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(71) Applicant(s)
THOMSON Licensing

(72) Inventor(s)
Van De Poel, Dirk;Goemaere, Patrick;Jonckheer, Kurt

(74) Agent / Attorney
FB Rice Pty Ltd, L 23 44 Market St, Sydney, NSW, 2000, AU

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(71) Applicant: **THOMSON LICENSING** [FR/FR]; 1-5 rue Jeanne d'Arc, F-92130 Issy-les-Moulineaux (FR).

(72) Inventors: **VAN DE POEL, Dirk**; Zwaluwenlaan 42, F-2630 Aartselaar (FR). **GOEMAERE, Patrick**; Kemphaanlaan 26, B-2960 Brecht (BE). **JONCKHEER, Kurt**; Hessenstraatje 10 bus 43, B-2000 Antwerpen (BE).

(74) Agent: **SCHMIDT-UHLIG, Thomas**; Deutsche Thomson OHG, European Patent Operations, Karl-Wiechert-Allee 74, 30625 Hannover (DE).

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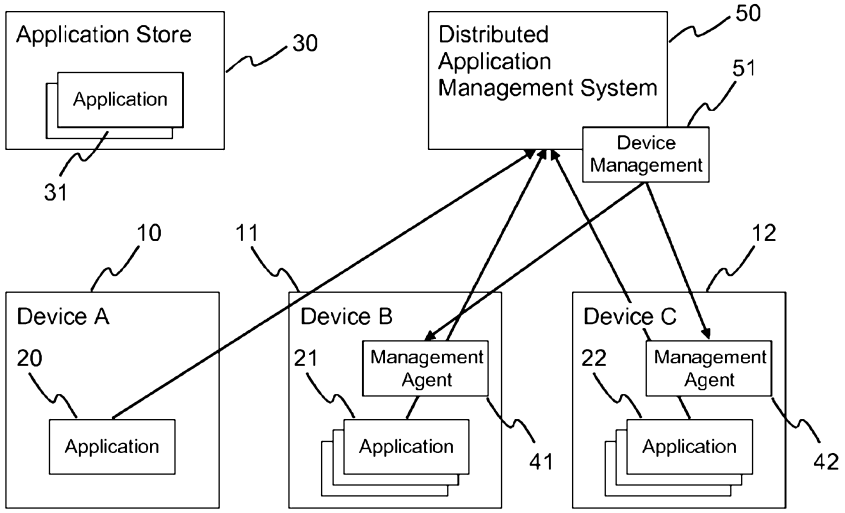

Fig. 2

(57) Abstract: Solution for distributed application life-cycle management A solution for managing applications (20, 21, 22, 31) in a network is proposed. A distributed application management system (50)receives information about a first application (20) installed on a first device (10) in the network and determines whether a second application is required or recommended for the first device or for a second device (11) in the network or whether a further device is required or recommended for the network based on the received information. A device management system (51) then informs a user about a required or recommended second application or a required or recommended further device.

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Solution for distributed application life-cycle management

FIELD OF THE DISCLOSURE

The disclosure relates to a solution for a distributed application life-cycle management, and more specifically to a solution for a distributed application life-cycle management, which is capable of handling interrelated distributed applications on multiple devices.

BACKGROUND OF THE DISCLOSURE

Today, not only traditional personal computers and mobile devices, such as smartphones and tablets, support dynamic installation of applications. Also devices under NSP management (NSP: Network Service Provider), such as broadband gateways and set top boxes, support application life-cycle management, i.e. the process of dynamically (at any point in time) installing, updating and uninstalling applications.

As an example, the Broadband Forum TR-069 CPE WAN Management Protocol (TR-069 Amendment 3 or later) defines a protocol that allows a so-called ACS (ACS: Auto Configuration Server) to dynamically install applications, also referred to as software components, on a CPE device (CPE: Customer Premises Equipment), such as a gateway, a router or a set top box.

European patent application EP 2 184 904 describes a state of the art TR-069 system for performing application life-cycle management on the same device while keeping track of cross-execution environment dependencies, e.g. OSGi (OSGi: Open Services Gateway initiative) and native Linux, as well as service subscription and configuration of needed applications.

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With the spread of more popular smartphones and tablets people are becoming aware of the so-called application stores and get familiar with searching for and installing applications on these devices. However, people are less aware and familiar with the fact that also other devices may support dynamic installation of components.

In addition, there is a trend towards ever more network connected devices and a number of services come with applications for phone or tablet.

Furthermore, multi-screen applications and services are becoming increasingly popular, whereby, for example, video content displayed on a TV is supported by tablet applications providing additional information. Such solutions often depend on a set of applications running on multiple devices, so called “distributed applications”.

Throughout this specification the word "comprise", or variations such as "comprises" or "comprising", will be understood to imply the inclusion of a stated element, integer or step, or group of elements, integers or steps, but not the exclusion of any other element, integer or step, or group of elements, integers or steps.

Any discussion of documents, acts, materials, devices, articles or the like which has been included in the present specification is not to be taken as an admission that any or all of these matters form part of the prior art base or were common general knowledge in the field relevant to the present disclosure as it existed before the priority date of each claim of this application.

SUMMARY OF THE DISCLOSURE

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The present disclosure proposes a method and an apparatus for a distributed application life-cycle management, which are capable of handling interrelated distributed applications on multiple devices.

A method for managing applications in a network, the method comprising:

- receiving, by a distributed application management system, information about a first application of a distributed application installed on a first device being used by a user in the network, wherein the distributed application comprises a set of applications which interface with each other and run on multiple devices to enable a service;
- verifying, by the distributed application management system, available dependencies of the first application based on dependency information in a database, wherein the dependency information comprises required or recommended dependencies between the first application and one or more further applications of the set of applications;
- determining, based on the verification of available dependencies, whether a further application in the set of applications is required or recommended on a further device of the user in the network;
- if it is determined that the further application on the further device is required:

instructing, by the distributed application management system, the further device to install or update the further application on the further device to enable a service to run on multiple devices, where the service includes execution of the first application on the first device interfaced with the further application; and

- if it is determined that the further application is recommended on the further device of the user:

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informing the user on the first device about an option of installing or updating the further application on the further device to enable a service to run on multiple devices, where the service includes execution of the first application on the first device interfaced with the further application.

An apparatus for managing applications in a network, the apparatus comprising:

- an input configured to receive information about a first application of a distributed application installed on a first device in the network, the first device being used by a user, wherein the distributed application comprises a set of applications which interface with each other and run on multiple devices to enable a service;
- a distributed application management system configured to verify available dependencies of the first application based on dependency information in a database to determine whether a further application on a further device of the user in the network is required or recommended for the network, wherein the dependency information comprises required or recommended dependencies between the first application and one or more further applications of the set of applications; and
- a device management system configured to receive instructions from the distributed application management system to:

install or update the further device of the user with the further application to enable a service to run on multiple devices, where the service includes execution of the first application on the first device interfaced with the further application if it is determined that the further application on the further device of the user is required; and

inform the user on the first device about an option of installing or updating the further application on the further device of the user to enable a service to run on multiple devices, where the service includes execution of the first

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application on the first device interfaced with the further application if it is determined that the first distributed application is recommended on the further device of the user.

A method for managing applications on a device in a network, the method comprising:

- installing or updating a first application of a distributed application on the first device in the network, the first device being used by a user, wherein the distributed application comprises a set of applications which interface with each other and run on multiple devices to enable a service;
- sending information about the first application to a distributed application management system; and
- receiving information at the first device about whether a further application is required or recommended on a further device of the user in the network from the distributed application management system based on verification of available dependencies of the first application based on dependency information in a database, wherein the dependency information comprises required or recommended dependencies between the first application and one or more further applications of the set of applications;

wherein if the further application is required on the further device:

the distributed management system instructs the further device to install or update the further application on the further device to enable a service to run on multiple devices, wherein the method further includes execution of the first application on the first device interfaced with the further application to enable the service; and

wherein if the further application is recommended on the further device of the user:

notifying, with the first device, an option to install or update the further application on the further device of the

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user to enable a service to run on multiple devices, where the service includes execution of the first application on the first device interfaced with the further application.

A network device configured to manage applications, wherein the network device is configured to:

- install or update a first application of a distributed application while the network device is being used in a network by a user, wherein the distributed application comprises a set of applications which interface with each other and run on multiple devices to enable a service;

- send information about the first distributed application to a distributed application management system; and

- receive information about whether a further application is required or recommended on a further device of the user in the network from the distributed application management system, the information determined based on verification of available dependencies of the first application based on dependency information in a database, wherein the dependency information comprises required or recommended dependencies between the first application and one or more further applications of the set of applications;

wherein if the further application is required on the further device of the user:

the distributed management system instructs the further device of the user to install or update the further application on the further device of the user to enable a service to run on multiple devices, wherein the network device is further configured to execute first application on the network device interfaced with the further application to enable the service; and

wherein if the further application is recommended on the further device of the user:

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the network device is configured to notify an option to install or update the further application on the further device of the user.

The present disclosure defines a high level distributed application backend or cloud system, to which the network devices connect. The system leverages on the different existing dedicated solutions for application life-cycle management for various devices, either under NSP remote management or not. It contains dependency information on distributed applications and the devices they can be running on. After receiving information about a first application, e.g. upon installation of the application or upon updating of the application, the system determines whether any depending upon applications are missing or if new devices or additional applications should be recommended for a better user experience. Possibly, direct links to device resellers are provided along with the recommendation for one-click purchase.

The proposed solution allows to overcome a number of issues. Users may not be aware of the availability of applications for given devices, which leads to a sub-optimal user experience because of missing parts of the distributed application. Also, while users may be familiar with installing applications on today's most popular devices, such as smartphones or tablets, they may not be familiar with installing applications on other home network devices. For some devices without user interface, the applications running on them may be invisible to the end-user while providing functionality on which other applications depend. Furthermore, pairing different devices and applications may be a cumbersome process requiring end-user configuration of user passwords. Not all devices in the home are possibly under management using a protocol such as TR-069, which means that a

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NSP can automatically install some parts of the distributed application, but not all of them.

The solution according to the disclosure yields an optimal user experience for enabling a service. An end-user selects an user interface oriented application from an existing application store he or she is familiar with and is automatically informed about all needed or recommended applications. There is no need perform any individual steps of subscribing to a service and searching and installing all applications that are compatible with devices the end-user owns. This minimizes the risk of problems between incompatible applications and reduces the ever growing complexity of distributed applications caused by the increasing number of network connected devices.

As a further advantage, the proposed solution does not require new application stores for devices such as broadband gateways, but relies upon user interface centered applications as a main distribution channel. Devices such as broadband gateways have limited user interface capabilities, which would make it difficult for end-users to be aware of the functionality residing on the device.

Favorably, at least part of the received information is compared with entries in a database with dependency information for determining a required or recommended second application or a required or recommended further device. The database with dependency information comprises mandatory or recommended dependencies between applications and the devices they are running on as well as information on devices owned by a subscriber. The dependency information advantageously comprises application version ranges for mandatory (for service) or recommended (for optimal user experience) applications, device types on which these can run, and device resellers of devices a

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customer does not yet have but which would support applications that maximize the user experience.

Advantageously, at least required applications are automatically installed on the appropriate devices, within or outside of the home. During installation, the system preferably reports what the installation status is.

For a better understanding the disclosure shall now be explained in more detail in the following description with reference to the figures. It is understood that the disclosure is not limited to this exemplary embodiment and that specified features can also expediently be combined and/or modified without departing from the scope of the present disclosure as defined in the appended claims.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 shows an exemplary topology of distributed applications;

Fig. 2 depicts the components of a distributed application life-cycle management solution according to the disclosure; and

Fig. 3 illustrates an exemplary distributed application management procedure.

DETAILED DESCRIPTION OF PREFERED EMBODIMENTS

In Fig. 1 an exemplary topology of distributed applications, which are all part of a particular service is visualized. For example, the particular service may be related to home automation or media or content sharing. The topology includes

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an application on a home sensor 1, which is able to sense environmental conditions such as motion, temperature, humidity, air quality, or elements, etc. and to translate this into events and data. User interface applications are installed on tablets 2, 3 within or outside the house. Further user interface applications are installed on mobile phones 4 and on a set top box 5 or a smart TV 6. Additional applications are installed on a broadband gateway 7 or other network devices 8.

Fig. 2 schematically illustrates the components that relate to the present disclosure. The devices 10, 11, 12 are network connected devices capable of running applications. Each device embeds at least one network interface, such as Ethernet, WiFi, mobile 3G/LTE (3G: 3rd generation of mobile telecommunications technology; LTE: Long Term Evolution), etc., and has a CPU (CPU: Central Processing Unit) as well as memory. Examples of such devices are tablets, smartphones, set top boxes, PCs (PC: Personal Computer), or broadband gateways, which are installed at customer premises and provide Internet access over Cable DOCSIS (DOCSIS: Data Over Cable Service Interface

Specification), DSL (DSL: Digital Subscriber Line), mobile 3G/LTE, fiber, etc.

Running on the devices 10, 11, 12 are applications 20, 21, 22. An application 20, 21, 22 can be dynamically installed on a device 10, 11, 12 and executed/started. The installation can be done manually by an end-user of the device 10, 11, 12, e.g. by installing it from a storage medium such as a compact disc or alternatively from a so-called application store 30, where end-users can select from a plurality of applications 31 for installation on a device. Typically the application store 30 is available via the Internet. Installation can also be done automatically, e.g. under control of a network service provider

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in the context of subscribing to a service and the NSP remotely managing a number of service related devices. In case of distributed applications, an application will directly, e.g. using web services, or indirectly, e.g. via a cloud or backend platform which provides the infrastructure for communication or messaging between applications, interface with other applications. An example of such communication is a tablet application with a rich user interface, which interfaces with a backend application reachable via the Internet and also communicates with one or more applications running within the home, e.g. on a broadband gateway and on a power metering device or another device connecting sensors or home control to the Internet. The proposed solution does not depend on one particular communication infrastructure, possible examples include, but are not limited to, 'push notifications' for mobile devices (as offered by Google, Apple, RIM…).

Devices 11, 12 that are under NSP control and remote management typically embed a remote management agent 41, 42. One example is a BroadbandForum TR-069 CPE WAN Management Protocol agent, another example is an OMA-Device Management agent (OMA: Open Mobile Alliance). Of course, also the leftmost device 10 may be under NSP control and remote management. The management agent 41, 42 typically connects to a device management system 51 using a standardized protocol, such as TR-069, OMA-DM, SNMP (SNMP : Simple Network Management Protocol), or a proprietary protocol enabling the device management system 51 to send remote management instructions, which are propagated and executed in the device 11, 12 as needed. One example of a management instruction is the installation of an application, as found in the TR-069 Amendment 3 specification.

All distributed applications connect to a distributed application management system (DAMS) 50. The DAMS holds all

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mandatory or recommended dependencies between applications and the devices they are running on. For this purpose it has information on the devices owned by subscribers. This information can be obtained by any suitable mechanism, for example the TR-069 CPE WAN Management Protocol in combination with the TR-098 or TR-181i2 data model for home network defined by BroadbandForum.

Exemplary information stored by the distributed application management system 50 advantageously comprises:

- Application information, with for each application:
    - o Application identity (name, version, author)
    - o Mandatory applications it depends on, with for each application:
        Application identity (name, version, author)
        Compatible version range (the versions the application is compatible with)
        The devices the application can run on, with for each device:
            - Operating system
            - Operating system version range
            - Manufacturer
            - Hardware/product identifier
        Mandatory devices, with for each device:
            - Manufacturer
            - Hardware/product identifier
            - Suppliers, with for each supplier:
                - o Name
                - o URL of Internet store web-site
                - o Price
    - o Recommended applications, with for each application:
        Application identity (name, version, author)
        Compatible version range (the versions the application is compatible with)

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The devices the application can run on, with for each device:

- Operating system
- Operating system version range
- Manufacturer
- Hardware/product identifier

Recommended devices, with for each device:

- Manufacturer
- Hardware/product identifier
- Suppliers, with for each supplier:
  - Name
  - URL of Internet store web-site
  - Price

- Subscriber information, with for each subscriber:
  - Subscriber identity (e.g. email address)
  - The list of subscriber owned devices, with for each device:

    Device identity (serial number or IMEI (IMEI: International Mobile Equipment Identity))

    Operating system

    Operating system version

    Manufacturer

    Hardware/product identifier

    IPv4 and/or IPv6 Address(es)

    List of installed applications, with for each application:

    - Application identity (name, version, author)
  - Service subscriptions, with for each subscription:

    Service name

    Service validity date

    Billing information (how billing is performed)

The device management system 51 communicates with the device management agents 41, 42 to perform application installation or

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uninstallation as determined by the distributed application management system 50. It may be part of or separate from the distributed application management system 50.

The flowchart in Fig. 3 illustrates an exemplary distributed application management procedure. In this example, installation of a first application (Application 1) automatically results in installation of a second application (Application 2) on another device.

In the example, a first application (Application 1) is installed from an application store 30 on a first device 10 (Device A) of a subscriber X. The first application notifies its installation and the necessary detailed information to the distributed application management system 50. The distributed application management system 50 verifies the available dependencies and instructs the device management 51 to initiate installation of a second application (Application 2) on a second device 11 (Device B) of the subscriber X. The device management 51 in turn instructs the management agent 41 of the second device 11 to install the second application. It further informs the first application about the installation of another application. The first application notifies the user accordingly. The installation instruction is executed by the management agent 41, which notifies the device management 51 once the installation of the second application is complete. The device management 51 in turn informs the distributed application management system 50 about completion of the installation. After installation, also the second application submits the necessary detailed information to the distributed application management system 50. The distributed application management system 50 inform the first application about completion of the installation and about potential recommended devices. The first application about in turn notifies the user

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about any recommended devices. Once the procedure is finished, the first application is able to communicate with the second application, if necessary.

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Claims

1. A method for managing applications in a network, the method comprising:

- receiving, by a distributed application management system, information about a first application of a distributed application installed on a first device being used by a user in the network, wherein the distributed application comprises a set of applications which interface with each other and run on multiple devices to enable a service;

- verifying, by the distributed application management system, available dependencies of the first application based on dependency information in a database, wherein the dependency information comprises required or recommended dependencies between the first application and one or more further applications of the set of applications;

- determining, based on the verification of available dependencies, whether a further application in the set of applications is required or recommended on a further device of the user in the network;

- if it is determined that the further application on the further device is required:

instructing, by the distributed application management system, the further device to install or update the further application on the further device to enable a service to run on multiple devices where the service includes execution of the first application on the first device interfaced with the further application; and

- if it is determined that the further application is recommended on the further device of the user:

informing the user on the first device about an option of installing or updating the further application on the further device to enable a service to run on multiple devices, where the service includes execution of the first

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application on the first device interfaced with the further application.

2. The method according to claim 1, wherein at least part of the received information is compared with entries in the database with dependency information for determining a required or recommended further device.

3. The method according to claim 1 or 2, wherein the database with dependency information comprises mandatory or recommended dependencies between applications and the devices they are running on as well as information on devices owned by a subscriber.

4. The method according to any one of the preceding claims, wherein the information about the first application installed on the first device is received upon installation of the first application on the first device or upon updating of the first application.

5. The method according to any of the preceding claims, wherein the step of instructing, by the distributed application management system, the further device to install or update the further application on the further device further comprises:

-instructing, by the distributed application management system, a device management system to initiate installation of the further application on the further device;

-instructing, by the device management system, a device management agent of the further device to install or update the further application on the further device.

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6. The method according to any of the preceding claims, wherein the first application interfaces with the further application by messaging between applications during the service.

7. A method for managing applications on a first device in a network, the method comprising:
- installing or updating a first application of a distributed application on the first device in the network, the first device being used by a user, wherein the distributed application comprises a set of applications which interface with each other and run on multiple devices to enable a service;
- sending information about the first application to a distributed application management system; and
- receiving information at the first device about whether a further application is required or recommended on a further device of the user in the network from the distributed application management system based on verification of available dependencies of the first application based on dependency information in a database, wherein the dependency information comprises required or recommended dependencies between the first application and one or more further applications of the set of applications;
wherein if the further application is required on the further device:
the distributed management system instructs the further device to install or update the further application on the further device to enable a service to run on multiple devices, wherein the method further includes execution of the first application on the first device interfaced with the further application to enable the service; and
wherein if the further application is recommended on the further device of the user:

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notifying, with the first device, an option to install or update the further application on the further device of the user to enable a service to run on multiple devices, where the service includes execution of the first application on the first device interfaced with the further application.

8. An apparatus for managing applications in a network, the apparatus comprising:

- an input configured to receive information about a first application of a distributed application installed on a first device in the network, the first device being used by a user, wherein the distributed application comprises a set of applications which interface with each other and run on multiple devices to enable a service;

- a distributed application management system configured to verify available dependencies of the first application based on dependency information in a database to determine whether a further application on a further device of the user in the network is required or recommended for the network, wherein the dependency information comprises required or recommended dependencies between the first application and one or more further applications of the set of applications; and

- a device management system configured to receive instructions from the distributed application management system to:

install or update the further device of the user with the further application to enable a service to run on multiple devices, where the service includes execution of the first application on the first device interfaced with the further application if it is determined that the further application on the further device of the user is required; and

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inform the user on the first device about an option of installing or updating the further application on the further device of the user to enable a service run on multiple devices, where the service includes execution of the first application on the first device interfaced with the further application if it is determined that the further application is recommended on the further device of the user.

9. The apparatus according to claim 8, wherein the distributed application management system is configured to compare at least part of the received information with entries in the database with dependency information for determining a required or recommended further device.

10. The apparatus according to claim 9, wherein the database with dependency information comprises mandatory or recommended dependencies between applications and the devices they are running on as well as information on devices owned by a subscriber.

11. The apparatus according to any one of claims 8 to 10, wherein the information about the first application installed on the first device is received upon installation of the first application on the first device or upon updating of the first application.

12. The apparatus according to any one of claims 8 to 11, wherein the device management system, upon receiving instructions to install or update the further device with the further application, is further configured to instruct a device management agent of the further device, the device management agent configured to install or update the further distributed application on the further device.

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13. The apparatus according to any one of claims 8 to 12, wherein the first application interfaces with the further application by messaging between applications during the service.

14. A network device configured to manage applications, wherein the network device is configured to:
- install or update a first application of a distributed application while the network device is being used in a network by a user, wherein the distributed application comprises a set of applications which interface with each other and run on multiple devices to enable a service;
- send information about the first application to a distributed application management system; and
- receive information about whether a further application is required or recommended on a further device of the user in the network from the distributed application management system, the information determined based on verification of available dependencies of the first application based on dependency information in a database, wherein the dependency information comprises required or recommended dependencies between the first application and one or more further applications of the set of applications,
wherein if the further application is required on the further device of the user:
the distributed management system instructs the further device of the user to install or update the further application on the further device of the user to enable a service to run on multiple devices, wherein the network device is further configured to execute the first application on the network device interfaced with the further application to enable the service; and

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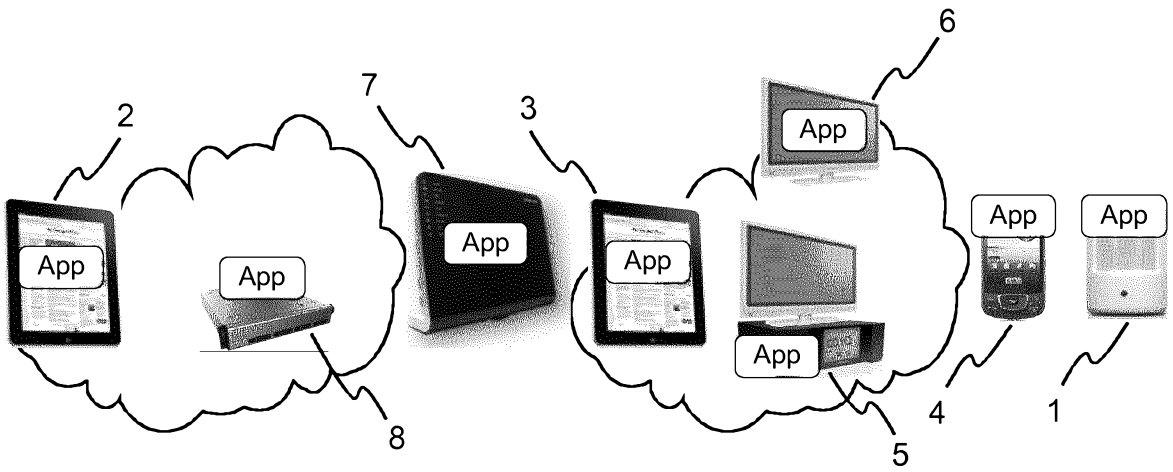
wherein if the further application is recommended on the further device of the user:

the network device is configured to notify an option to install or update the further application on the further device of the user to enable a service to run on multiple devices, where the service includes execution of the first application on the network device interfaced with the further applications.


6
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8
5
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1

Fig. 1

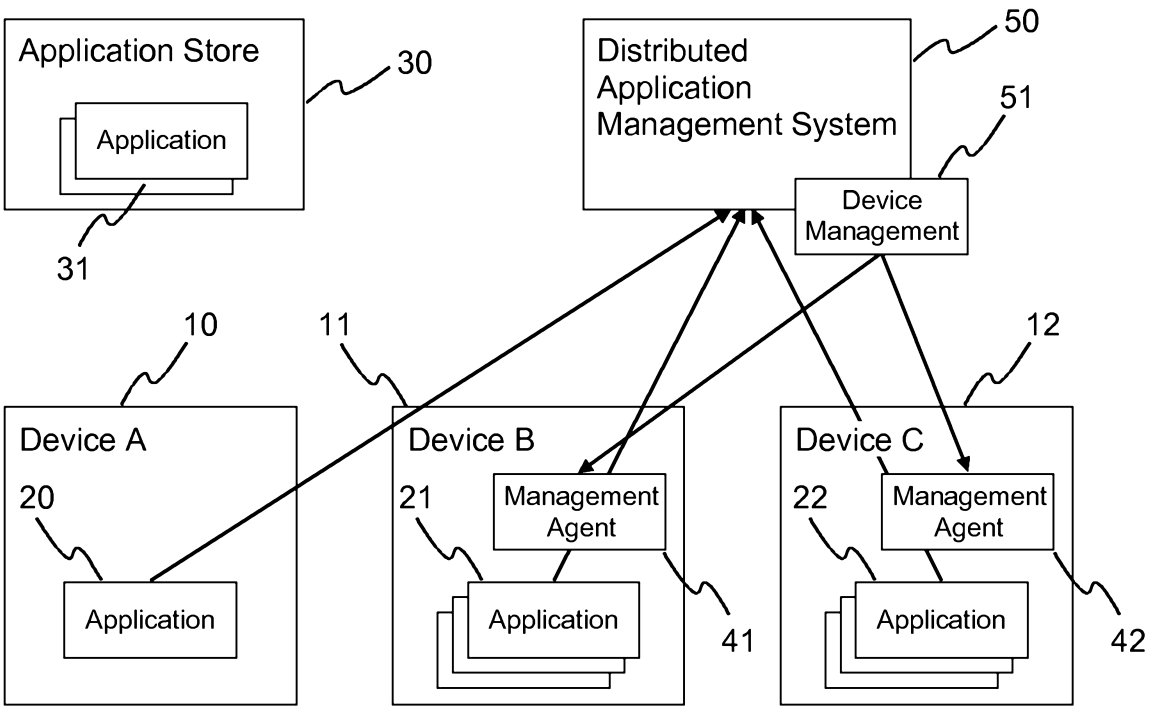
Application Store
30
Application
31
Distributed
Application
Management System
50
51
Device
Management
10
11
12
Device A
20
Application
Device B
21
Management
Agent
Application
41
Device C
22
Management
Agent
Application
42

Fig. 2

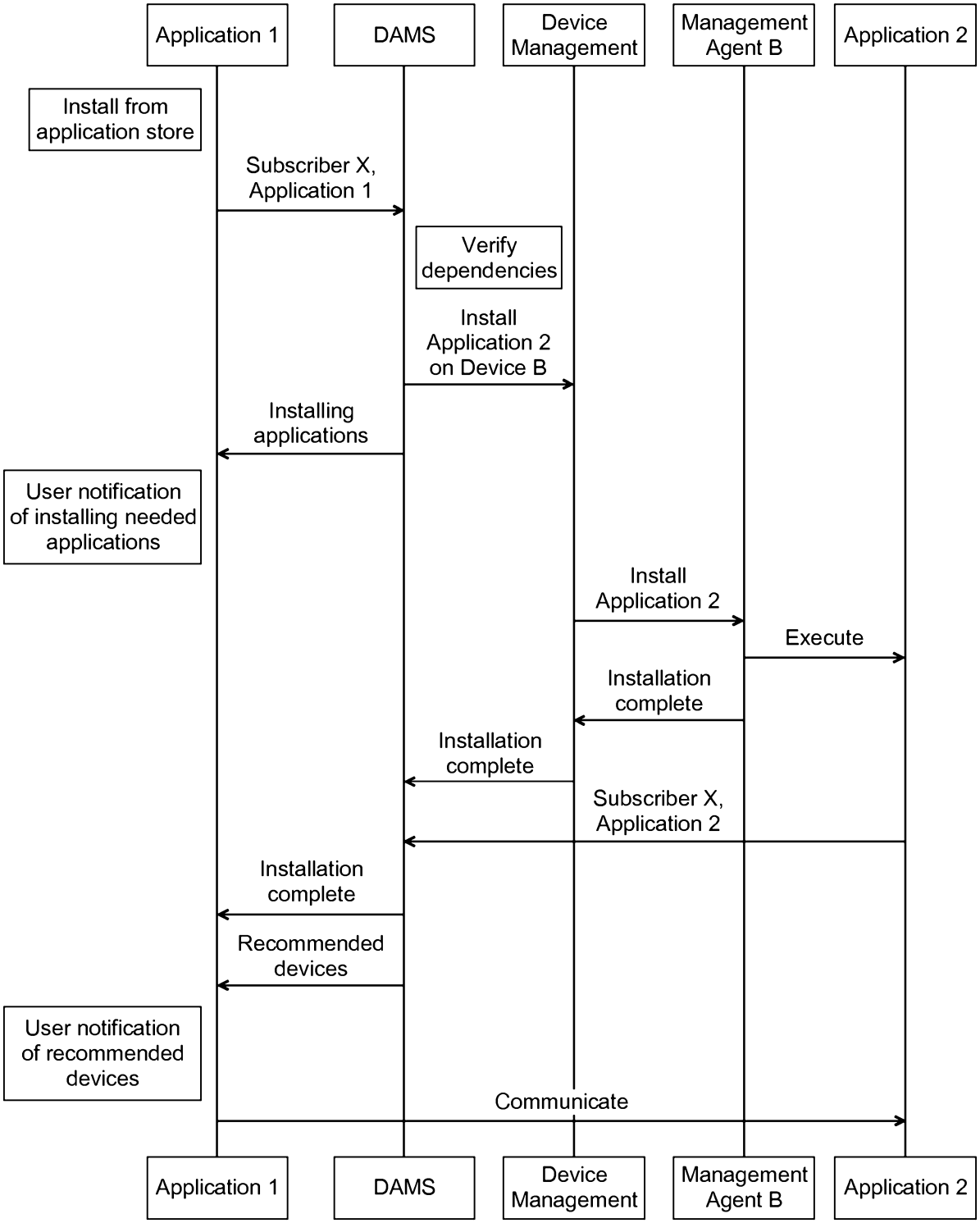
Application 1
DAMS
Device Management
Management Agent B
Application 2
Install from application store
Subscriber X, Application 1
Verify dependencies
Install Application 2 on Device B
Installing applications
User notification of installing needed applications
Install Application 2
Execute
Installation complete
Installation complete
Subscriber X, Application 2
Installation complete
Recommended devices
User notification of recommended devices
Communicate
Application 1
DAMS
Device Management
Management Agent B
Application 2

Fig. 3