



- (51) **International Patent Classification:**
H02J 3/14 (2006.01) G05B 15/02 (2006.01)
H02J 13/00 (2006.01)
- (21) **International Application Number:** PCT/EP2016/068107
- (22) **International Filing Date:** 28 July 2016 (28.07.2016)
- (25) **Filing Language:** English
- (26) **Publication Language:** English
- (30) **Priority Data:**
15178887.4 29 July 2015 (29.07.2015) EP
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- (81) **Designated States** (unless otherwise indicated, for every
kind of national protection available): AE, AG, AL, AM,

AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

- (84) **Designated States** (unless otherwise indicated, for every
kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Published:
— with international search report (Art. 21(3))

(54) **Title:** METHOD FOR IMPROVED CONTROLLING OF ELECTRICAL POWER USAGE BY AT LEAST ONE POWER CONSUMING DEVICE BEING CONNECTED TO AT LEAST ONE ELECTRICAL POWER GENERATING AND/OR STORING MEANS, SYSTEM FOR IMPROVED CONTROLLING OF ELECTRICAL POWER USAGE, PROGRAM AND COMPUTER PROGRAM PRODUCT

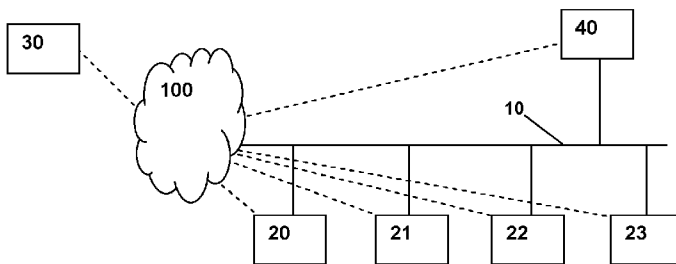


Fig. 1

(57) **Abstract:** The invention relates to a method for improved controlling of electrical power usage by at least one power consuming device being connected - via a telecommunications network - to at least one electrical power generating and/or storing means, wherein additionally an electrical power transmission means serves to transmit electrical power between the at least one electrical power generating and/or storing means and the at least one power consuming device, wherein the electrical power generating and/or storing means is associated with an expected and a current electrical power supply profile, and wherein an electrical power management entity is coupled - via the telecommunications network - to the at least one power consuming device such that demand of electrical power consumption by the at least one power consuming device is influenced, by the electrical power management entity, by means of transmitting electrical power control information between the electrical power management entity and the at least one power consuming device, wherein the method comprises the steps of: - in a first step, an electrical power consumption profile information is transmitted to or accessed by the electrical power management entity, the electrical power consumption profile information being related to the at least one power consuming device or to a mode of operation thereof, - in a second step, subsequent to the first step, a first and/or a second electrical power control information is transmitted, by the electrical power management entity, to the at least one power consuming device, the first electrical power control information indicating to activate a power consumption mode of operation corresponding to the electrical power consumption profile information transmitted to or accessed by the electrical power management entity, whereas the second electrical power control information indicating to modify or to adapt a power consumption mode of operation of the power consuming device.



Method for improved controlling of electrical power usage by at least one power consuming device being connected to at least one electrical power generating and/or storing means, system for improved controlling of electrical power usage, program and computer program product

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BACKGROUND

[0001] The present invention relates a method for improved controlling of electrical power usage by at least one power consuming device being connected – via a telecommunications network – to at least one electrical power generating and/or storing means, wherein additionally an electrical power transmission means serves to transmit electrical power between the at least one electrical power generating and/or storing means and the at least one power consuming device.

[0002] Furthermore, the present invention relates to a system for improved controlling of electrical power usage by at least one power consuming device being connected – via a telecommunications network – to at least one electrical power generating and/or storing means, wherein additionally an electrical power transmission means serves to transmit electrical power between the at least one electrical power generating and/or storing means and the at least one power consuming device.

[0003] Furthermore, the present invention relates to a program and a computer program product to perform the inventive method.

[0004] In the context of internet of Things (IoT), various different use cases have been identified leveraging from smart devices connected via a telecommunications network or transport network, e.g. the internet. Among prominent use cases or frameworks are use cases or frameworks promoted by regulatory and administrative bodies within the European Union.

[0005] One example is the introduction of smart meters for metering electrical power consumption by industrial, agricultural, or home appliances. Thereby, it is tried to achieve savings of, e.g., consumed electrical energy. By introduction of smart meters, energy producers could develop new models of variable, time variant energy pricing models, e.g. with the aim to flatten peak consumptions around noon, by increasing the energy prices for the end customer.

[0006] However, the underlying problem trying to be solved by smart meters is to achieve a balance between energy demand and energy production. Especially in the context of energy production by renewable energy sources, it becomes obvious that energy preferably needs to be consumed at the same time it is produced.

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SUMMARY

[0007] An object of the present invention is to provide a technically simple, effective and cost effective solution for an improved controlling of electrical power usage by at least one power consuming device being connected – via a telecommunications network
10 and via an electrical power transmission means – to at least one electrical power generating and/or storing means. A further object of the present invention is to provide a corresponding system comprising at least one power consuming device and at least one electrical power generating and/or storing means being connected via a telecommunications network and via an electrical power transmission means wherein the
15 system is provided such that an improved controlling of electrical power usage is possible.

[0008] The object of the present invention is achieved by a method for improved controlling of electrical power usage by at least one power consuming device being connected – via a telecommunications network – to at least one electrical power
20 generating and/or storing means, wherein additionally an electrical power transmission means serves to transmit electrical power between the at least one electrical power generating and/or storing means and the at least one power consuming device, wherein the electrical power generating and/or storing means is associated with an expected and a current electrical power supply profile, and wherein an electrical power management
25 entity is coupled – via the telecommunications network – to the at least one power consuming device such that demand of electrical power consumption by the at least one power consuming device is influenced, by the electrical power management entity, by means of transmitting electrical power control information between the electrical power management entity and the at least one power consuming device, wherein the method
30 comprises the steps of:

-- in a first step, an electrical power consumption profile information is transmitted to or accessed by the electrical power management entity, the electrical power consumption profile information being related to the at least one power consuming device or to a mode of operation thereof,

-- in a second step, subsequent to the first step, a first and/or a second electrical power control information is transmitted, by the electrical power management entity, to the at least one power consuming device, the first electrical power control information indicating to activate a power consumption mode of operation corresponding to the electrical power consumption profile information transmitted to or accessed by the electrical power management entity, whereas the second electrical power control information indicating to modify or to adapt a power consumption mode of operation of the power consuming device, wherein the electrical power management entity transmits, dependent on the electrical power consumption profile information, the electrical power control information to the at least one power consuming device such that the demand of electrical power by the at least one power consuming device is influenced by means of postponing or preponing expected future demand of electrical power.

[0009] The object of the present invention is also achieved by a method for improved controlling of electrical power usage by at least one power consuming device being connected – via a telecommunications network – to at least one electrical power generating and/or storing means, wherein additionally an electrical power transmission means serves to transmit electrical power between the at least one electrical power generating and/or storing means and the at least one power consuming device, wherein the electrical power generating and/or storing means is associated with an expected and a current electrical power supply profile, and wherein an electrical power management entity is coupled – via the telecommunications network – to the at least one power consuming device such that demand of electrical power consumption by the at least one power consuming device is influenced, by the electrical power management entity, by means of transmitting electrical power control information between the electrical power management entity and the at least one power consuming device, wherein the method comprises the steps of:

-- in a first step, an electrical power consumption profile information is transmitted to or accessed by the electrical power management entity, the electrical power consumption profile information being related to the at least one power consuming device or to a mode of operation thereof,

-- in a second step, subsequent to the first step, a first and/or a second electrical power control information is transmitted, by the electrical power management entity, to the at least one power consuming device, the first electrical power control information indicating to activate a power consumption mode of operation corresponding to the electrical power consumption profile information transmitted to or accessed by the electrical power management entity, whereas the second electrical power control information indicating to

modify or to adapt a power consumption mode of operation of the power consuming device.

[0010] Generally, the production of electrical power and the demand or consumption of electrical power needs to be adapted or balanced. Otherwise, the stability of the network providing the transmission of electrical power would be unstable and hence unreliable. Traditionally, actual power consumption for a large number of energy consumers such as private homes, industrial consumers, etc. varies considerably during a given time period, such as, e.g., a day. The typical pattern of such variations can be predicted, however such prediction involves a considerable error and hence, it is difficult to precisely anticipate the actual power consumption needs at a given point in time. As the electrical power production of renewable power sources is typically more unpredictable as compared to conventional electrical power sources, the increased usage of renewable power sources means that the precise prediction of overall actual power production is even more difficult. Typically, such a situation requires using costly balance energy sources (such as, e.g., power buffers or power storages or peak demand power sources) that are able to close any gap between the current production and consumption of electrical power.

[0011] According to the present invention, it is advantageously possible to provide smart scheduling of electrical power consuming devices and appliances such that the need of generation of costly balance energy or the need for costly power buffers/storages is reduced. Thereby, the present invention is potentially applied on a more local level, e.g. at one extremely local level involving only a single home or a single industrial site or the like, or involving (on a slightly less local level) a plurality (of two, three, four, five, six, ten, twenty or thirty) of homes or industrial sites. Additionally, the present invention is potentially applied on a geographically more general level, e.g. involving (most of) the homes and industrial sites of a whole region or even a nation state. At any level, there is at least one electrical power generating and/or storing means – for an individual home or an industrial site, e.g. a photovoltaic device and/or a wind power device and/or a biogas device, and for whole region typically a multitude of power plants, photovoltaic devices and/or wind power devices. At any level, the power generating devices (that might also comprise power storage capabilities) are collectively called electrical power generating and/or storing means. According to the present invention, the electrical power generating and/or storing means is associated with a typical – and hence expected – electrical power supply profile as well as with a current electrical power supply profile. Furthermore at any level of application of the present invention, typically a certain number of power consuming devices are to be considered, each one of which being hereinafter referred to

by the term “at least one power consuming device”. These power consuming devices are connected not only via an electrical power transmission means but also via a telecommunications network to at least one electrical power generating and/or storing means.

5 **[0012]** Furthermore according to the present invention, an electrical power management entity is coupled – via the telecommunications network – to the at least one power consuming device. By means of the electrical power management entity, the demand of electrical power consumed by the at least one power consuming device can be influenced by means of transmitting electrical power control information between the
10 electrical power management entity and the at least one power consuming device.

[0013] In order to realize this, according to the present invention, an electrical power consumption profile information needs to be made available to the electrical power management entity, typically by transmitting such electrical power consumption profile information to the electrical power management entity or by accessing the electrical
15 power consumption profile information by the electrical power management entity. The electrical power consumption profile information is typically related to one power consuming device or to a mode of operation thereof. The electrical power consumption profile information typically comprises indications about the typical elasticity (in time and/or regarding the required power level) of the power consumption of the respective
20 power consuming device in general or regarding specific modes of operation of the respective power consuming device considered.

[0014] According to the present invention, the electrical power management entity transmits a first and/or a second electrical power control information to the at least one power consuming device. The first electrical power control information indicate to activate
25 a power consumption mode of operation corresponding to the electrical power consumption profile information. The second electrical power control information indicate to modify or to adapt a power consumption mode of operation of the power consuming device, i.e. the power consuming device is typically already activated (either by a first electrical power control information, i.e. by the electrical power management entity, or via
30 another activation path, including the activation by the user of the power consuming device), and balancing power generation and electrical power demand requires (or makes it desirable) to modify or to adapt the power consumption mode of operation of the power consuming device.

[0015] According to a preferred embodiment of the present invention, prior, during or after the first step, an electrical power request information is transmitted to or accessed by the electrical power management entity, the electrical power request information being related to both a user interaction and the at least one power consuming device, wherein
5 the user interaction especially corresponds to activate the at least one power consuming device.

[0016] By means of the electrical power request information it is advantageously possible to provide the information to the electrical power management entity that electrical power needs to be consumed by the power consuming device in some future
10 point in time. According to a preferred embodiment of the present invention, the electrical power request information relates to a specific power consuming device, e.g. a washing machine, and indicates that a certain mode of operation of the power consuming device (in the example of a washing machine e.g. a certain washing program) should be started. By means of the corresponding electrical power consumption profile information (related
15 to the considered power consuming device, i.e. the washing machine in this example, and especially more specifically related to the requested mode of operation or program of that power consuming device, e.g. a hot water cycle in contrast to a delicate cycle in a washing machine) the electrical power management entity is aware not only about the requested overall consumption of electrical power but also about the distribution in time of
20 the requested electrical power consumption.

[0017] Furthermore, it is preferred according to the present invention that the electrical power management entity transmits, dependent on the electrical power consumption profile information and/or the electrical power request information, the electrical power control information to the at least one power consuming device such that
25 the demand of electrical power by the at least one power consuming device is influenced, especially influenced by means of postponing or preponing expected future demand of electrical power and/or by means of reducing or increasing current demand of electrical power, wherein the demand of electrical power is especially influenced in view of adapting supply and demand of electrical power to each other such that differences
30 between current supply and demand of electrical power are as low as possible and as non-volatile as possible.

[0018] According to a further preferred embodiment of the present invention, the electrical power management entity transmits, dependent on the electrical power request information, the electrical power control information to the at least one power consuming
35 device such that the demand of electrical power by the at least one power consuming

device is influenced, especially influenced by means of postponing or preponing expected future demand of electrical power and/or by means of reducing or increasing current demand of electrical power, wherein the demand of electrical power is especially influenced in view of adapting supply and demand of electrical power to each other such
5 that differences between current supply and demand of electrical power are as low as possible and as non-volatile as possible.

[0019] According to a further preferred embodiment of the present invention, the electrical power management entity transmits, dependent on the electrical power consumption profile information, the electrical power control information to the at least
10 one power consuming device such that the demand of electrical power by the at least one power consuming device is influenced, especially influenced by means of reducing or increasing current demand of electrical power.

[0020] According to the present invention, it is thereby advantageously possible that the current consumption of electrical power can be more or less instantaneously matched
15 with the current production of electrical power. This is able to be achieved according to the present invention at any level of application of the electrical power management entity, i.e. regardless of the electrical power management entity being responsible on a local level, e.g. involving only a single home or a single industrial site, or on a slightly less local level involving a plurality of homes or industrial sites, or on a geographically more
20 general level, e.g. involving typically most of the homes and industrial sites of a whole region or even a nation state. Matching of the current consumption of electrical power with the current production of electrical power is advantageously possible according to the present invention due to the fact the electrical power management entity is able to relatively precisely know which amount of consumption of electrical power is to expected
25 in a given time interval of, e.g., a minute, an hour, several hours, a day or a week. Likewise, also the power generation is typically predictable – even in case of using renewable power source – for longer or shorter intervals of time due to experience of comparable weather conditions (especially influencing solar radiation and wind harvesting possibilities). Thus by means of the knowledge, at the electrical power management
30 entity, of both the expected consumption of electrical power and the generation of electrical power, it is advantageously possible to reduce the need of balance energy or reserve power, e.g. by using peak load power plants such as pumped storage power plants or even storage devices based on batteries. In case of a current situation where not enough electrical power is produced (compared to the current consumption of
35 electrical power), the electrical power management entity indicates – by means of transmitting electrical power control information – to one or a plurality of power

consuming device(s) to postpone expected future demand of electrical power and/or to reduce current demand of electrical power. Likewise, in case of a current situation of excess electrical power being produced, the electrical power management entity indicates – likewise by means of transmitting electrical power control information – to one
5 or a plurality of power consuming device(s) to prepone expected future demand of electrical power and/or to increase current demand of electrical power. This means that in order to try to always match supply and demand of electrical power, the electrical power management entity continuously verifies power consumption and power generation (by, e.g., using energy meters and/or power meters) such that the flow of energy is always
10 and permanently monitored.

[0021] According to a further preferred embodiment of the present invention, the at least one power consuming device is able to be operated – at least for comparably short intervals of time, especially for one or a plurality of seconds or fractions of a second or for one or a plurality of minutes – in a mode of operation of negative demand of electrical
15 power or of surplus energy (supply of electrical power), wherein the electrical power management entity transmits, dependent on the electrical power consumption profile information and/or the electrical power request information, the electrical power control information to the at least one power consuming device such that the negative demand of electrical power (supply of electrical power) by the at least one power consuming device
20 is influenced, especially influenced by means of preponing or postponing expected future negative demand of electrical power and/or by means of increasing or decreasing current negative demand of electrical power.

[0022] Thereby, it is advantageously possible to achieve a still higher degree of flexibility in managing the system comprising the electrical power generating and/or
25 storing means and the power consuming device.

[0023] According to a preferred embodiment of the present invention, the electrical power consumption profile information and/or the electrical power request information comprise at least one out of the following:

- information about the expected evolution of the electrical power demand by the at
30 least one power consuming device,
- information about the postponing flexibility, in terms of time flexibility to use the electrical power later and/or in terms of flexibility regarding lowering the electrical power level, in demanding the electrical power,
- information about the preponing flexibility, in terms of time flexibility to use the
35 electrical power earlier and/or in terms of flexibility regarding increasing the electrical

power level, in demanding the electrical power,

-- information whether the electrical power demand is able to be interrupted after the at least one power consuming device having been activated.

-- information how often the electrical power demand is able to be interrupted after the 5 at least one power consuming device has been activated.

[0024] Thereby, it is advantageously possible, according to the present invention, to precisely indicate the future demand profile and flexibility profile of the at least one power consuming device such that managing and matching the generation and consumption of electrical power is able to be realized more easily and more precisely.

10 **[0025]** According to a further preferred embodiment of the present invention, the electrical power consumption profile information comprises abstraction model information of the expected behaviour of the at least one power consuming device regarding future (positive and/or negative) electrical power demand, the abstraction model information of the expected behaviour of the at least one power consuming device being especially 15 associated with different typical modes of operation of the at least one power consuming device such as different programs, especially cleaning or working programs, of a household appliance and/or different programs or modes of operation of the at least one power consuming device for industrial, agricultural, transportation or healthcare purposes.

[0026] By means of using abstraction model information of the electrical power 20 consumption profile information, i.e. of the expected behaviour of the at least one power consuming device regarding future (positive and/or negative) electrical power demand, it is advantageously possible according to the present invention to easily provide, to the electrical power management entity, the respective information to match power generation with power consumption.

25 **[0027]** According to still a further preferred embodiment of the present invention, the electrical power request information comprises abstraction model information of user or customer requirements regarding the at least one power consuming device (or of a plurality of power consuming devices), the abstraction model information of user or customer requirements being especially associated with time and/or completion 30 requirements of the user or customer regarding the service to be provided by the at least one power consuming device.

[0028] By means of using abstraction model information of the electrical power request information, i.e. especially abstraction model information regarding the service needs to be met by the power consuming device or the service requirements of the user

or users of the power consuming device (e.g. that a washing machine should have finished a specified program or mode of operation at a given time in the future, e.g. the time of expected or typical or return of a user of the power consuming device), it is advantageously possible according to the present invention to easily provide, to the 5 electrical power management entity, the respective information to match power generation with power consumption.

[0029] Furthermore, the present invention relates to a system for improved controlling of electrical power usage by at least one power consuming device being connected – via a telecommunications network – to at least one electrical power 10 generating and/or storing means, wherein additionally an electrical power transmission means serves to transmit electrical power between the at least one electrical power generating and/or storing means and the at least one power consuming device, wherein the electrical power generating and/or storing means is associated with an expected and a current electrical power supply profile, and wherein an electrical power management 15 entity is coupled – via the telecommunications network – to the at least one power consuming device such that demand of electrical power consumption by the at least one power consuming device is influenced, by the electrical power management entity, by means of transmitting electrical power control information between the electrical power management entity and the at least one power consuming device, wherein the system 20 comprises the telecommunications network, especially a mobile communication network, the at least one power consuming device, the electrical power generating and/or storing means, the electrical power management entity, and the electrical power transmission means, wherein the system is configured such that:

-- an electrical power consumption profile information is transmitted to or accessed by 25 the electrical power management entity, the electrical power consumption profile information being related to the at least one power consuming device or to a mode of operation thereof,

-- a first and/or a second electrical power control information is transmitted, by the electrical power management entity, to the at least one power consuming device, the first 30 electrical power control information indicating to activate a power consumption mode of operation corresponding to the electrical power consumption profile information transmitted to or accessed by the electrical power management entity, whereas the second electrical power control information indicating to modify or to adapt a power consumption mode of operation of the power consuming device, wherein the electrical 35 power management entity is configured to transmit, dependent on the electrical power consumption profile information, the electrical power control information to the at least

one power consuming device such that the demand of electrical power by the at least one power consuming device is influenced by means of postponing or preponing expected future demand of electrical power.

[0030] The object of the present invention is also achieved by a system for improved
5 controlling of electrical power usage by at least one power consuming device being
connected – via a telecommunications network – to at least one electrical power
generating and/or storing means, wherein additionally an electrical power transmission
means serves to transmit electrical power between the at least one electrical power
10 the electrical power generating and/or storing means is associated with an expected and
a current electrical power supply profile, and wherein an electrical power management
entity is coupled – via the telecommunications network – to the at least one power
consuming device such that demand of electrical power consumption by the at least one
power consuming device is influenced, by the electrical power management entity, by
15 means of transmitting electrical power control information between the electrical power
management entity and the at least one power consuming device, wherein the system
comprises the telecommunications network, especially a mobile communication network,
the at least one power consuming device, the electrical power generating and/or storing
means, the electrical power management entity, and the electrical power transmission
20 means, wherein the system is configured such that:

- an electrical power consumption profile information is transmitted to or accessed by
the electrical power management entity, the electrical power consumption profile
information being related to the at least one power consuming device or to a mode of
operation thereof,
- 25 -- a first and/or a second electrical power control information is transmitted, by the
electrical power management entity, to the at least one power consuming device, the first
electrical power control information indicating to activate a power consumption mode of
operation corresponding to the electrical power consumption profile information
transmitted to or accessed by the electrical power management entity, whereas the
30 second electrical power control information indicating to modify or to adapt a power
consumption mode of operation of the power consuming device.

[0031] According to the present invention, it is advantageously possible – especially
with an inventive system – to provide smart scheduling of electrical power consuming
devices and appliances such that the need of generation of costly balance energy or the
35 need for costly power buffers/storages is reduced. As regarding to the inventive method,
the inventive system is potentially applied to or refers to a more local application level,

e.g. involving only a single home or a single industrial site, or involving a plurality of homes or industrial sites, or involving – on a geographically more general level – e.g. the homes and industrial sites of a whole region or even a nation state. At any level, the system comprises at least one electrical power generating and/or storing means and 5 typically a plurality of (but at least one) power consuming device(s).

[0032] It is furthermore preferred according to the present invention – especially with respect to the system – that the power consuming device and/or electrical power management entity is configured such that an electrical power request information is transmitted to or accessed by the electrical power management entity, the electrical 10 power request information being related to both a user interaction and the at least one power consuming device, wherein the user interaction especially corresponds to activate the at least one power consuming device.

[0033] It is furthermore preferred according to the present invention – also with respect to the system – that the electrical power management entity is configured to 15 transmit, dependent on the electrical power consumption profile information and/or the electrical power request information, the electrical power control information to the at least one power consuming device such that the demand of electrical power by the at least one power consuming device is influenced, especially influenced by means of postponing or preponing expected future demand of electrical power and/or by means of 20 reducing or increasing current demand of electrical power, wherein the demand of electrical power is especially influenced in view of adapting supply and demand of electrical power to each other such that differences between current supply and demand of electrical power are as low as possible and as non-volatile as possible.

[0034] According to a preferred embodiment of the present invention – also with 25 respect to the system – the electrical power management entity is configured to transmit, dependent on the electrical power request information, the electrical power control information to the at least one power consuming device such that the demand of electrical power by the at least one power consuming device is influenced, especially influenced by means of postponing or preponing expected future demand of electrical 30 power and/or by means of reducing or increasing current demand of electrical power, wherein the demand of electrical power is especially influenced in view of adapting supply and demand of electrical power to each other such that differences between current supply and demand of electrical power are as low as possible and as non-volatile as possible.

[0035] According to a further preferred embodiment of the present invention – also with respect to the system – the electrical power management entity is configured to transmit, dependent on the electrical power consumption profile information, the electrical power control information to the at least one power consuming device such that the
5 demand of electrical power by the at least one power consuming device is influenced, especially influenced by means of reducing or increasing current demand of electrical power.

[0036] According to a preferred embodiment of the present invention – also with respect to the system –, the electrical power transmission means is a grid or a grid-like
10 electrical power transmission structure, extending within or being related with

- a home and/or an industrial, agricultural, transportation-related or healthcare site or plant, or
- an area comprising a plurality of homes and/or a plurality of industrial, agricultural, transportation-related or healthcare sites or plants, or
- 15 -- a region or a state comprising a plurality of homes and a plurality of industrial, agricultural, transportation-related or healthcare sites or plants,

wherein the electrical power management entity corresponds to either a single entity associated to the entire electrical power transmission means or to a plurality of entities, each one being associated to parts or areas of the electrical power transmission means.

20 **[0037]** Furthermore, the present invention relates to an electrical power management entity configured to be used in an inventive system and/or configured to be used when executing the inventive method.

[0038] Additionally, the present invention relates to a program comprising a computer readable program code which, when executed on a computer and/or on an
25 electrical power management entity and/or on a power consuming device and/or on a network component of a telecommunications network or in part on an electrical power management entity and/or in part on a power consuming device and/or in part on a network component of a telecommunications network, causes the computer and/or the electrical power management entity and/or the power consuming device and/or the
30 network component of the telecommunications network to perform the inventive method.

[0039] Still additionally, the present invention relates to computer program product for improved communication between network nodes of a mobile communication network, the computer program product comprising a computer program stored on a storage medium, the computer program comprising program code which, when executed on a

computer and/or on an electrical power management entity and/or on a power consuming device and/or on a network component of a telecommunications network or in part on an electrical power management entity and/or in part on a power consuming device and/or in part on a network component of a telecommunications network, causes the computer
5 and/or the electrical power management entity and/or the power consuming device and/or the network component of the telecommunications network to perform the inventive method.

[0040] These and other characteristics, features and advantages of the present invention will become apparent from the following detailed description, taken in
10 conjunction with the accompanying drawings, which illustrate, by way of example, the principles of the invention. The description is given for the sake of example only, without limiting the scope of the invention. The reference figures quoted below refer to the attached drawings.

15

BRIEF DESCRIPTION OF THE DRAWINGS

[0041] Figure 1 schematically illustrates a system for improved controlling of electrical power usage by at least one power consuming device, the system including a electrical power generating and/or storing means and an electrical power management entity.

20 **[0042]** Figure 2 schematically illustrates an exemplary power consumption diagram, a power generation diagram and a superposition of a power generation and consumption diagram.

DETAILED DESCRIPTION

25 **[0043]** The present invention will be described with respect to particular embodiments and with reference to certain drawings but the invention is not limited thereto but only by the claims. The drawings described are only schematic and are non-limiting. In the drawings, the size of some of the elements may be exaggerated and not drawn on scale for illustrative purposes.

[0044] Where an indefinite or definite article is used when referring to a singular noun, e.g. “a”, “an”, “the”, this includes a plural of that noun unless something else is specifically stated.

[0045] Furthermore, the terms first, second, third and the like in the description and 5 in the claims are used for distinguishing between similar elements and not necessarily for describing a sequential or chronological order. It is to be understood that the terms so used are interchangeable under appropriate circumstances and that the embodiments of the invention described herein are capable of operation in other sequences than described or illustrated herein.

10 **[0046]** In Figure 1, a system for improved controlling of electrical power usage by at least one power consuming device is schematically shown. The system schematically shown in Figure 1 exemplarily comprises four different power consuming devices, a first power consuming device 20, a second power consuming device 21, a third power consuming device 22, and a fourth power consuming device 23. The system furthermore 15 includes an electrical power generating and/or storing means 40 and an electrical power management entity 30. The electrical power generating and/or storing means 40 is connected to the power consuming devices 20, 21, 22, 23 via an electrical power transmission means 10, this electrical power transmission means 10 especially being a grid or a grid-like electrical power transmission structure that extends within (or is related 20 with) a home and/or an industrial, agricultural, transportation-related or healthcare site or plant, or an area comprising a plurality of homes and/or a plurality of industrial, agricultural, transportation-related or healthcare sites or plants, or a region or a state comprising a plurality of homes and a plurality of industrial, agricultural, transportation-related or healthcare sites or plants. The electrical power management entity 30 25 corresponds either to a single entity associated to the entire electrical power transmission means 10 or to a plurality of entities, each one being associated to parts or areas of the electrical power transmission means 10.

[0047] According to the present invention, the power consuming devices 20, 21, 22, 23 are connected to the at least one electrical power generating and/or storing means 40 30 via a telecommunications network 100. The telecommunications network 100 is generally a data transmission or data transport network, typically either a fixed line telecommunications network or comprising at least parts that rely on transmitting data wirelessly, such as a mobile communication network, or power consuming devices 20, 21, 22, 23 being connected to the telecommunications network 100 by using a short 35 range WLAN and/or WiFi and/or Bluetooth and/or other wireless communication

standards. Hence, the telecommunications network 100 can be provided as an Ethernet communication network, it can comprise optical components and optical data transmission lines as well as wireless data transmission elements.

[0048] According to the present invention, the electrical power generating and/or 5 storing means 40 is associated with an expected and a current electrical power supply profile, and the electrical power management entity 30 is coupled to the at least one power consuming device 20, 21, 22, 23 in such a manner that demand of electrical power consumption by the at least one power consuming device 20, 21, 22, 23 is influenced, by the electrical power management entity 30, by means of transmitting electrical power 10 control information between the electrical power management entity 30 and the at least one power consuming device 20, 21, 22, 23. According to the invention, this can be realized by transmitting an electrical power consumption profile information (or making such an information available) to the electrical power management entity 30. According to the invention, the electrical power consumption profile information is related to the at least 15 one power consuming device 20, 21, 22, 23 or to a mode of operation thereof.

[0049] The matching of supply and demand of electrical power is provided by the electrical power management entity 30 and carried out by means of transmitting first and/or second electrical power control information to the at least one power consuming device 20, 21, 22, 23. The first electrical power control information indicate to activate a 20 specific power consumption mode of operation corresponding to the electrical power consumption profile information transmitted to or accessed by the electrical power management entity 30, and the second electrical power control information indicate to modify or to adapt a power consumption mode of operation of the power consuming device 20, 21, 22, 23.

25 **[0050]** Typically, energy production by renewable energy sources cannot be controlled as flexibly as traditional or conventional (typically fossil fuel powered) power plants. Today, the power consumption over time is predicted by historical statistics and experience. The energy production by renewable energy sources is also being predicted, with a certain level of accuracy. The remaining difference (in case of lack of electrical 30 power) needs to be provided as so-called balance energy by special power plants, being able to provide energy fast and being able to be dynamically controlled, e.g. power plants based on Pelton turbines are such power plants. However, such balance energy is costly and usually an additional burden for the energy transport networks. A reduction of balance energy is hence obviously desirable.

[0051] Especially with energy generation from renewable sources, the possibilities to influence the current production of electrical power is rather limited (e.g. wind- and/or sun-strength dependence). Hence the invention proposes to find a solution to modify or adapt power demand of power consuming devices 20, 21, 22, 23. Depending on the application, such power consuming device 20, 21, 22, 23 can be structured into different classes: Some power consuming devices 20, 21, 22, 23 cannot be delayed in their operation and need to be switched on/off immediately once the user wishes to operate the device, however, other classes of power consuming devices 20, 21, 22, 23 are power consuming devices 20, 21, 22, 23 being able to be switched on with a certain delay, without losing comfort or a loss of functionality. Just as an example, fridges do have the possibility to store energy for typically a relatively long time interval of, say, at least many minutes or even a few hours or up to perhaps 10 or 20 hours due to their efficient insulation. Consequently such power consuming devices 20, 21, 22, 23 may be supplied with electrical power in a delayed manner without risking any loss of comfort or functionality to a user. Just as another example of power consuming devices, the same is often applicable for water heaters. Other examples include washing machines, dish washers etc. being able to be scheduled in their operation within a certain range without losing comfort. The examples given here mainly relate to home application or home appliances, however the invention is not restricted to the area home appliances or home devices: Devices or appliances in other areas such as industrial, agriculture, automotive, healthcare etc., are likewise able to be classified in the same way.

[0052] Such devices as mentioned above are also referred to as the Internet of Things (IoT) or internet-of-things devices are becoming increasingly equipped with networking functionality and are becoming increasingly smart by adding additional computation functions on top of their base functionality. However, one of the main problems to be solved in the field of internet-of-things, is the description of the different devices, i.e. expressing the capabilities, identifiers etc. in a semantic manner being able to be understood and interpreted correctly by other (smart) machines or devices. The art of describing such devices is typically subject to the field of ontology and typically requires an abstraction information model such as it is partly used in global internet-of-things specifications. E.g., in the exemplary case of a refrigerator, such an abstraction information model might comprise common characteristics such as a vendor-specific characteristic, a version number, a device model, as well as device-specific characteristics, such as a door status information, a door alarm on/off information, a temperature unit information, etc. Likewise, in the exemplary case of a washing machine, such an abstraction information model might comprise common characteristics such as a

vendor-specific characteristic, a version number, a device model, as well as device-specific characteristics, such as a spin level information, a water flow information, a water level information, etc.

[0053] According to the present invention, such abstraction information model also
5 comprise electrical power consumption profile information providing general information about the possibility – for the electrical power management entity 30 – to influence the current and future consumption of electrical power. In order to provide an efficient management of power consuming devices 20, 21, 22, 23, on the one hand side the current generated power need to be known. This can either be measured and signaled
10 locally (within a house, company property/facilities), but in case of a “geographically or functionally” larger area/grid also being measured, aggregated and controlled by a controlling entity responsible for a larger area (power grid section etc.). Together with the current generated power as well as the typical predicted evolution of generated power, the other important parameter needed in order to be able to match power supply and
15 demand typically refers

- to the knowledge about the power consumption profile $P(t)$
- to the flexibility in time the power consuming devices 20, 21, 22, 23 can be delayed in switching on compared to the originally indented point in time
- to the flexibility in time the power consuming devices 20, 21, 22, 23 can be switched
20 on in advance to the originally indented point in time
- to the information whether the power can be interrupted again, after initial switch on
- whether a “penalty time” need to be applied before the device is allowed to be switched on again
- how often the power consuming devices 20, 21, 22, 23 are allowed to be interrupted.

25 **[0054]** According to the present invention, such information about the abstract information model are made available to a respective controlling entity or platform (i.e. the electrical power management entity 30). In this case the controlling entity or IoT platform (electrical power management entity 30) is beneficially able to calculate the optimal switching point or switching time for all power consuming devices 20, 21, 22, 23 within
30 the scope of the controller (i.e. the area for which the electrical power management entity 30 responsible).

[0055] Figure 2 schematically shows an exemplary power consumption diagram (Figure 2a), a power generation diagram (Figure 2b) and a superposition of a power generation and consumption diagram (Figure 2c), i.e the aggregated power consumption
35 of a certain grid, the respective energy offer (energy production, e.g. by photovoltaic

production, wind power etc...) within a certain grid. Figure 2c shows the energy flow between the grid and the electrical power generating and/or storing means 40 without any proactive management of power consuming appliances. Hatched areas (with an inclination to the right) in Figure 2a correspond to power consumption. Hatched areas 5 (with an inclination to the left) in Figure 2b correspond to power production (or generation). Hatched areas with an inclination to the right in Figure 2c are representing the amount of energy being obtained from the supplying grid (i.e. the consumption of electrical power exceeds the generation of electrical power), horizontally hatched areas in Figure 2c are representing the amount of energy being generated within the (power 10 managed) grid and instantaneous consumed power, and hatched areas with an inclination to the left in Figure 2c are representing the amount of energy being generated in excess within the (power managed) grid and, hence, fed back to the supplying grid. In order to reduce the amount of balance energy needed (i.e. the hatched areas with inclination in Figure 2c) and to reduce the load for the supplying grid, the energy shall 15 preferably being consumed instantaneously once it is generated within the grid, i.e. consequently the hatched areas with inclination areas shall be decreased as much as possible and the horizontally hatched areas should be maximized in Figure 2c.

[0056] According to the present invention, the aggregated power consumption (within a considered grid or part thereof) need to be parted into the individual power 20 consumptions of the devices on the grid (or respective part thereof). According to the present invention, different power consuming devices 20, 21, 22, 23 and device classes contribute to the overall power consumption. The following additional information/parameters shall be assumed as being part of the internet-of-things device profile (i.e. the electrical power consumption profile information):

25 -- some power consuming devices 20, 21, 22, 23 having a power consumption profile (corresponding to a electrical power consumption profile information) such that these are not able to be delayed or interrupted with regards to their operation;

-- some power consuming devices 20, 21, 22, 23 can only be delayed a maximum of one time unit but can be switched on three time units in advance;

30 -- some power consuming devices 20, 21, 22, 23 can only be delayed a maximum of two time units;

-- some power consuming devices 20, 21, 22, 23 create a power consumption profile (corresponding to a electrical power consumption profile information) and can only be delayed a maximum of two time units but can be switched on three time units in advance, 35 and are allowed to be interrupted two times within the expected operation time.

[0057] According to the present invention, it is advantageously possible that with the respective knowledge about the power consumption profile of a sufficiently important number of power consuming devices 20, 21, 22, 23 (if not all power consuming devices 20, 21, 22, 23 within the considered grid or part thereof) that with the given or anticipated
5 actual power on offer (i.e. the generation of electrical power), the power management entity 30, is able to schedule the device operation (of the power consuming devices 20, 21, 22, 23) in a way that the demand of balance energy can be reduced.

[0058] With additional information and knowledge such as listed above regarding the number of possible interruptions and the like, i.e. information having regard to scheduling
10 flexibility as well as constraints with regards to power interruptions, the functionality of the grid of the considered part of the grid can be further enhanced.

[0059] According to the present invention, the functionality can be further enhanced with more accurate predictions of the power generation, e.g. considerations of weather conditions in case of power generation by photovoltaic or wind.

PATENT CLAIMS

1. Method for improved controlling of electrical power usage by at least one power consuming device (20, 21, 22, 23) being connected – via a telecommunications network (100) – to at least one electrical power generating and/or storing means (40), wherein additionally an electrical power transmission means (10) serves to transmit electrical power between the at least one electrical power generating and/or storing means (40) and the at least one power consuming device (20, 21, 22, 23), wherein the electrical power generating and/or storing means (40) is associated with an expected and a current electrical power supply profile, and wherein an electrical power management entity (30) is coupled – via the telecommunications network (100) – to the at least one power consuming device (20, 21, 22, 23) such that demand of electrical power consumption by the at least one power consuming device (20, 21, 22, 23) is influenced, by the electrical power management entity (30), by means of transmitting electrical power control information between the electrical power management entity (30) and the at least one power consuming device (20, 21, 22, 23), wherein the method comprises the steps of:
- in a first step, an electrical power consumption profile information is transmitted to or accessed by the electrical power management entity (30), the electrical power consumption profile information being related to the at least one power consuming device (20, 21, 22, 23) or to a mode of operation thereof,
 - in a second step, subsequent to the first step, a first and/or a second electrical power control information is transmitted, by the electrical power management entity (30), to the at least one power consuming device (20, 21, 22, 23), the first electrical power control information indicating to activate a power consumption mode of operation corresponding to the electrical power consumption profile information transmitted to or accessed by the electrical power management entity (30), whereas the second electrical power control information indicating to modify or to adapt a power consumption mode of operation of the power consuming device (20, 21, 22, 23), wherein the electrical power management entity (30) transmits, dependent on the electrical power consumption profile information, the electrical power control information to the at least one power consuming device (20, 21, 22, 23) such that the

demand of electrical power by the at least one power consuming device (20, 21, 22, 23) is influenced by means of postponing or preponing expected future demand of electrical power.

- 5 2. Method according to claim 1, wherein prior, during or after the first step, an electrical power request information is transmitted to or accessed by the electrical power management entity (30), the electrical power request information being related to both a user interaction and the at least one power consuming device (20, 21, 22, 23), wherein the user interaction especially
- 10 corresponds to activate the at least one power consuming device (20, 21, 22, 23).
3. Method according to one of the preceding claims, wherein the electrical power management entity (30) transmits, dependent on the electrical power request
- 15 information, the electrical power control information to the at least one power consuming device (20, 21, 22, 23) such that the demand of electrical power by the at least one power consuming device (20, 21, 22, 23) is influenced, especially influenced by means of postponing or preponing expected future
- demand of electrical power and/or by means of reducing or increasing current
- 20 demand of electrical power, wherein the demand of electrical power is especially influenced in view of adapting supply and demand of electrical power to each other such that differences between current supply and demand of electrical power are as low as possible and as non-volatile as possible.
4. Method according to one of the preceding claims, wherein the electrical power management entity (30) transmits, dependent on the electrical power
- 25 consumption profile information, the electrical power control information to the at least one power consuming device (20, 21, 22, 23) such that the demand of electrical power by the at least one power consuming device (20, 21, 22, 23) is
- 30 influenced, especially influenced by means of reducing or increasing current demand of electrical power.
5. Method according to one of the preceding claims, wherein the at least one power consuming device (20, 21, 22, 23) is able to be operated – at least for
- 35 comparably short intervals of time, especially for one or a plurality of seconds or fractions of a second or for one or a plurality of minutes – in a mode of operation of negative demand of electrical power or of surplus energy (supply

of electrical power), wherein the electrical power management entity (30) transmits, dependent on the electrical power consumption profile information and/or the electrical power request information, the electrical power control information to the at least one power consuming device (20, 21, 22, 23) such that the negative demand of electrical power (supply of electrical power) by the at least one power consuming device (20, 21, 22, 23) is influenced, especially influenced by means of preponing or postponing expected future negative demand of electrical power and/or by means of increasing or decreasing current negative demand of electrical power.

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6. Method according to one of the preceding claims, wherein the electrical power consumption profile information and/or the electrical power request information comprise at least one out of the following:

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-- information about the expected evolution of the electrical power demand by the at least one power consuming device (20, 21, 22, 23),

-- information about the postponing flexibility, in terms of time flexibility to use the electrical power later and/or in terms of flexibility regarding lowering the electrical power level, in demanding the electrical power,

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-- information about the preponing flexibility, in terms of time flexibility to use the electrical power earlier and/or in terms of flexibility regarding increasing the electrical power level, in demanding the electrical power,

-- information whether the electrical power demand is able to be interrupted after the at least one power consuming device (20, 21, 22, 23) having been activated.

25

-- information how often the electrical power demand is able to be interrupted after the at least one power consuming device (20, 21, 22, 23) has been activated.

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7. Method according to one of the preceding claims, wherein the electrical power consumption profile information comprises abstraction model information of the expected behaviour of the at least one power consuming device (20, 21, 22, 23) regarding future (positive and/or negative) electrical power demand, the abstraction model information of the expected behaviour of the at least one power consuming device (20, 21, 22, 23) being especially associated with different typical modes of operation of the at least one power consuming device (20, 21, 22, 23) such as different programs, especially cleaning or working programs, of a household appliance and/or different programs or

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modes of operation of the at least one power consuming device (20, 21, 22, 23) for industrial, agricultural, transportation or healthcare purposes.

- 5 8. Method according to one of the preceding claims, wherein the electrical power request information comprises abstraction model information of user or customer requirements regarding the at least one power consuming device (20, 21, 22, 23), the abstraction model information of user or customer requirements being especially associated with time and/or completion requirements of the user or customer regarding the service to be provided by
10 the at least one power consuming device (20, 21, 22, 23).
9. System for improved controlling of electrical power usage by at least one power consuming device (20, 21, 22, 23) being connected – via a telecommunications network (100) – to at least one electrical power
15 generating and/or storing means (40), wherein additionally an electrical power transmission means (10) serves to transmit electrical power between the at least one electrical power generating and/or storing means (40) and the at least one power consuming device (20, 21, 22, 23), wherein the electrical power generating and/or storing means (40) is associated with an expected
20 and a current electrical power supply profile, and wherein an electrical power management entity (30) is coupled – via the telecommunications network (100) – to the at least one power consuming device (20, 21, 22, 23) such that demand of electrical power consumption by the at least one power consuming device (20, 21, 22, 23) is influenced, by the electrical power management
25 entity (30), by means of transmitting electrical power control information between the electrical power management entity (30) and the at least one power consuming device (20, 21, 22, 23), wherein the system comprises the telecommunications network (100), especially a mobile communication network, the at least one power consuming device (20, 21, 22, 23), the
30 electrical power generating and/or storing means (40), the electrical power management entity (30), and the electrical power transmission means (10), wherein the system is configured such that:
- an electrical power consumption profile information is transmitted to or accessed by the electrical power management entity (30), the electrical power
35 consumption profile information being related to the at least one power consuming device (20, 21, 22, 23) or to a mode of operation thereof,
 - a first and/or a second electrical power control information is transmitted,

by the electrical power management entity (30), to the at least one power consuming device (20, 21, 22, 23), the first electrical power control information indicating to activate a power consumption mode of operation corresponding to the electrical power consumption profile information transmitted to or
5 accessed by the electrical power management entity (30), whereas the second electrical power control information indicating to modify or to adapt a power consumption mode of operation of the power consuming device (20, 21, 22, 23), wherein the electrical power management entity (30) is configured to transmit, dependent on the electrical power consumption profile information,
10 the electrical power control information to the at least one power consuming device (20, 21, 22, 23) such that the demand of electrical power by the at least one power consuming device (20, 21, 22, 23) is influenced by means of postponing or preponing expected future demand of electrical power.

15 10. System according to claim 8, wherein the power consuming device (20, 21, 22, 23) and/or electrical power management entity (30) is configured such that an electrical power request information is transmitted to or accessed by the electrical power management entity (30), the electrical power request information being related to both a user interaction and the at least one power
20 consuming device (20, 21, 22, 23), wherein the user interaction especially corresponds to activate the at least one power consuming device (20, 21, 22, 23).

25 11. System according to claim 8 or 9, wherein the electrical power management entity (30) is configured to transmit, dependent on the electrical power request information, the electrical power control information to the at least one power consuming device (20, 21, 22, 23) such that the demand of electrical power by the at least one power consuming device (20, 21, 22, 23) is influenced, especially influenced by means of postponing or preponing expected future
30 demand of electrical power and/or by means of reducing or increasing current demand of electrical power, wherein the demand of electrical power is especially influenced in view of adapting supply and demand of electrical power to each other such that differences between current supply and demand of electrical power are as low as possible and as non-volatile as possible.

35 12. System according to claim 8, 9 or 10, wherein the electrical power transmission means (10) is a grid or a grid-like electrical power transmission

structure, extending within or being related with

-- a home and/or an industrial, agricultural, transportation-related or healthcare site or plant, or

5 -- an area comprising a plurality of homes and/or a plurality of industrial, agricultural, transportation-related or healthcare sites or plants, or

-- a region or a state comprising a plurality of homes and a plurality of industrial, agricultural, transportation-related or healthcare sites or plants, wherein the electrical power management entity (30) corresponds to either a single entity associated to the entire electrical power transmission means (10) or to a plurality of entities, each one being associated to parts or areas of the electrical power transmission means (10).

13. Electrical power management entity (30) configured to be used in a system according to one of claims 8 to 11 and/or configured to be used when executing a method according to one of claims 1 to 7.

14. Program comprising a computer readable program code which, when executed on a computer and/or on an electrical power management entity (30) and/or on a power consuming device (20, 21, 22, 23) and/or on a network component of a telecommunications network (100) or in part on an electrical power management entity (30) and/or in part on a power consuming device (20, 21, 22, 23) and/or in part on a network component of a telecommunications network (100), causes the computer and/or the electrical power management entity (30) and/or the power consuming device (20, 21, 22, 23) and/or the network component of the telecommunications network (100) to perform a method according one of claims 1 to 7.

15. Computer program product for improved communication between network nodes of a mobile communication network (100), the computer program product comprising a computer program stored on a storage medium, the computer program comprising program code which, when executed on a computer and/or on an electrical power management entity (30) and/or on a power consuming device (20, 21, 22, 23) and/or on a network component of a telecommunications network (100) or in part on an electrical power management entity (30) and/or in part on a power consuming device (20, 21, 22, 23) and/or in part on a network component of a telecommunications network (100), causes the computer and/or the electrical power management

entity (30) and/or the power consuming device (20, 21, 22, 23) and/or the network component of the telecommunications network (100) to perform a method according one of claims 1 to 7.

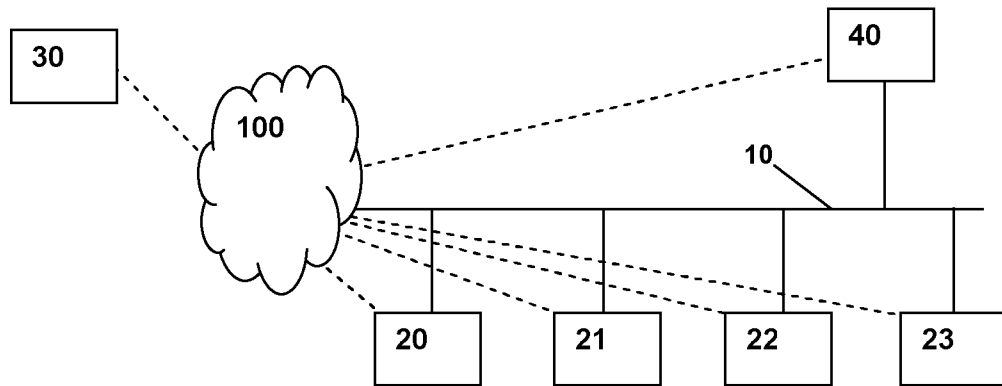


Fig. 1

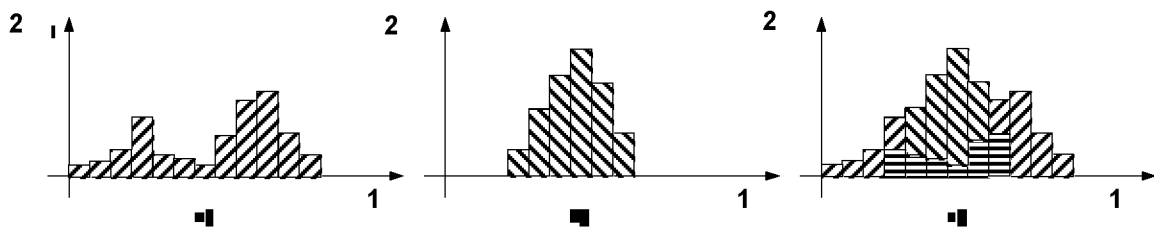


Fig. 2

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2016/068107

A. CLASSIFICATION OF SUBJECT MATTER
 INV. H02J3/14 H02J13/00 G05B15/02
 ADD.
 According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED
 Minimum documentation searched (classification system followed by classification symbols)
 H02J

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
 EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2014/379099 A1 (PREMEREUR GEERT [BE] ET AL) 25 December 2014 (2014-12-25) the whole document	1-15
X	US 2013/116844 A1 (MCNALLY JOHN M [US] ET AL) 9 May 2013 (2013-05-09) abstract; figures paragraphs [0006] - [0010], [0020] - [0031]	1-15
X	US 2012/326503 A1 (BIRKELUND MOGENS [DK]) 27 December 2012 (2012-12-27) abstract; figures 1,2,5-9 paragraphs [0014], [0020] - [0022], [0055] - [74.80]	1-15
X	US 8 588 991 B1 (FORBES JR JOSEPH W [US]) 19 November 2013 (2013-11-19) abstract; figures	1,9

Further documents are listed in the continuation of Box C.

See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"E" earlier application or patent but published on or after the international filing date	"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"O" document referring to an oral disclosure, use, exhibition or other means	"&" document member of the same patent family
"P" document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search 13 October 2016	Date of mailing of the international search report 21/10/2016
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Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Authorized officer Hartmann, Martin
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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2016/068107

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