM Server.	DM Scheduling 1.0
DM-SCHED-HLFR-04	DM Scheduling enabler SHALL support the installation, reconfiguration, termination, and getting information of the Schedules on the Device.	DM Scheduling 1.0
DM-SCHED-HLFR-05	DM Scheduling enabler SHALL support the user interaction functionalities provided and driven by the Device, for example, giving information to the User about the Schedules on the Device.	DM Scheduling 1.0
DM-SCHED-HLFR-06	When there is a Condition Match the schedules task SHALL be executed.	DM Scheduling 1.0
DM-SCHED-HLFR-07	DM Scheduling enabler SHOULD be able to report results or status, during and after the completion of scheduling tasks.	DM Scheduling 1.0
DM-SCHED-HLFR-08	The events or status changes occurred to a Schedule in the Device SHOULD be able to be reported to the DM Server.	DM Scheduling 1.0
DM-SCHED-HLFR-09	DM Scheduling enabler SHALL provide an error-reporting capability.	DM Scheduling 1.0

Table 1: High-Level Functional Requirements

6.1.1 Security

Label	Description	Enabler Release
DM-SCHED-SEC-01	The integrity of the Schedules SHALL be protected during the installation process and modification by the DMS..	DM Scheduling 1.0
DM-SCHED-SEC-02	The DM Server SHALL have the sufficient access rights for the requested management actions that are scheduled.	DM Scheduling 1.0
DM-SCHED-SEC-03	Only Authenticated DM Server with the right access conditions SHALL be able to create, modify and access Schedules on the Device.	DM Scheduling 1.0

Table 2: High-Level Functional Requirements – Security Items

6.1.2 Charging

Label	Description	Enabler Release

Table 3: High-Level Functional Requirements – Charging Items

6.1.3 Administration and Configuration

Label	Description	Enabler Release
DM-SCHED-ADM-01	DM Scheduling enabler SHALL provide a mechanism to install and handle Schedules on the Device.	DM Scheduling 1.0
DM-SCHED-ADM-02	The authenticated DM server SHALL be able to find and access the Schedules that are installed on the Device.	DM Scheduling 1.0
DM-SCHED-ADM-03 Ref: UC 5.2	The DM Scheduling enabler SHALL provide mechanism by which the DM Server can specify a maximum delay or deadline in the execution of a Schedule..	DM Scheduling 1.0

Table 4: High-Level Functional Requirements – Administration and Configuration Items

6.1.4 Usability

Label	Description	Enabler Release
DM-SCHED-U-01	The DM Scheduling enabler MAY be capable of offering the User the possibility to defer the execution of the scheduled management task.	DM Scheduling 1.0
DM-SCHED-U-02	The DM Scheduling enabler MAY be capable of offering the User the possibility to alter the timing of the Schedule if the DM server gave permission to do so for that particular Schedule.	DM Scheduling 1.0
DM-SCHED-U-03	The DM Scheduling Client MAY be able to provide information on installed Schedules, e.g. Schedule description, execution time, etc.	DM Scheduling 1.0

Table 5: High-Level Functional Requirements – Usability Items

6.1.5 Interoperability

Label	Description	Enabler Release
DM-SCHED-IOP-01	The DM Scheduling enabler SHOULD be interoperable with other OMA enablers as well as other DM enablers.	DM Scheduling 1.0

Table 6: High-Level Functional Requirements – Interoperability Items

6.1.6 Privacy

Label	Description	Enabler Release
DM-SCHED-PRIV-01	The DM Scheduling enabler MAY provide mechanisms by which the User can reject requests from the DM server for installing and reconfiguring Schedules on the device before the Schedules are installed or reconfigured.	DM Scheduling 1.0
DM-SCHED-PRIV-02	The DM Scheduling enabler MAY be capable of offering the User the possibility to remove a Schedule out of the Device.	DM Scheduling 1.0
DM-SCHED-PRIV-03 Ref: UC 5.2	The DM Scheduling enabler MAY provide the mechanism by which the User is informed of the imminent scheduled tasks so that the User is able to know what is going to happen to his/her Device and defer the execution of the task.	DM Scheduling 1.0

Table 7: High-Level Functional Requirements – Privacy Items

6.2 Overall System Requirements

Label	Description	Enabler Release
DM-SCHED-OSR-01	DM Server and DM Client that are compliant to the requirements in this document SHALL also be fully compliant to DM v1.2 specifications or higher.	DM Scheduling 1.0
DM-SCHED-OSR-02	Scheduling Enabler MAY be capable of synchronizing the server time and the device time.	DM Scheduling 1.0

Table 8: High-Level System Requirements

6.2.1 Schedule

This section will be used to put together such things as what can be scheduled, how it can be scheduled, how to create and continuously manage the schedules, etc.

Label	Description	Enabler Release
DM-SCHED-SCH-01	The DM Scheduling enabler SHALL support scheduling of Device Management Operations.	DM Scheduling 1.0
DM-SCHED-SCH-02	The DM Scheduling enabler SHALL support time based Condition.	DM Scheduling 1.0
DM-SCHED-SCH-03	The DM Scheduling enabler SHOULD support event based Condition. These status and events include, but are not limited to, the Threshold Crossing Events (TCE) of the Management Object value, Traps, etc.	DM Scheduling 1.0
DM-SCHED-SCH-04	DM Schedules SHALL only contain Device Management operations on the Device.	DM Scheduling 1.0
DM-SCHED-SCH-05	Device Management Server SHOULD be able to modify or uninstall already installed Schedules on the Device.	DM Scheduling 1.0
DM-SCHED-SCH-10 Ref: UC 5.6	The schedule SHALL be able to specify the intervals between each invocation of the scheduled tasks for periodic activities.	DM Scheduling 1.0

Table 9: High-Level System Requirements - Schedule

6.2.2 Executing Schedules

Label	Description	Enabler Release
DM-SCHED-EXE-01	The DM Scheduling enabler SHALL provide a mechanism by which the DM server can specify the maximum allowed delay in detecting the specified Condition matches.	DM Scheduling 1.0
DM-SCHED-EXE-02	The DM Server MAY be able to tell the device what to do with the time-based Schedule that were to be done while the Device was switched-off, (perform some or all the missed schedules or discard all of them, as requested by the DM server).	DM Scheduling 1.0
DM-SCHED-EXE-03	The DM Server MAY be able to allow the Device that in case it is aware of the Schedules that are intended to be executed when the the user attempts to switch off the device and it may inform the user of the possibility to execute them before the device is switched off.	DM Scheduling 1.0
DM-SCHED-EXE-05	Overdue Schedules MAY be reported back to the DM Server.	DM Scheduling 1.0

Table 10: High-Level System Requirements – Executing Schedules

6.2.3 Reporting

Label	Description	Enabler Release
DM-SCHED-Report-01	The DM Scheduling enabler SHALL provide mechanisms by which the DM servers are informed of the status of the Schedules on the devices, e.g. the result of performing scheduled management actions, errors, or abnormal conditions occurred to the Schedules, etc.	DM Scheduling 1.0
DM-SCHED-Report-02	The DM Scheduling enabler SHALL provide a mechanism by which the DM server can select the types or characteristics of the status reporting that it wants to be informed of by the DM client.	DM Scheduling 1.0

Table 11: High-Level System Requirements – Reporting

6.2.4 User Interaction

Label	Description	Enabler Release
DM-SCHED-UI-01	It MAY be possible for the User to be informed before the installation, modification, and termination of the Schedules.	DM Scheduling 1.0
DM-SCHED-UI-02 .	User MAY be capable to reject the installation, reconfiguration, and termination of the Schedules.	DM Scheduling 1.0
DM-SCHED-UI-03	It MAY be possible for the User to be informed before the execution of the scheduled management tasks.	DM Scheduling 1.0
DM-SCHED-UI-04 Ref: UC 5.2	User MAY be prompted in order to accept, defer, or reject the execution of the scheduled management tasks.	DM Scheduling 1.0
DM-SCHED-UI-05 Ref: UC 5.2, 5.3	User MAY be allowed to remove a Schedule.	DM Scheduling 1.0
DM-SCHED-UI-06 Ref: Use Case 5.2	User MAY be allowed to modify the time of the execution of a Schedule.	DM Scheduling 1.0
DM-SCHED-UI-07	It MAY be possible for the User to initiate the scheduled task immediately.	DM Scheduling 1.0

Table 12: High-Level System Requirements – User Interaction

6.2.5 Interface

Label	Description	Enabler Release
DM-SCHED-IF-01 Ref: OSR-02	The interface between the Device and the DM server SHALL use the transport and mechanism provided by the underlying DM enablers, i.e. DM v1.2 specifications or higher.	DM Scheduling 1.0
DM-SCHED-IF-02 Ref: OSR-02	The data link between the Device and the DM server SHALL be secured by utilizing the secure connectivity provided by underlying protocol as specified in DM v1.2 specification.	DM Scheduling 1.0

Table 13: High-Level System Requirements – Interface

6.2.6 Device

Label	Description	Enabler Release
DM-SCHED-DEVICE-01	The Device SHALL monitor Condition matches for the execution of the scheduled management tasks on the Device.	DM Scheduling 1.0
DM-SCHED-DEVICE-02	The Device SHOULD support the event based Schedules, for example Threshold Crossing Events (TCE), Traps, etc.	1.0

DM-SCHED-DEVICE-03	The Device SHALL support time based Schedules.	DM Scheduling 1.0
DM-SCHED-DEVICE-04	The Device SHALL first verify to the extent possible the Schedule and be able to reject the request for installing or reconfiguring the schedules if, for example, it cannot support the Schedule, the DM Server does not have sufficient rights.	DM Scheduling 1.0
DM-SCHED-DEVICE-05	When the Condition for the Schedule matches, the Device SHALL execute the scheduled management tasks.	DM Scheduling 1.0
DM-SCHED-DEVICE-06	The Device MAY provide the user interface so that the User may alter, suspend, resume, terminate, and get information of the Schedules on the Device (only for the special Schedules where the DM Server grants such a control to the User).	DM Scheduling 1.0
DM-SCHED-DEVICE-07	The Device MAY provide the user interface to inform and get input from the User before the installation, reconfiguration, and termination of the Schedules on the Device, where the DM Server grants such a control to the User.	DM Scheduling 1.0
DM-SCHED-DEVICE-08	The Device MAY provide the user interface to inform and get input from the User before the execution of the scheduled tasks, in case the DM Server allows this..	DM Scheduling 1.0
DM-SCHED-DEVICE-9	The Device SHALL proactively report the status changes of the Schedules to the DM server if it is requested by the DM server which created them., in case the DM Server provides this schedule with the capability to do so..	DM Scheduling 1.0
DM-SCHED-DEVICE-10	The Device SHALL proactively report the progress of the scheduled management tasks to the DM server if it is requested by the DM server that created them.	DM Scheduling 1.0
DM-SCHED-DEVICE-11	The Device MAY be able to detect the missed time-based Schedules and retroactively perform all the missed schedules as indicated by DM Server (execute them, delay them or discard them informing the Server).	DM Scheduling 1.0
DM-SCHED-DEVICE-12	If allowed to do so by the DM Server, the Device MAY be aware of the Schedules that are intended to be executed when the user attempts to switch off the Device and MAY inform the User of the possibility to execute them before the Device is switched off..	DM Scheduling 1.0
DM-SCHED-DEVICE-13	The Device SHALL store Schedules as Management Objects	DM Scheduling 1.0
DM-SCHED-DEVICE-14	The Device SHALL be able to provide information on the list of the Schedule on the Device to the DM Server with sufficient access rights.	DM Scheduling 1.0
DM-SCHED-DEVICE-15	The Device SHALL be able to give information about the support for the DM Scheduling functionality.	DM Scheduling 1.0
DM-SCHED-DEVICE-16	The Device SHALL be able to receive and process the Scheduling Request from the DM server.	DM Scheduling 1.0
DM-SCHED-DEVICE-17	The Device SHALL send response to the Scheduling Request from the DM server indicating the success or failure.	DM Scheduling 1.0
DM-SCHED-DEVICE-18	The Device SHALL be capable of reporting back to the DM Server the status changes of the Schedule on the Device, in case this was allowed by the DM Server.	DM Scheduling 1.0
DM-SCHED-DEVICE-19	Device SHOULD be able to report to DM Server errors related to Schedule operations.	DM Scheduling 1.0

Table 14: High-Level System Requirements – Device

6.2.7 Device Management System

Label	Description	Enabler Release
DM-SCHED-DMS-01	The DM server SHALL be able to create the Schedules, transfer the Schedules, modify the Schedules, and terminate the Schedules.	DM Scheduling 1.0

DM-SCHED-DMS-02	The DM server SHALL be able to receive and process the status reportings about the Schedule received from the Device.	DM Scheduling 1.0
DM-SCHED-DMS-03	DM server SHOULD be able to specify to the Device what to do with the missed Schedule	DM Scheduling 1.0
DM-SCHED-DMS-04	The DM server SHALL be able to get information of the Schedules on the Device.	DM Scheduling 1.0
DM-SCHED-DMS-05	The DM server SHALL be able to know about the the capability of the Device to support the DM Scheduling functionality.	DM Scheduling 1.0
DM-SCHED-DMS-06	The DM server MAY keep the record for the Schedules it installed on the Device.	DM Scheduling 1.0
DM-SCHED-DMS-07	The DM server SHALL be able to receive and process the status reportings about the Schedule received from the Device.	DM Scheduling 1.0
DM-SCHED-DMS-09	The DM server SHALL be able to receive the response for the Scheduling Request from the Device.	DM Scheduling 1.0

Table 15: High-Level System Requirements – Device Management System

Appendix A. Change History (Informative)

A.1 Approved Version History

Reference	Date	Description
n/a	n/a	No prior version –or- No previous version within OMA

A.2 Draft/Candidate Version 1.0 History

Document Identifier	Date	Sections	Description
Draft Versions OMA-RD-DM_Scheduling-V1_0	14 Mar 2005	new Draft Document	Incorporates first draft.
	14 June 2005	5 and 6	New use Cases and Requirements
	13 Dec 2005	6	New Requirements
	31 Jan 2006	6	Requirements Modification
	08 Feb 2006	Appendix A	History Update
Candidate Versions OMA-RD-DM_Scheduling-V1_0	28 Mar 2006	All	TP approved R&A