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Inventor(s)	KIM; Junsung et al.

ELECTRONIC DEVICE FOR MERGING CLUSTERS OF NAN COMMUNICATION AND OPERATION METHOD THEREOF

Abstract

Various embodiments of the present invention relate to a device and a method for merging NAN clusters by an electronic device. The electronic device may comprise a communication circuit and a processor, wherein the processor: forms a first NAN cluster with a first external electronic device; on the basis of discovery of a second NAN cluster, updates a first cluster grade of the first NAN cluster on the basis of a second merging reference value of the second NAN cluster and a first merging reference value of the first NAN cluster; and identifies the direction of merging the first NAN cluster and the second NAN cluster on the basis of the first merging reference value, the second merging reference value, the updated first cluster grade, and/or a second cluster grade of the second NAN cluster. Other embodiments may also be possible.

Inventors: **KIM; Junsung (Suwon-si, KR), JUNG; Buseop (Suwon-si, KR)**

Applicant: **SAMSUNG ELECTRONICS CO., LTD.** (Suwon-si, KR)

Family ID: **90931045**

Assignee: **SAMSUNG ELECTRONICS CO., LTD. (Suwon-si, KR)**

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Background/Summary

CROSS-REFERENCE TO RELATED APPLICATION [0001] This application is a by-pass continuation application of International Application No. PCT/KR2023/017161, filed on Oct. 31, 2023, which is based on and claims priority to Korean Patent Application No. 10-2022-0145041, filed on Nov. 3, 2022, and Korean Patent Application No. 10-2022-0156464, filed on Nov. 21, 2022, in the Korean Patent Office, the disclosures of which are incorporated by reference herein in their entireties.

1. FIELD
[0002] The present disclosure relates to an electronic device for merging clusters in neighbor awareness networking (NAN) communication, and an operation method.
2. DESCRIPTION OF RELATED ART
[0003] Electronic devices can provide various types of proximity services utilizing low-power discovery technology. Proximity services may refer to communication functions that enable nearby electronic devices to quickly exchange data through a proximity network. For example, proximity services may include low-power proximity services using Bluetooth low energy (BLE) beacons, or low-power proximity services based on low-power short-range communication technologies (e.g., neighbor awareness networking (NAN) and/or Wi-Fi aware (hereinafter referred to as “NAN”)) based on wireless local area networks (WLANs).
[0004] NAN-based low-power proximity services can represent a communication function that exchanges data by forming a proximity network that dynamically changes according to the movement of electronic devices. Electronic devices included in a cluster may transmit and/or receive signals for discovery (e.g., beacons) and/or service discovery frames (SDFs) to notify the existence of the cluster or for synchronization within a time duration (or a communication period) (e.g., a discovery window (DW)) that is synchronized with each other. For example, a cluster may represent a set of electronic devices forming a proximity network.
SUMMARY
[0005] Aspects of the disclosure are to address at least the above-mentioned problems and/or disadvantages and to provide at least the advantages described below. Accordingly, an aspect of the disclosure is to provide an apparatus and a method for controlling merging of NAN clusters in an electronic device.
[0006] According to an aspect of the disclosure, an electronic device includes a communication circuitry, at least one processor operatively connected to the communication circuitry and memory storing instructions, wherein the instructions, when executed by the at least one processor individually or collectively, cause the electronic device to: form a first neighbor awareness network (NAN) cluster with at least one first external electronic device; identify a second merging criterion value of a second NAN cluster and a second cluster grade of the second NAN cluster that is different from the first NAN cluster, based on a discovery of the second NAN cluster; update a first cluster grade of the first NAN cluster based on the second merging criterion value and a first merging criterion value of the first NAN cluster; and identify a merging direction of the first NAN

cluster and the second NAN cluster based on at least one of the first merging criterion value, the second merging criterion value, the updated first cluster grade, or the second cluster grade.
[0007] The first merging criterion value may be configured based on at least one of a cluster size of the first NAN cluster, a number of NAN data paths (NDPs) activated within the first NAN cluster, or a number of NAN data links (NDLs) activated within the first NAN cluster, and the second merging criterion value may be configured based on at least one of a cluster size of the second NAN cluster, a number of NDPs activated within the second NAN cluster, or a number of NDLs activated within the second NAN cluster.
[0008] The instructions, when executed by the at least one processor individually or collectively, cause the electronic device to, in a case that the second merging criterion value is greater than the first merging criterion value and the first cluster grade is greater than the second cluster grade, update the first cluster grade to be less than the second cluster grade.
[0009] The instructions, when executed by the at least one processor individually or collectively, cause the electronic device to, in a case that the first merging criterion value is greater than the second merging criterion value and the second cluster grade is greater than the first cluster grade, update the first cluster grade to be greater than the second cluster grade.
[0010] The instructions, when executed by the at least one processor individually or collectively, cause the electronic device to update the first cluster grade by updating at least one of a master preference value of an anchor master device of the first NAN cluster, or a random factor value associated with the first cluster grade.
[0011] The instructions, when executed by the at least one processor individually or collectively, cause the electronic device to, in a case that the second merging criterion value is greater than the first merging criterion value and the second cluster grade is greater than the updated first cluster grade, configure the merging direction such that the first NAN cluster is merged into the second NAN cluster.
[0012] The instructions, when executed by the at least one processor individually or collectively, cause the electronic device to, in a case that the electronic device is an anchor master device of the first NAN cluster, transmit information related to the second NAN cluster to at least one first external electronic device included in the first NAN cluster, based on the first NAN cluster being merged into the second NAN cluster through the communication circuit; and perform synchronization with the second NAN cluster through the communication circuit.
[0013] The instructions, when executed by the at least one processor individually or collectively, cause the electronic device to, in a case that the first merging criterion value is greater than the second merging criterion value and the updated first cluster grade is greater than the second cluster grade, configure the merging direction such that the second NAN cluster is merged into the first NAN cluster.
[0014] According to an aspect of the disclosure, an operation method of an electronic device includes forming a first neighbor awareness network (NAN) cluster with at least one first external electronic device; identifying a second merging criterion value of a second NAN cluster and second cluster grade of the second NAN cluster based on a discovery of the second NAN cluster that is different from the first NAN cluster; updating a first cluster grade of the first NAN cluster based on the second merging criterion value and a first merging criterion value of the first NAN cluster; and identifying a merging direction of the first NAN cluster and the second NAN cluster based on at least one of the first merging criterion value, the second merging criterion value, the updated first cluster grade, or the second cluster grade.
[0015] The first merging criterion value may be configured based on at least one of a cluster size of the first NAN cluster, a number of NDPs activated within the first NAN cluster, or a number of NDLs activated within the first NAN cluster, and the second merging criterion value may be configured based on at least one of a cluster size of the second NAN cluster, a number of NDPs activated within the second NAN cluster, or a number of NDLs activated within the second NAN

cluster.
[0016] The updating of the first cluster grade may include, in a case that the second merging criterion value is greater than the first merging criterion value and the first cluster grade is greater than the second cluster grade, updating the first cluster grade to be less than the second cluster grade.
[0017] The updating of the first cluster grade may include, in a case that the first merging criterion value is greater than the second merging criterion value and the second cluster grade is greater than the first cluster grade, updating the first cluster grade to be greater than the second cluster grade.
[0018] The updating of the first cluster grade may include updating the first cluster grade by updating at least one of a master preference value of an anchor master device of the first NAN cluster, or a random factor value associated with the first cluster grade.
[0019] The identifying of the merging direction may include, in a case that the second merging criterion value is greater than the first merging criterion value and the second cluster grade is greater than the updated first cluster grade, configuring the merging direction such that the first NAN cluster is merged into the second NAN cluster.
[0020] The identifying of the merging direction, in a case that the first merging criterion value is greater than the second merging criterion value and the updated first cluster grade is greater than the second cluster grade, may include configuring the merging direction such that the second NAN cluster is merged into the first NAN cluster.
[0021] According to various embodiments of the disclosure, an electronic device may configure a merging direction with another NAN cluster based on a merging criterion value configured based on the number of electronic devices included in a NAN cluster (e.g., the size of the NAN cluster) and/or the number of NAN data paths (NDPs) or NAN data links (NDLs) activated for data communication within the NAN cluster, thereby reducing the probability of failure (or error) and/or power consumption of data transmission due to merging of NAN clusters, and reducing the time required for merging NAN clusters.
[0022] The effects that can be obtained from various embodiments of the present invention are not limited to the effects mentioned above, and other effects that are not mentioned can be clearly understood by those skilled in the art in which various embodiments of the present invention belong from the description below.

Description

BRIEF DESCRIPTION OF THE DRAWINGS
[0023] The above and other aspects and features of certain embodiments of the present disclosure are more apparent from the following description taken in conjunction with the accompanying drawings, in which:
[0024] FIG. **1** is a block diagram illustrating an electronic device in a network environment according to various embodiments.
[0025] FIG. **2** is a diagram illustrating a NAN cluster according to various embodiments.
[0026] FIG. **3** is a diagram illustrating a protocol for transmitting signals of an electronic device included in a NAN cluster according to various embodiments.
[0027] FIG. **4** is a diagram illustrating an example of data transmission and/or reception within a NAN cluster according to various embodiments.
[0028] FIG. **5**A is a diagram illustrating a first NAN cluster and a second NAN cluster according to various embodiments.
[0029] FIG. **5**B is a diagram illustrating an example of merging a first NAN cluster and a second NAN cluster according to various embodiments.
[0030] FIG. **6** is a block diagram illustrating an electronic device for merging NAN clusters

according to various embodiments.
[0031] FIG. **7** is a flowchart for merging NAN clusters in an electronic device according to various embodiments.
[0032] FIG. **8** is a flowchart for configuring a merging direction of NAN clusters in an electronic device according to various embodiments.
[0033] FIG. **9** is a diagram illustrating an example for merging NAN clusters in an electronic device according to various embodiments.
[0034] FIG. **10**A is a diagram illustrating an example for sharing a merging criterion value in an electronic device according to various embodiments.
[0035] FIG. **10**B is a diagram illustrating an example for sharing a merge reference value in an electronic device according to various embodiments.
[0036] FIG. **10**C is a diagram illustrating an example for sharing a merge reference value in an electronic device according to various embodiments.

DETAILED DESCRIPTION

[0037] The embodiments described in the disclosure, and the configurations shown in the drawings, are only examples of embodiments, and various modifications may be made without departing from the scope and spirit of the disclosure.
[0038] The various embodiments described herein are not necessarily mutually exclusive, as some embodiments can be combined with one or more other embodiments to form new embodiments. The term "or" as used herein, refers to a non-exclusive or, unless otherwise indicated. The examples used herein are intended to facilitate an understanding of ways in which the disclosure can be practiced and to further enable those skilled in the art to practice the disclosure. Accordingly, the examples should not be construed as limiting the scope of the disclosure.
[0039] The expressions "at least one of A, B and C" and "at least one of A, B, or C", both indicate "A", only "B", only "C", both "A and B", both "A and C", both "B and C", and all of "A, B, and C".
[0040] The accompanying drawings are used to help understand various technical features and it should be understood that the embodiments presented herein are not limited by the accompanying drawings. As such, the present disclosure should be construed to extend to any alterations, equivalents, and substitutes in addition to those which are set out in the accompanying drawings. Although the terms first, second, for example, may be used herein to describe various elements, these elements should not be limited by these terms. These terms are used to distinguish one element from another.
[0041] FIG. **1** is a block diagram illustrating an example electronic device **101** in a network environment **100** according to various embodiments. Referring to FIG. **1**, the electronic device **101** in the network environment **100** may communicate with an electronic device **102** via a first network **198** (e.g., a short-range wireless communication network), or at least one of an electronic device **104** or a server **108** via a second network **199** (e.g., a long-range wireless communication network). According to an embodiment, the electronic device **101** may communicate with the electronic device **104** via the server **108**. According to an embodiment, the electronic device **101** may include a processor **120**, memory **130**, an input module **150**, a sound output module **155**, a display module **160**, an audio module **170**, a sensor module **176**, an interface **177**, a connecting terminal **178**, a haptic module **179**, a camera module **180**, a power management module **188**, a battery **189**, a communication module **190**, a subscriber identification module (SIM) **196**, or an antenna module **197**. In some embodiments, at least one of the components (e.g., the connecting terminal **178**) may be omitted from the electronic device **101**, or one or more other components may be added in the electronic device **101**. In some embodiments, some of the components (e.g., the sensor module **176**, the camera module **180**, or the antenna module **197**) may be implemented as a single component (e.g., the display module **160**).
[0042] The processor **120** may execute, for example, software (e.g., a program **140**) to control at

least one other component (e.g., a hardware or software component) of the electronic device **101** coupled with the processor **120**, and may perform various data processing or computation. According to an embodiment, as at least part of the data processing or computation, the processor **120** may store a command or data received from another component (e.g., the sensor module **176** or the communication module **190**) in volatile memory **132**, process the command or the data stored in the volatile memory **132**, and store resulting data in non-volatile memory **134**. According to an embodiment, the processor **120** may include a main processor **121** (e.g., a central processing unit (CPU) or an application processor (AP)), or an auxiliary processor **123** (e.g., a graphics processing unit (GPU), a neural processing unit (NPU), an image signal processor (ISP), a sensor hub processor, or a communication processor (CP)) that is operable independently from, or in conjunction with, the main processor **121**. For example, when the electronic device **101** includes the main processor **121** and the auxiliary processor **123**, the auxiliary processor **123** may be adapted to consume less power than the main processor **121**, or to be specific to a specified function. The auxiliary processor **123** may be implemented as separate from, or as part of the main processor **121**.

[0043] The auxiliary processor **123** may control at least some of functions or states related to at least one component (e.g., the display module **160**, the sensor module **176**, or the communication module **190**) among the components of the electronic device **101**, instead of the main processor **121** while the main processor **121** is in an inactive (e.g., sleep) state, or together with the main processor **121** while the main processor **121** is in an active state (e.g., executing an application). According to an embodiment, the auxiliary processor **123** (e.g., an image signal processor or a communication processor) may be implemented as part of another component (e.g., the camera module **180** or the communication module **190**) functionally related to the auxiliary processor **123**. According to an embodiment, the auxiliary processor **123** (e.g., the neural processing unit) may include a hardware structure specified for artificial intelligence model processing. An artificial intelligence model may be generated by machine learning. Such learning may be performed, e.g., by the electronic device **101** where the artificial intelligence is performed or via a separate server (e.g., the server **108**). Learning algorithms may include, but are not limited to, e.g., supervised learning, unsupervised learning, semi-supervised learning, or reinforcement learning. The artificial intelligence model may include a plurality of artificial neural network layers. The artificial neural network may be a deep neural network (DNN), a convolutional neural network (CNN), a recurrent neural network (RNN), a restricted boltzmann machine (RBM), a deep belief network (DBN), a bidirectional recurrent deep neural network (BRDNN), deep Q-network or a combination of two or more thereof but is not limited thereto. The artificial intelligence model may, additionally or alternatively, include a software structure other than the hardware structure.

[0044] The memory **130** may store various data used by at least one component (e.g., the processor **120** or the sensor module **176**) of the electronic device **101**. The various data may include, for example, software (e.g., the program **140**) and input data or output data for a command related thereto. The memory **130** may include the volatile memory **132** or the non-volatile memory **134**.

[0045] The program **140** may be stored in the memory **130** as software, and may include, for example, an operating system (OS) **142**, middleware **144**, or an application **146**.

[0046] The input module **150** may receive a command or data to be used by another component (e.g., the processor **120**) of the electronic device **101**, from the outside (e.g., a user) of the electronic device **101**. The input module **150** may include, for example, a microphone, a mouse, a keyboard, a key (e.g., a button), or a digital pen (e.g., a stylus pen).

[0047] The sound output module **155** may output sound signals to the outside of the electronic device **101**. The sound output module **155** may include, for example, a speaker or a receiver. The speaker may be used for general purposes, such as playing multimedia or playing record. The receiver may be used for receiving incoming calls. According to an embodiment, the receiver may be implemented as separate from, or as part of the speaker.

[0048] The display module **160** may visually provide information to the outside (e.g., a user) of the electronic device **101**. The display module **160** may include, for example, a display, a hologram device, or a projector and control circuitry to control a corresponding one of the display, hologram device, and projector. According to an embodiment, the display module **160** may include a touch sensor adapted to detect a touch, or a pressure sensor adapted to measure the intensity of force incurred by the touch.
[0049] The audio module **170** may convert a sound into an electrical signal and vice versa. According to an embodiment, the audio module **170** may obtain the sound via the input module **150**, or output the sound via the sound output module **155** or a headphone of an external electronic device (e.g., an electronic device **102**) directly (e.g., wiredly) or wirelessly coupled with the electronic device **101**.
[0050] The sensor module **176** may detect an operational state (e.g., power or temperature) of the electronic device **101** or an environmental state (e.g., a state of a user) external to the electronic device **101**, and then generate an electrical signal or data value corresponding to the detected state. According to an embodiment, the sensor module **176** may include, for example, a gesture sensor, a gyro sensor, an atmospheric pressure sensor, a magnetic sensor, an acceleration sensor, a grip sensor, a proximity sensor, a color sensor, an infrared (IR) sensor, a biometric sensor, a temperature sensor, a humidity sensor, or an illuminance sensor.
[0051] The interface **177** may support one or more specified protocols to be used for the electronic device **101** to be coupled with the external electronic device (e.g., the electronic device **102**) directly (e.g., wiredly) or wirelessly. According to an embodiment, the interface **177** may include, for example, a high definition multimedia interface (HDMI), a universal serial bus (USB) interface, a secure digital (SD) card interface, or an audio interface.
[0052] A connecting terminal **178** may include a connector via which the electronic device **101** may be physically connected with the external electronic device (e.g., the electronic device **102**). According to an embodiment, the connecting terminal **178** may include, for example, a HDMI connector, a USB connector, a SD card connector, or an audio connector (e.g., a headphone connector).
[0053] The haptic module **179** may convert an electrical signal into a mechanical stimulus (e.g., a vibration or a movement) or electrical stimulus which may be recognized by a user via his tactile sensation or kinesthetic sensation. According to an embodiment, the haptic module **179** may include, for example, a motor, a piezoelectric element, or an electric stimulator.
[0054] The camera module **180** may capture a still image or moving images. According to an embodiment, the camera module **180** may include one or more lenses, image sensors, image signal processors, or flashes.
[0055] The power management module **188** may manage power supplied to the electronic device **101**. According to an embodiment, the power management module **188** may be implemented as at least part of, for example, a power management integrated circuit (PMIC).
[0056] The battery **189** may supply power to at least one component of the electronic device **101**. According to an embodiment, the battery **189** may include, for example, a primary cell which is not rechargeable, a secondary cell which is rechargeable, or a fuel cell.
[0057] The communication module **190** may support establishing a direct (e.g., wired) communication channel or a wireless communication channel between the electronic device **101** and the external electronic device (e.g., the electronic device **102**, the electronic device **104**, or the server **108**) and performing communication via the established communication channel. The communication module **190** may include one or more communication processors that are operable independently from the processor **120** (e.g., the application processor (AP)) and supports a direct (e.g., wired) communication or a wireless communication. According to an embodiment, the communication module **190** may include a wireless communication module **192** (e.g., a cellular communication module, a short-range wireless communication module, or a global navigation

satellite system (GNSS) communication module) or a wired communication module **194** (e.g., a local area network (LAN) communication module or a power line communication (PLC) module). A corresponding one of these communication modules may communicate with the external electronic device via the first network **198** (e.g., a short-range communication network, such as Bluetooth™, wireless-fidelity (Wi-Fi) direct, or infrared data association (IrDA)) or the second network **199** (e.g., a long-range communication network, such as a legacy cellular network, a 5G network, a next-generation communication network, the Internet, or a computer network (e.g., LAN or wide area network (WAN)). These various types of communication modules may be implemented as a single component (e.g., a single chip), or may be implemented as multi components (e.g., multi chips) separate from each other. The wireless communication module **192** may identify and authenticate the electronic device **101** in a communication network, such as the first network **198** or the second network **199**, using subscriber information (e.g., international mobile subscriber identity (IMSI)) stored in the subscriber identification module **196**.

[0058] The wireless communication module **192** may support a 5G network, after a 4G network, and next-generation communication technology, e.g., new radio (NR) access technology. The NR access technology may support enhanced mobile broadband (eMBB), massive machine type communications (mMTC), or ultra-reliable and low-latency communications (URLLC). The wireless communication module **192** may support a high-frequency band (e.g., the mmWave band) to achieve, e.g., a high data transmission rate. The wireless communication module **192** may support various technologies for securing performance on a high-frequency band, such as, e.g., beamforming, massive multiple-input and multiple-output (massive MIMO), full dimensional MIMO (FD-MIMO), array antenna, analog beam-forming, or large scale antenna. The wireless communication module **192** may support various requirements specified in the electronic device **101**, an external electronic device (e.g., the electronic device **104**), or a network system (e.g., the second network **199**). According to an embodiment, the wireless communication module **192** may support a peak data rate (e.g., 20 Gbps or more) for implementing eMBB, loss coverage (e.g., 164 dB or less) for implementing mMTC, or U-plane latency (e.g., 0.5 ms or less for each of downlink (DL) and uplink (UL), or a round trip of 1 ms or less) for implementing URLLC. According to an embodiment, the subscriber identification module **196** may include a plurality of subscriber identification modules. For example, the plurality of subscriber identification modules may store different subscriber information.

[0059] The antenna module **197** may transmit or receive a signal or power to or from the outside (e.g., the external electronic device) of the electronic device **101**. According to an embodiment, the antenna module **197** may include an antenna including a radiating element including a conductive material or a conductive pattern formed in or on a substrate (e.g., a printed circuit board (PCB)). According to an embodiment, the antenna module **197** may include a plurality of antennas (e.g., array antennas). In such a case, at least one antenna appropriate for a communication scheme used in the communication network, such as the first network **198** or the second network **199**, may be selected, for example, by the communication module **190** (e.g., the wireless communication module **192**) from the plurality of antennas. The signal or the power may then be transmitted or received between the communication module **190** and the external electronic device via the selected at least one antenna. According to an embodiment, another component (e.g., a radio frequency integrated circuit (RFIC)) other than the radiating element may be additionally formed as part of the antenna module **197**.

[0060] According to various embodiments, the antenna module **197** may form a mmWave antenna module. According to an embodiment, the mmWave antenna module may include a printed circuit board, a RFIC disposed on a first surface (e.g., the bottom surface) of the printed circuit board, or adjacent to the first surface and capable of supporting a designated high-frequency band (e.g., the mmWave band), and a plurality of antennas (e.g., array antennas) disposed on a second surface (e.g., the top or a side surface) of the printed circuit board, or adjacent to the second surface and

capable of transmitting or receiving signals of the designated high-frequency band.
[0061] At least some of the above-described components may be coupled mutually and communicate signals (e.g., commands or data) therebetween via an inter-peripheral communication scheme (e.g., a bus, general purpose input and output (GPIO), serial peripheral interface (SPI), or mobile industry processor interface (MIPI)).
[0062] According to an embodiment, commands or data may be transmitted or received between the electronic device **101** and the external electronic device **104** via the server **108** coupled with the second network **199**. Each of the electronic devices **102** or **104** may be a device of a same type as, or a different type, from the electronic device **101**. According to an embodiment, all or some of operations to be executed at the electronic device **101** may be executed at one or more of the external electronic devices **102**, **104**, or **108**. For example, if the electronic device **101** should perform a function or a service automatically, or in response to a request from a user or another device, the electronic device **101**, instead of, or in addition to, executing the function or the service, may request the one or more external electronic devices to perform at least part of the function or the service. The one or more external electronic devices receiving the request may perform the at least part of the function or the service requested, or an additional function or an additional service related to the request, and transfer an outcome of the performing to the electronic device **101**. The electronic device **101** may provide the outcome, with or without further processing of the outcome, as at least part of a reply to the request. To that end, a cloud computing, distributed computing, mobile edge computing (MEC), or client-server computing technology may be used, for example. The electronic device **101** may provide ultra low-latency services using, e.g., distributed computing or mobile edge computing. In an embodiment, the external electronic device **104** may include an internet-of-things (IoT) device. The server **108** may be an intelligent server using machine learning and/or a neural network. According to an embodiment, the external electronic device **104** or the server **108** may be included in the second network **199**. The electronic device **101** may be applied to intelligent services (e.g., smart home, smart city, smart car, or healthcare) based on 5G communication technology or IoT-related technology.
[0063] The electronic device according to various embodiments may be one of various types of electronic devices. The electronic devices may include, for example, a portable communication device (e.g., a smartphone), a computer device, a portable multimedia device, a portable medical device, a camera, a wearable device, a home appliance, or the like. According to an embodiment of the disclosure, the electronic devices are not limited to those described above.
[0064] It should be appreciated that various embodiments of the present disclosure and the terms used therein are not intended to limit the technological features set forth herein to particular embodiments and include various changes, equivalents, or replacements for a corresponding embodiment. With regard to the description of the drawings, similar reference numerals may be used to refer to similar or related elements. It is to be understood that a singular form of a noun corresponding to an item may include one or more of the things, unless the relevant context clearly indicates otherwise. As used herein, each of such phrases as “A or B,” “at least one of A and B,” “at least one of A or B,” “A, B, or C,” “at least one of A, B, and C,” and “at least one of A, B, or C,” may include any one of, or all possible combinations of the items enumerated together in a corresponding one of the phrases. As used herein, such terms as “1st” and “2nd,” or “first” and “second” may be used to simply distinguish a corresponding component from another, and does not limit the components in other aspect (e.g., importance or order). It is to be understood that if an element (e.g., a first element) is referred to, with or without the term “operatively” or “communicatively”, as “coupled with,” “coupled to,” “connected with,” or “connected to” another element (e.g., a second element), the element may be coupled with the other element directly (e.g., wiredly), wirelessly, or via a third element.
[0065] As used in connection with various embodiments of the disclosure, the term “module” may include a unit implemented in hardware, software, or firmware, or any combination thereof, and

may interchangeably be used with other terms, for example, “logic,” “logic block,” “part,” or “circuitry”. A module may be a single integral component, or a minimum unit or part thereof, adapted to perform one or more functions. For example, according to an embodiment, the module may be implemented in a form of an application-specific integrated circuit (ASIC).

[0066] Various embodiments as set forth herein may be implemented as software (e.g., the program **140**) including one or more instructions that are stored in a storage medium (e.g., internal memory **136** or external memory **138**) that is readable by a machine (e.g., the electronic device **101**). For example, a processor (e.g., the processor **120**) of the machine (e.g., the electronic device **101**) may invoke at least one of the one or more instructions stored in the storage medium, and execute it, with or without using one or more other components under the control of the processor. This allows the machine to be operated to perform at least one function according to the at least one instruction invoked. The one or more instructions may include a code generated by a compiler or a code executable by an interpreter. The machine-readable storage medium may be provided in the form of a non-transitory storage medium. Wherein, the “non-transitory” storage medium is a tangible device, and may not include a signal (e.g., an electromagnetic wave), but this term does not differentiate between where data is semi-permanently stored in the storage medium and where the data is temporarily stored in the storage medium.

[0067] According to an embodiment, a method according to various embodiments of the disclosure may be included and provided in a computer program product. The computer program product may be traded as a product between a seller and a buyer. The computer program product may be distributed in the form of a machine-readable storage medium (e.g., compact disc read only memory (CD-ROM)), or be distributed (e.g., downloaded or uploaded) online via an application store (e.g., PlayStore™), or between two user devices (e.g., smart phones) directly. If distributed online, at least part of the computer program product may be temporarily generated or at least temporarily stored in the machine-readable storage medium, such as memory of the manufacturer's server, a server of the application store, or a relay server.

[0068] According to various embodiments, each component (e.g., a module or a program) of the above-described components may include a single entity or multiple entities, and some of the multiple entities may be separately disposed in different components. According to various embodiments, one or more of the above-described components may be omitted, or one or more other components may be added. Alternatively or additionally, a plurality of components (e.g., modules or programs) may be integrated into a single component. In such a case, according to various embodiments, the integrated component may still perform one or more functions of each of the plurality of components in the same or similar manner as they are performed by a corresponding one of the plurality of components before the integration. According to various embodiments, operations performed by the module, the program, or another component may be carried out sequentially, in parallel, repeatedly, or heuristically, or one or more of the operations may be executed in a different order or omitted, or one or more other operations may be added.

[0069] FIG. **2** is a diagram illustrating a neighbor awareness network (NAN) cluster according to various embodiments.

[0070] According to various embodiments, FIG. **2** is a diagram illustrating an example of the configuration of a NAN cluster **200** for a proximity network. According to one embodiment, the NAN cluster **200** may mean a set of electronic devices **101**, **210**, **220**, and/or **230** that establish a proximity network so that the respective electronic device (or NAN devices) **101**, **210**, **220**, and/or **230** can transmit and/or receive data to each other.

[0071] According to various embodiments, the NAN cluster **200** may include a plurality of electronic devices **101**, **210**, **220**, and/or **230**. The electronic devices **101**, **210**, **220** and/or **230** included in the NAN cluster **200** may transmit and/or receive a beacon (or discovery beacon), a service discovery frame (SDF), and/or a NAN action frame (NAF) within a synchronized time duration (or communication period) (e.g., a discovery window (DW)).

[0072] According to various embodiments, the electronic devices **101**, **210**, **220**, and/or **230** within the NAN cluster **200** may have their time clocks synchronized with each other. For example, the electronic devices **101**, **210**, **220**, and/or **230** may be synchronized to the time clock of one electronic device (e.g., the electronic device **101**), and transmit and/or receive a beacon, an SDF, and/or an NAF in the same discovery window.
[0073] According to one embodiment, the electronic device **101** supporting a low-power short-range communication technology based on NAN may broadcast a search signal (e.g., a beacon) to discover external electronic devices **210**, **220**, and/or **230** every predetermined first period (e.g., about 100 msec), and perform scanning every predetermined second period (e.g., about 10 msec) to receive the search signal broadcast from the external electronic devices **210**, **220**, and/or **230**.
[0074] According to one embodiment, the electronic device **101** may detect at least one external electronic device **210**, **220** and/or **230** located around the electronic device **101** based on the search signal received through scanning, and perform NAN cluster synchronization with the detected at least one external electronic device **210**, **220** and/or **230**. The NAN cluster synchronization may include an operation of receiving time clock information of an electronic device (e.g., the electronic device **101**) representing a NAN cluster so that the electronic devices **101**, **210**, **220** and/or **230** included in the NAN cluster transmit and/or receive data on the same channel and/or during the same time.
[0075] According to one embodiment, each of the plurality of electronic devices **101**, **210**, **220** and/or **230** may form a single NAN cluster **200** that operates according to the synchronized time clock by transmitting a beacon and receiving a beacon from other electronic devices **101**, **210**, **220** and/or **230**. The electronic devices **101**, **210**, **220** and/or **230** included in the NAN cluster **200** may perform NAN cluster synchronization (e.g., time and/or channel synchronization).
[0076] According to various embodiments, NAN cluster synchronization may be performed based on the time and channel of the electronic device (e.g., the electronic device **101**) with the highest master preference within the NAN cluster **200**. For example, the electronic devices **101**, **210**, **220**, and/or **230** included in the NAN cluster **200** formed through discovery may exchange signals related to master preference information indicating a preference for operating as an anchor master device. The electronic devices **101**, **210**, **220**, and/or **230** included in the NAN cluster **200** may determine the electronic device (e.g., the electronic device **101**) with the highest master preference as an anchor master device (or a master electronic device) through the signals related to the master preference information.
[0077] According to various embodiments, the anchor master device (e.g., the electronic device **101**) may mean an electronic device that serves as a reference for time and channel synchronization of the electronic devices **101**, **210**, **220**, and/or **230** included in the cluster **200**. The anchor master device may be changed according to the master preference of the electronic devices **101**, **210**, **220**, and/or **230**. Each of the time and channel synchronized electronic devices **101**, **210**, **220**, and/or **230** may transmit a beacon and/or an SDF within a discovery window (or a search period) that is repeated according to a predetermined cycle, and receive the beacon and the SDF from the other electronic devices **101**, **210**, **220**, and/or **230** within the NAN cluster **200**. In one embodiment, the beacon may be transmitted and/or received periodically every discovery window to continuously maintain time and channel synchronization of the electronic devices **101**, **210**, **220**, and/or **230** within the NAN cluster **200**. The SDF may be transmitted and/or received within the discovery window as needed to provide services to the discovered electronic devices **101**, **210**, **220**, and/or **230**. According to one embodiment, among the time and channel synchronized electronic devices **101**, **210**, **220**, and/or **230**, the electronic device (e.g., the electronic device **101**) operating as the anchor master device may transmit a beacon (e.g., discovery beacon) during the interval between the discovery windows to detect new electronic devices.
[0078] According to one embodiment, each of the NAN cluster-synchronized (e.g., time and/or channel-synchronized) electronic devices **101**, **210**, **220**, and/or **230** may transmit a NAN action

frame (NAF) and receive NAFs from other electronic devices **101**, **210**, **220**, and/or **230** within the NAN cluster **200** during a discovery window (or search interval) that repeats according to a predetermined cycle. For example, the NAF may include at least one of information related to configuring of a NAN data path (NDP), information related to scheduling update, or information related to NAN ranging to perform data communication in the interval between the discovery windows. For example, the NAF may control scheduling of wireless resources for coexistence of NAN operation and non-NAN operation (e.g., Wi-Fi Direct, mesh, IBSS, WLAN, Bluetooth, or NFC). The NAF may include time and/or channel information available for NAN communication.

[0079] According to various embodiments, each of the electronic devices **101**, **210**, **220**, and/or **230** included in the NAN cluster **200** may operate in an active state during the discovery window, and operate in a low-power state (e.g., a sleep state) during the remaining interval other than the discovery window, thereby reducing current consumption.

[0080] According to one embodiment, the discovery window is a period (e.g., in milliseconds) during which the electronic device **101**, **210**, **220**, or **230** enters an active (or wake-up) state, consuming a significant amount of power. In the interval other than the discovery window, the electronic device **101**, **210**, **220**, or **230** remains in a sleep state, enabling low-power discovery.

[0081] According to various embodiments, the electronic devices **101**, **210**, **220** and/or **230** included in the NAN cluster **200** may be simultaneously activated at the start time of the synchronized discovery window (e.g., DW start) and simultaneously transition to a sleep state at the end time of the discovery window (e.g., DW end).

[0082] According to various embodiments, each of the electronic devices **101**, **210**, **220**, and/or **230** included in the NAN cluster **200** may transmit and/or receive data not only in the discovery window but also in the interval between the discovery windows. According to one embodiment, the electronic devices **101**, **210**, **220**, and/or **230** included in the NAN cluster **200** may perform additional communication by configuring an active time slot in the interval between the discovery windows. For example, electronic devices **101**, **210**, **220** and/or **230** included in the NAN cluster **200** may transmit and/or receive SDFs that were not transmitted and/or received within the discovery window, through the active time slot. For example, the electronic devices **101**, **210**, **220** and/or **230** included in the NAN cluster **200** may perform NAN communication and/or non-NAN communication during the active time slot by configuring (or designating) a NAN communication operation period and/or a non-NAN communication operation period during the active time slot.

[0083] According to various embodiments, the electronic devices **101**, **210**, **220**, and/or **230** included in the NAN cluster **200** may perform discovery, synchronization, and/or data exchange operations using a protocol illustrated in FIG. **3** described below.

[0084] FIG. **3** is a diagram illustrating a protocol for transmitting signals of an electronic device included in a NAN cluster according to various embodiments.

[0085] According to various embodiments, FIG. **3** is a diagram illustrating an example of a discovery window. In FIG. **3**, it may be illustrated that electronic devices (e.g., the electronic devices **101**, **210**, **220**, and/or **230** of FIG. **2**) included in one NAN cluster (e.g., the NAN cluster **200** of FIG. **2**) transmit signals through a specific channel (e.g., channel 6 (Ch6)) based on a NAN standard.

[0086] According to various embodiments, the electronic devices **101**, **210**, **220** and/or **230** included in one NAN cluster (e.g., the NAN cluster **200** of FIG. **2**) may transmit a sync beacon **310** and an SDF **320** in a synchronized discovery window **325**. A discovery beacon **330** may be transmitted by at least one electronic device **101**, **210**, **220** and/or **230** in another interval **340** (e.g., an interval between discovery windows) other than the discovery window **325**. According to one embodiment, the electronic devices **101**, **210**, **220** and/or **230** may transmit the sync beacon **310** and the SDF **320** on a contention basis. For example, the sync beacon **310** and the SDF **320** may be transmitted on the contention basis between the respective electronic devices **101**, **210**, **220** and/or **230** belonging to a NAN cluster (e.g., the NAN cluster **200** of FIG. **2**).

[0087] According to various embodiments, the electronic devices **101**, **210**, **220**, and/or **230** included in one NAN cluster (e.g., the NAN cluster (**200**) of FIG. **2**) may transmit and/or receive NAFs in the discovery window **325**. For example, the NAF may include at least one of information related to configuring of a NAN data path (NDP), information related to scheduling update, or information related to NAN ranging to perform data communication in the interval between the discovery windows.
[0088] According to various embodiments, the discovery window **325** may be a period during which the electronic devices **101**, **210**, **220**, and/or **230** is activated from a sleep state that is a power-saving mode, to a wake-up state for the purpose of data exchange between the electronic devices **101**, **210**, **220**, and/or **230**. For example, the discovery window **325** may be divided into time units (TUs) which are millisecond units. According to one embodiment, the discovery window **325** for transmitting and receiving the sync beacon **310** and the SDF **320** may occupy 16 time units (16 TUs) and may have a cycle (or interval) that repeats with 512 time units (512 TUs).
[0089] According to various embodiments, the discovery beacon **330** may represent a signal transmitted so that other electronic devices that have not joined the NAN cluster (e.g., the NAN cluster **200** of FIG. **2**) can discover the NAN cluster. For example, the discovery beacon **330** is a signal for notifying the existence of the NAN cluster, and the electronic devices that have not joined the NAN cluster may perform passive scanning to receive the discovery beacon **330**, thereby discovering and joining the NAN cluster.
[0090] According to various embodiments, the discovery beacon **330** may include information necessary to synchronize with the NAN cluster. For example, the discovery beacon **330** may include at least one of a frame control (FC) field indicating the function of a signal (e.g., a beacon), a broadcast address, a media access control (MAC) address of a transmission electronic device, a cluster identifier (ID), a sequence control field, a time stamp for a beacon frame, a beacon interval indicating a transmission interval of the discovery beacon **330**, or capability information about an electronic device transmitting the discovery beacon **330**.
[0091] According to various embodiments, the discovery beacon **330** may include at least one proximity network (or cluster) related information element. In one embodiment, the proximity network-related information may be referred to as attribute information.
[0092] According to various embodiments, the sync beacon **310** may indicate a signal for maintaining synchronization between the sync electronic devices **101**, **210**, **220**, and/or **230** within the NAN cluster (e.g., the NAN cluster **200** of FIG. **2**). The sync beacon **310** may be transmitted by the sync device among the electronic devices within the NAN cluster. For example, the sync device may include an anchor master device, a master device, or a non-master sync device defined in the NAN standard.
[0093] According to various embodiments, the sync beacon **310** may include information necessary for the electronic devices **101**, **210**, **220**, and/or **230** to be synchronized within the NAN cluster (e.g., the NAN cluster **200** of FIG. **2**). For example, the sync beacon **310** may include at least one of an FC field indicating the function of a signal (e.g., a beacon), a broadcast address, a MAC address of a transmission electronic device, a cluster ID, a sequence control field, a timestamp for a beacon frame, a beacon interval indicating the interval between the start points of the discovery windows **325**, or capability information for a transmission electronic device. According to one embodiment, the sync beacon **310** may include at least one proximity network (or NAN cluster) related information element. For example, the proximity network-related information may include contents for a service provided through the proximity network.
[0094] According to various embodiments, the SDF **320** may represent a signal for exchanging data through the proximity network. According to one embodiment, the SDF **320** represents a vendor related public action frame and may include various fields. For example, the SDF **320** may include a category or action field and include at least one piece of proximity network-related information.
[0095] According to various embodiments, the sync beacon **310**, the SDF **320**, and the discovery

beacon **330** may include proximity network-related information. In one embodiment, the proximity network-related information may include an ID indicating a type of information, a length of the information, and a body field that is the corresponding information. According to one embodiment, the corresponding information may include at least one piece of master indication information, cluster information, service ID list information, service descriptor information, connection capability information, wireless LAN infrastructure information, peer to peer (P2P) operation information, independent basic service set (IBSS) information, mesh information, further proximity network service discovery information, further availability map information, country code information, ranging information, cluster discovery information, or vendor specific information.

[0096] FIG. **4** is a diagram illustrating an example of data transmission and/or reception within a NAN cluster according to various embodiments.

[0097] According to various embodiments, FIG. **4** illustrates an example in which an electronic device **101**, an external electronic device **1 210**, and an external electronic device **2 220** form a single NAN cluster through a wireless short-range communication technology, and each of the electronic devices **101**, **210**, and/or **220** may transmit and/or receive a beacon, an SDF, and/or an NAF to each other. According to one embodiment, FIG. **4** illustrates an example in which the electronic device **101** among the electronic devices **101**, **210**, and/or **220** forming the NAN cluster performs the role of a master electronic device.

[0098] According to various embodiments, the electronic device **101** may transmit a beacon, an SDF, and/or an NAF within a discovery window **450**. The electronic device **101** may broadcast the beacon, the SDF, and/or the NAF every discovery window **450** that is repeated every predetermined interval (e.g., interval **460**).

[0099] According to various embodiments, the external electronic device **1 210** and the external electronic device **2 220** may receive the beacon, the SDF, and/or the NAF transmitted by the electronic device **101**. According to one embodiment, each of the external electronic device **1 210** and the external electronic device **2 220** may receive the broadcast beacon, the SDF, and/or the NAF from the electronic device **101** every discovery window **450**.

[0100] According to various embodiments, the beacon transmitted within the discovery window **450** may include a sync beacon and include information for maintaining synchronization between the electronic devices **101**, **210**, and/or **220**. For example, the external electronic device **1 210** and/or the external electronic device **2 220** may perform NAN cluster synchronization based on time clock information of the electronic device **101** included in the beacon transmitted by the electronic device **101** operating as a master. The external electronic device **1 210** and/or the external electronic device **2 220** may be synchronized based on the time clock information of the electronic device **101**, so that the discovery window **450** may be activated at the same time.

[0101] According to various embodiments, in an interval other than the discovery window **450** (e.g., interval **460**), the electronic devices **101**, **210**, and/or **220** may maintain a sleep state to reduce current consumption. According to one embodiment, the electronic devices **101**, **210**, and/or **220** may operate in a wake state in the discovery window **450** based on a synchronized time clock to reduce current consumption.

[0102] According to various embodiments, in the interval other than the discovery window **450** (e.g., interval **460**), the electronic devices **101**, **210** and/or **220** may perform additional communication by configuring an active time slot. According to one embodiment, the electronic devices **101**, **210** and/or **220** may transmit and/or receive SDFs that were not transmitted and/or received within the discovery window through the active time slot. According to one embodiment, the electronic devices **101**, **210** and/or **220** may perform a connection using legacy Wi-Fi or discovery operation through the active time slot by designating an operation for Wi-Fi Direct, mesh, IBSS, WLAN, Bluetooth or NFC connection in the active time slot.

[0103] FIG. **5**A is a diagram illustrating a first NAN cluster and a second NAN cluster according to various embodiments.

[0104] According to various embodiments referring to FIG. **5**A, a first NAN cluster **510** (e.g., the NAN cluster **200** of FIG. **2**) may include an electronic device **101**, an external electronic device **1 210**, an external electronic device **2 220**, and/or an external electronic device **3 230**. The electronic devices **101**, **210**, **220**, and/or **230** included in the first NAN cluster **510** may operate according to a synchronized time clock. The electronic devices **101**, **210**, **220**, and/or **230** may transmit and/or receive various signals (e.g., a beacon signal and/or a sync signal) during a promised discovery window (e.g., the discovery window **450** of FIG. **4**) in the first NAN cluster **510**. The electronic devices **101**, **210**, **220** and/or **230** may perform scanning to determine whether the second NAN cluster **520**, which is a NAN cluster different from the first NAN cluster **510**, exists in an interval other than the discovery window. For example, the electronic devices **101**, **210**, **220** and/or **230** included in the first NAN cluster **510** may perform scanning in the interval other than the discovery window to determine whether signals broadcast by the electronic devices **521** and/or **522** included in the second NAN cluster **520** are detected (or received).
[0105] According to various embodiments, the second NAN cluster **520** may include an external electronic device **4 521** and/or an external electronic device **5 522**. The electronic devices **521** and/or **522** included in the second NAN cluster **520** may operate according to a synchronized time clock. The electronic devices **521** and/or **522** may transmit and/or receive various signals (e.g., beacon signals and/or sync signals) during a promised discovery window in the second NAN cluster **520**. The electronic devices **521** and/or **522** may perform scanning to determine whether the first NAN cluster **510**, which is a NAN cluster different from the second NAN cluster **520**, exists in the interval other than the discovery window. For example, the electronic devices **521** and/or **522** included in the second NAN cluster **520** may detect (or receive) signals broadcast by the electronic devices **101**, **210**, **220** and/or **230** included in the first NAN cluster **510** through scanning in the interval other than the discovery window.
[0106] Hereinafter, an embodiment in which the first NAN cluster **510** and the second NAN cluster **520** are merged will be described, and for convenience of description, the electronic device **101** of the first NAN cluster **510** (e.g., anchor master device) and the external electronic device **4 521** of the second NAN cluster **520** (e.g., anchor master device) will be described as the basis, but other electronic devices (e.g., the external electronic device **1 210**, the external electronic device **2 220**, the external electronic device **3 230**, and/or the external electronic device **5 522**) can also operate in the same manner.
[0107] According to various embodiments, the electronic device **101** may receive a signal (e.g., a sync beacon, which is a signal for synchronization of the second NAN cluster **520** or a discovery beacon, which is a signal for searching for another NAN cluster) broadcast by the electronic device **521** or **522** of the second NAN cluster **520** while performing scanning. The electronic device **101** may identify the existence of the second NAN cluster **520** based on information (e.g., attribute information of the second NAN cluster **520**) included in signals transmitted by the external electronic device **4 521** and/or the external electronic device **5 522**.
[0108] According to various embodiments, when the electronic device **101** recognizes the existence of the second NAN cluster **520** through scanning, the electronic device **101** may determine whether to perform merging of the first NAN cluster **510** and the second NAN cluster **520**. The electronic device **101** may determine whether to perform merging of the first NAN cluster **510** and the second NAN cluster **520** based on the characteristics of the second NAN cluster **520** included in the signal transmitted (or broadcast) by the external electronic device **4 521** and/or the external electronic device **5 522**. According to one embodiment, the electronic device **101** may determine not to merge the first NAN cluster **510** and the second NAN cluster **520** based on determining that a first merging criterion (MC) value (e.g., about “4”) of the first NAN cluster **510** is greater than a second MC value (e.g., about “2”) of the second NAN cluster **520** included in the characteristics of the second NAN cluster **520**. For example, when the first MC value of the first NAN cluster **510** is greater than the second MC value of the second NAN cluster **520**, the electronic device **101** may

compare a first cluster grade (CG) of the first NAN cluster **510** with the second CG of the second NAN cluster **520** included in the characteristics of the second NAN cluster **520**. The electronic device **101** may update the first CG to a value (e.g., about “85”) higher than the second CG when the second CG (e.g., about “80”) of the second NAN cluster **520** included in the characteristics of the second NAN cluster **520** is greater than the first CG (e.g., about “60”) of the first NAN cluster **510**. The electronic device **101** may determine not to merge the first NAN cluster **510** and the second NAN cluster **520** based on determining that the first MC value and the first CG of the first NAN cluster **510** are greater than the second MC value and the second CG of the second NAN cluster **520**. For example, the determination not to merge the first NAN cluster **510** and the second NAN cluster **520** may include determining that the electronic devices included in the second NAN cluster **520** (e.g., the external electronic device **4 521** and/or external electronic device **5 522**) perform merging into the first NAN cluster **510**. For example, the update of the CG may include a series of operations that modify a master preference (MP) value of the electronic device **101** (e.g., an anchor master device) and/or a random factor value associated with the CG. For example, the MC value may be configured based on at least one of the size of the NAN cluster **510** or **520**, the number of NAN data paths (NDPs) activated within the NAN cluster **510** or **520**, or the number of NAN data links (NDLs) activated within the NAN cluster **510** or **520**. For example, the size of the NAN cluster **510** or **520** may represent the number of electronic devices included in the NAN cluster **510** or **520**.

[0109] According to various embodiments, the external electronic device **4 521** may receive a signal (e.g., a sync beacon, which is a signal for synchronizing the first NAN cluster **510**, or a discovery beacon, which is a signal for searching for another NAN cluster) broadcast by the electronic devices **101**, **210**, **220**, and/or **230** of the first NAN cluster **510** while performing scanning. The external electronic device **4 521** may identify the existence of the first NAN cluster **510** based on information (e.g., attribute information of the first NAN cluster **510**) included in the signal transmitted by the electronic devices **101**, **210**, **220**, and/or **230** of the first NAN cluster **510**.

[0110] According to various embodiments, when the external electronic device **4 521** recognizes the existence of the first NAN cluster **510** through scanning, the external electronic device **4 521** may determine whether to merge the first NAN cluster **510** and the second NAN cluster **520**. The external electronic device **4 521** may determine whether to merge the first NAN cluster **510** and the second NAN cluster **520** based on the characteristics of the first NAN cluster **510** included in the signal transmitted (or broadcast) by the electronic device **101**, **210**, **220**, and/or **230** of the first NAN cluster **510**. According to one embodiment, the external electronic device **4 521** may determine to merge the first NAN cluster **510** and the second NAN cluster **520** based on the determination that the first MC value (e.g., about “4”) of the first NAN cluster **510** included in the characteristics of the first NAN cluster **510** is greater than the second MC value (e.g., about “2”) of the second NAN cluster **520**. For example, when the first MC value of the first NAN cluster **510** is greater than the second MC value of the second NAN cluster **520**, the external electronic device **4 521** may compare a first CG of the first NAN cluster **510** and a second CG of the second NAN cluster **520** included in the characteristics of the first NAN cluster **510**. When the second CG (e.g., about “80”) of the second NAN cluster **520** is greater than the first CG (e.g., about “60”) of the first NAN cluster **510**, the external electronic device **4 521** may update the second CG to a lower value (e.g., about “50”) than the first CG. The external electronic device **4 521** may determine to merge the first NAN cluster **510** and the second NAN cluster **520** based on the determination that the first MC value and the first CG of the first NAN cluster **510** is greater than the second MC value and the second CG of the second NAN cluster **520**. For example, the merging of the first NAN cluster **510** and the second NAN cluster **520** may include a state in which the electronic devices **521** and/or **522** included in the second NAN cluster **520** perform merging into the first NAN cluster **510**. For example, the update of the CG may include a series of operations that modify a master preference (MP) value of the external electronic device **4 521** (e.g., an anchor master device) and/or a random factor value associated with the CG.

[0111] According to various embodiments, based on determination to merge the first NAN cluster **510** and the second NAN cluster **520**, the external electronic device **4 521** (e.g., the anchor master device) may transmit a signal (e.g., a beacon signal or a sync signal) including information (attribute information of the first NAN cluster **510**) of the first NAN cluster **510** different from the currently included second NAN cluster **520**, to other electronic devices (e.g., the external electronic device **5 522**) included in the second NAN cluster **520**, during a discovery window of the second NAN cluster **520**. According to one embodiment, the external electronic device **4 521** may merge (or join) into the first NAN cluster **510** based on the determination to merge the first NAN cluster **510** and the second NAN cluster **520**.

[0112] According to one embodiment, the external electronic device **5 522** may merge (or join) into the first NAN cluster **510** based on the information transmitted by the external electronic device **4 521**.

[0113] According to one embodiment, the external electronic device **5 522** may determine to merge the first NAN cluster **510** and the second NAN cluster **520** based on the determination that the first MC value (e.g., about "4") of the first NAN cluster **510** included in the characteristics of the first NAN cluster is greater than the second MC value (e.g., about "2") of the second NAN cluster **520**. The external electronic device **5 522** may merge (or join) into the first NAN cluster **510** based on determination to merge the first NAN cluster **510** and the second NAN cluster **520**.

[0114] FIG. **5**B is a diagram illustrating an example of merging a first NAN cluster and a second NAN cluster according to various embodiments.

[0115] According to various embodiments referring to FIG. **5**B, the external electronic device **4 521** and/or external electronic device **5 522** included in a second NAN cluster (e.g., the second NAN cluster **520** of FIG. **5**A) may be merged into the first NAN cluster **510**.

[0116] According to various embodiments, the electronic devices **101**, **210**, **220**, **230**, **521** and/or **522** included in the first NAN cluster **510** may operate according to a synchronized time clock. The electronic devices **101**, **210**, **220**, **230**, **521** and/or **522** may transmit or receive various signals (e.g., beacon signals and/or sync signals) during a promised discovery window (e.g., the discovery window **450** of FIG. **4**) in the first NAN cluster **101**.

[0117] FIG. **6** is a block diagram illustrating an electronic device for merging NAN clusters according to various embodiments. According to one embodiment, the electronic device **101** of FIG. **6** may be at least partially similar to the electronic device **101** of FIG. **1**, FIG. **2**, FIG. **3**, FIG. **4**, FIG. **5**A or FIG. **5**B, or may include other embodiments of the electronic device.

[0118] According to various embodiments referring to FIG. **6**, the electronic device **101** may include a processor (e.g., including processing circuitry) **600**, a communication circuit (or communication circuitry) **610**, and/or a memory **620**. According to one embodiment, the processor **600** may be substantially the same as the processor **120** (e.g., an application processor and/or a communication processor) of FIG. **1**, or may be included in the processor **120**. The communication circuit **610** may be substantially the same as the wireless communication module **192** of FIG. **1**, or may be included in the wireless communication module **192**. The memory **620** may be substantially the same as the memory **130** of FIG. **1**, or may be included in the memory **130**. According to one embodiment, the processor **600** may be operatively, functionally, and/or electrically connected to the communication circuit **610** and/or the memory **620**.

[0119] According to various embodiments, the communication circuit **610** may include various circuit structures used for modulating and/or demodulating signals within the electronic device **101**. According to one embodiment, the communication circuit **610** may modulate a baseband signal into a signal of a radio frequency (RF) band to be output through an antenna (not shown), or demodulate the signal of the RF band received through the antenna into the baseband signal and transmit the demodulated signal to the processor **600**. According to one embodiment, the communication circuit **610** may transmit and/or receive a variety of data to and from other electronic devices (e.g., the electronic devices **101**, **210**, **220** and/or **230** of FIG. **2**) through a frequency band (e.g., about 2.4 GHz band, about 5 GHz band, and/or about 6 GHz band) used by the electronic devices (e.g., the electronic devices **101**, **210**, **220** and/or **230** of FIG. **2**) of the first NAN cluster (e.g., the NAN cluster **200** of FIG. **2** or the first NAN cluster **510** of FIG. **5**A).

[0120] According to various embodiments, the processor **600** may control the communication circuit **610** to form a first NAN cluster (e.g., the NAN cluster **200** of FIG. **2** or the first NAN cluster **510** of FIG. **5**A) through NAN cluster synchronization with at least one external electronic device (e.g., the external electronic devices **210**, **220**, and/or **230** of FIG. **2**). According to one embodiment, the processor **600** may perform NAN cluster synchronization based on NAN cluster information included in a signal broadcast by an external electronic device (e.g., the external electronic devices **210**, **220**, and/or **230** of FIG. **2**) included in a cluster (or network) (e.g., the NAN cluster **200** of FIG. **2**) implemented in a NAN manner.

[0121] According to various embodiments, the processor **600** may receive the NAN cluster information via a non-NAN-based communication method (e.g., Bluetooth, or short-range wireless communication including Wi-Fi). According to one embodiment, the processor **600** may control the communication circuit **610** to transmit a probe request signal to find an external electronic device (e.g., the external electronic devices **210**, **220**, and/or **230** of FIG. **2**) via a wireless LAN (e.g., Wi-Fi) network. The processor **600** may perform NAN cluster synchronization based on the NAN cluster information included in a probe response message received from the external electronic device (e.g., the external electronic devices **210**, **220**, and/or **230** of FIG. **2**) in response to the probe request signal.

[0122] According to various embodiments, NAN cluster synchronization may include an operation of receiving time clock information of the electronic device **101** representing a first NAN cluster (e.g., a master device or an anchor master device) so that the electronic devices (e.g., the electronic devices **101**, **210**, **220**, and/or **230** of FIG. **2**) included in the first NAN cluster (e.g., the NAN cluster **200** of FIG. **2** or the first NAN cluster **510** of FIG. **5**A) transmit and/or receive data through the same channel and/or the same time resource. According to one embodiment, the processor **600** may control the communication circuit **610** to transmit (or broadcast) a beacon including time clock information of the electronic device **101** through a discovery window for NAN cluster synchronization of the external electronic device (e.g., the external electronic devices **210**, **220**, and/or **230** of FIG. **2**). According to one embodiment, the processor **600** may perform NAN cluster synchronization based on time clock information of the external electronic device (e.g., the external electronic devices **210**, **220** and/or **230** of FIG. **2**) included in the beacon received from the external electronic device (e.g., the external electronic devices **210**, **220** and/or **230** of FIG. **2**).

[0123] According to various embodiments, the processor **600** may identify the first MC value and/or first CG of the first NAN cluster in which the electronic device **101** is included. According to one embodiment, the processor **600** may identify (or estimate) the first MC value of the first NAN cluster based on at least one of the size of the first NAN cluster, the number of NAN data paths (NDPs) activated within the first NAN cluster, or the number of NAN data links (NDLs) activated within the first NAN cluster. For example, the size of the first NAN cluster indicates the number of electronic devices included in the first NAN cluster, and may be identified (or estimated) based on information related to an NAN management interface address (NMI) recorded (or stored) in a bloom filter included in the electronic device **101**, as in the following Equation 1.

[00001] $x = -m$ .Math. $\ln(1 - \frac{N}{m}) / k$ [Equation1]

[0124] For example, x denotes the size of the first NAN cluster, m denotes the size of the bloom filter, N denotes the number of bits in which information related to the NMI is recorded (or stored) in the bloom filter, and k indicates the number of hash functions included in the bloom filter. For example, the information related to the NMI recorded (or stored) in the bloom filter may include a hash value obtained by processing NMI of “AA:BB:CC:DD:EE:FF” received by the electronic device **101** from an external electronic device through hash functions included in the bloom filter.

[0125] For example, the number of NDPs activated within the first NAN cluster and/or the number of NDLs activated within the first NAN cluster, which represents the number of data links activated for data communication in the first NAN cluster, may be identified (or estimated) based on information related to NAN data interface address (NDI) recorded (or stored) in the bloom filter included in the electronic device **101**. For example, the number of NDPs activated within the first NAN cluster and/or the number of NDLs activated within the first NAN cluster may be obtained (or estimated) by replacing "N" in Equation 1 with the number of bits in which the information related to the NDI is recorded (or stored) in the bloom filter.

[0126] According to one embodiment, the processor **600** may determine (or estimate) the first GC of the first NAN cluster based on at least one of a master preference (MP) of an anchor master device (e.g., the electronic device **101**) of the first NAN cluster or a time synchronization function (TSF) thereof.

[0127] According to various embodiments, the processor **600** may control the communication circuit **610** to perform scanning to determine whether a second NAN cluster (e.g., the second NAN cluster **520** of FIG. **5**A) other than the first NAN cluster including the electronic device **101** exists. According to one embodiment, the processor **600** may control the communication circuit **610** to perform scanning in an interval other than the discovery window. The processor **600** may receive a signal (e.g., a discovery beacon of the second NAN cluster) broadcast by the electronic device of the second NAN cluster (e.g., the external electronic devices **521** and/or **522** of FIG. **5**A) through scanning. The processor **600** may identify the existence of the second NAN cluster based on information (e.g., attribute information of the second NAN cluster) included in a signal acquired from the electronic device of the second NAN cluster through scanning. For example, the scanning may include a series of operations for determining whether the signal broadcasted by the electronic devices (e.g., the external electronic devices **521** and/or **522** of FIG. **5**A) included in the second NAN cluster other than the first NAN cluster including the electronic device **101** is detected (or received). For example, an interval other than the discovery window may include an interval between the discovery windows.

[0128] According to one embodiment, the processor **600** may receive the signal (e.g., a sync beacon of the second NAN cluster) broadcast by the electronic device of the second NAN cluster (e.g., the external electronic devices **521** and/or **522** of FIG. **5**A) in the discovery window. The processor **600** may identify the existence of the second NAN cluster based on information (e.g., attribute information of the second NAN cluster) included in the signal acquired from the electronic device of the second NAN cluster through scanning.

[0129] According to various embodiments, when the processor **600** identifies the existence of the second NAN cluster (e.g., the second NAN cluster **520** of FIG. **5**A) different from the first NAN cluster including the electronic device **101**, the processor **600** may identify a second MC value and/or second CG of the second NAN cluster. According to one embodiment, the processor **600** may identify (or obtain) information related to the second MC value and/or second CG of the second NAN cluster from the signal (e.g., a sync beacon and/or a discovery beacon of the second NAN cluster) received from the electronic device of the second NAN cluster (e.g., the external electronic devices **521** and/or **522** of FIG. **5**A).

[0130] According to various embodiments, the processor **600** may identify (or determine) the merging direction of the first NAN cluster and the second NAN cluster. According to one embodiment, when the electronic device **101** is an anchor master device of the first NAN cluster, the processor **600** may identify (or determine) the merging direction of the first NAN cluster and the second NAN cluster based on the first MC value and first CG of the first NAN cluster and the second MC value and second CG of the second NAN cluster. For example, when the first MC value and first CG of the first NAN cluster are greater than the second MC value and second CG of the second NAN cluster, the processor **600** may determine that the second NAN cluster is merged into the first NAN cluster. For example, merging into the first NAN cluster may include a series of operations in which the electronic devices included in the second NAN cluster are synchronized to the first NAN cluster.

[0131] For example, the processor **600** may determine that the first NAN cluster is merged into the second NAN cluster when the second MC value and second CG of the second NAN cluster are greater than the first MC value and first CG of the first NAN cluster. As an example, merging into the second NAN cluster may include a series of operations in which the electronic devices included in the first NAN cluster are synchronized to the first NAN cluster.

[0132] For example, when the first MC value of the first NAN cluster is greater than the second MC value of the second NAN cluster, but the second CG of the second NAN cluster is greater than the first CG of the first NAN cluster, the processor **600** may update the first CG to a value higher than the second CG. The processor **600** may determine that the second NAN cluster is merged into the first NAN cluster based on the determination that the first MC value and the first CG of the first NAN cluster is greater than the second MC value and the second CG of the second NAN cluster. For example, the update of the CG may include a series of operations that modify a master preference (MP) value of the electronic device **101** (e.g., an anchor master) and/or a random factor value associated with the CG.

[0133] For example, the processor **600** may update the first CG to a value lower than the second CG when the second MC value of the second NAN cluster is greater than the first MC value of the first NAN cluster, but the first CG of the first NAN cluster is greater than the second CG of the second NAN cluster. The processor **600** may determine that the first NAN cluster is merged into the second NAN cluster based on the determination that the second MC value and second CG of the second NAN cluster are greater than the first MC value and first CG of the first NAN cluster.

[0134] According to one embodiment, the processor **600** may identify (or determine) the merging direction of the first NAN cluster and the second NAN cluster based on the first MC value of the first NAN cluster and the second MC value of the second NAN cluster, when the electronic device **101** is not the anchor master device of the first NAN cluster (e.g., a master electronic device, a non-master synchronous device, and/or a non-master asynchronous device). For example, the processor **600** may determine that the second NAN cluster is merged into the first NAN cluster when the first MC value of the first NAN cluster is greater than the second MC value of the second NAN cluster. For example, the processor **600** may determine that the first NAN cluster is merged into the second NAN cluster when the second MC value of the second NAN cluster is greater than the first MC value of the first NAN cluster.

[0135] According to various embodiments, when the processor **600** determines to merge into the second NAN cluster, the processor **600** may control the communication circuit **610** to perform the merging into the second NAN cluster. According to one embodiment, when the electronic device **101** is the anchor master device of the first NAN cluster, the processor **600** may control the communication circuit **610** to transmit a signal (e.g., a beacon signal or a synchronization signal) including information related to the second NAN cluster (e.g., attribute information of the second NAN cluster) to other electronic devices included in the first NAN cluster during the discovery window of the first NAN cluster. The processor **600** may control the communication circuit **610** to perform merging into the second NAN cluster after transmitting the signal including information related to the second NAN cluster. For example, merging into the second NAN cluster may include at least one operation among clock synchronization with the electronic devices included in the second NAN cluster, address configuring of the electronic device **101** based on the address of the anchor master device of the second NAN cluster, or reconfiguring of ID information of the NAN cluster of the electronic device **101**.

[0136] According to various embodiments, the memory **620** may store a variety of data used by at least one component of the electronic device **101** (e.g., the processor **600** and/or the communication circuit **610**). According to one embodiment, the memory **620** may store various instructions that can be executed by the processor **600**.

[0137] According to various embodiments, the electronic device other than the electronic device **101** included in the first NAN cluster may perform merging into the second NAN cluster based on the signal including information related to the second NAN cluster (e.g., attribute information of the second NAN cluster) received from the electronic device **101**.

[0138] According to various embodiments, an electronic device (e.g., the electronic device **101** of FIG. **1**, FIG. **2**, FIG. **3**, FIG. **4**, FIG. **5**A, FIG. **5**B or FIG. **6** may include a communication circuitry (e.g., the wireless communication module **192** of FIG. **1** or the communication circuit **610** of FIG. **6**) and at least one processor (e.g., the processor **120** of FIG. **1** or the processor **600** of FIG. **6**) operatively connected to the communication circuitry. According to one embodiment, memory storing instructions, when executed by the at least one processor individually or collectively, cause the electronic device to form a first neighbor awareness network (NAN) cluster (e.g., the NAN cluster **200** of FIG. **2**, the first NAN cluster **510** of FIG. **5**A or FIG. **5**B, or a first NAN cluster **960** of FIG. **9**) with at least one first external electronic device. According to one embodiment, the instructions, when executed by the at least one processor individually or collectively, cause the electronic device to identify a second MC value of a second NAN cluster and second CG of the second NAN cluster based on the discovery of the second NAN cluster (e.g., the NAN cluster **200** of FIG. **2**, the second NAN cluster **520** of FIG. **5**A or FIG. **5**B, or the second NAN cluster **970** of FIG. **9**) that is different from the first NAN cluster. According to one embodiment, the instructions, when executed by the at least one processor individually or collectively, cause the electronic device to update a first CG of the first NAN cluster based on the second MC value and the first MC value of the first NAN cluster. According to one embodiment, the instructions, when executed by the at least one processor individually or collectively, cause the electronic device to identify the merging direction of the first NAN cluster and the second NAN cluster based on at least one of the first MC value, the second MC value, the updated first CG, or the updated second CG.

[0139] According to various embodiments, the first MC value may be configured based on at least one of a cluster size of the first NAN cluster, the number of NAN data paths (NDPs) activated within the first NAN cluster, or the number of NAN data links (NDLs) activated within the first NAN cluster.

[0140] According to various embodiments, the second MC value may be configured based on at least one of a cluster size of the second NAN cluster, the number of NDPs activated within the second NAN cluster, or the number of NDLs activated within the second NAN cluster.

[0141] According to various embodiments, instructions, when executed by the at least one processor individually or collectively, cause the electronic device to identify at least one of the cluster size of the first NAN cluster, the number of NDPs activated within the first NAN cluster, or the number of NDLs activated within the first NAN cluster based on information stored in a bloom filter of the electronic device.

[0142] According to various embodiments, the instructions, when executed by the at least one processor individually or collectively, cause the electronic device to identify the second NAN cluster based on a signal of at least one second external electronic device included in the second NAN cluster received through scanning during an interval other than a DM of the first NAN cluster.

[0143] According to various embodiments, the instructions, when executed by the at least one processor individually or collectively, cause the electronic device to update the first CG to be less than the second CG when the second MV value is greater than the first MC value and the first CG is greater than the second CG.

[0144] According to various embodiments, the instructions, when executed by the at least one processor individually or collectively, cause the electronic device to update the first CG to be greater than the second CG when the first MC value is greater than the second MC value and the second CG is greater than the first CG.

[0145] According to various embodiments, the instructions, when executed by the at least one processor individually or collectively, cause the electronic device to update the first CG by updating at least one of a master preference value of an anchor master device of the first NAN cluster or a random factor value associated with the configuring of the first CG.
[0146] According to various embodiments, the instructions, when executed by the at least one processor individually or collectively, cause the electronic device to configure a merging direction in which the first NAN cluster is merged into the second NAN cluster when the second MC value is greater than the first MC value and the second CG is greater than the updated first CG.
[0147] According to various embodiments, the instructions, when executed by the at least one processor individually or collectively, cause the electronic device to transmit information related to the second NAN cluster to at least one first external electronic device included in the first NAN cluster based on a determination that the first NAN cluster is merged into the second NAN cluster through the communication circuit, when the electronic device is an anchor master device of the first NAN cluster, and perform synchronization with the second NAN cluster.
[0148] According to various embodiments, the instructions, when executed by the at least one processor individually or collectively, cause the electronic device to configure the merging direction in that the second NAN cluster is merged into the first NAN cluster when the first MC value is greater than the second MC value and the updated first CG is greater than the second CG.
[0149] FIG. **7** is a flowchart **700** for merging NAN clusters in an electronic device according to various embodiments. In the following embodiments, operations may be performed sequentially, but are not necessarily performed sequentially. For example, the order of the operations may be changed, and at least two operations may be performed in parallel. For example, the electronic device of FIG. **7** may be the electronic device **101** of FIG. **1**, FIG. **2**, FIG. **3**, FIG. **4**, FIG. **5**A, FIG. **5**B, or FIG. **6**. For example, at least a portion of FIG. **7** may be described with reference to FIG. **9**. FIG. **9** is a diagram illustrating an example for merging NAN clusters in an electronic device according to various embodiments.
[0150] According to various embodiments referring to FIGS. **7** and **9**, in operation **701**, an electronic device (e.g., the electronic device **101** of FIG. **1**, FIG. **2**, FIG. **3**, FIG. **4**, FIG. **5**A, FIG. **5**B, or FIG. **6**) or a processor (e.g., the processor **120** of FIG. **1** or the processor **600** of FIG. **6**) may form (or generate) a first NAN cluster with at least one external electronic device. According to one embodiment, the processor **600** may control the communication circuit **610** to form a first NAN cluster **960** through NAN cluster synchronization with at least one external electronic device (e.g., the external electronic devices **210**, **220**, and/or **230** of FIG. **2** or FIG. **5**A), as shown in FIG. **9**. For example, NAN cluster synchronization may include a series of operations in which electronic devices included in the first NAN cluster (e.g., the electronic devices **101**, **210**, **220**, and/or **230** of FIG. **2**) are synchronized based on time clock information of the electronic device **101** representing the first NAN cluster (e.g., a master device or an anchor master device) so that data is transmitted and/or received through the same channel and/or the same time resource. For example, the time clock information of the electronic device **101** (e.g., an anchor master device) may be transmitted (or broadcast) to the electronic devices included in the first NAN cluster via a beacon (e.g., a sync beacon) within a discovery window.
[0151] According to various embodiments, in operation **703**, the electronic device (e.g., the electronic device **101**) or the processor (e.g., processor **120** or **600**) may identify a first MC value and/or first CG of the first NAN cluster including the electronic device **101**. According to one embodiment, the processor **600** may identify (or estimate) the first CG (e.g., about “100”) of the first NAN cluster based on at least one of a master preference (MP) or a time synchronization function (TSF) of the anchor master device (e.g., the electronic device **101**) of the first NAN cluster.
[0152] According to one embodiment, the processor **600** may identify (or estimate) the first MC value (e.g., about “3”) of the first NAN cluster based on at least one of the size of the first NAN

cluster, the number of NAN data paths (NDPs) activated within the first NAN cluster, or the number of NAN data links (NDLs) activated within the first NAN cluster. For example, the size of the first NAN cluster indicates the number of electronic devices included in the first NAN cluster, and may be identified (or estimated) based on information related to an NAN management interface address (NMI) recorded (or stored) in a bloom filter included in the electronic device **101**, as in Equation 1. For example, the number of NDPs activated within the first NAN cluster and/or the number of NDLs activated within the first NAN cluster may be identified (or estimated) based on information related to an NAN data interface address (NDI) recorded (or stored) in a bloom filter included in the electronic device **101**, which indicates the number of data links activated for data communication in the first NAN cluster.

[0153] According to one embodiment, the processor **600** may determine a first MC value to which a weight is applied based on an average of the MC values to which weights are applied based on a weighted average method, when a plurality of MC values are included based on different criteria. According to one embodiment, the processor **600** may select one of the plurality of MC values as the first MC value based on a priority of each MC value, when the plurality of MC values are included based on different criteria.

[0154] According to various embodiments, in operation **705**, the electronic device (e.g., the electronic device **101**) or the processor (e.g., the processor **120** or **600**) may detect a second NAN cluster that is different from the first NAN cluster including the electronic device **101**. According to one embodiment, the processor **600** may receive a signal (e.g., a discovery beacon of the second NAN cluster) broadcast by the electronic device (e.g., the external electronic devices **521** and/or **522** of FIG. **5**A) of the second NAN cluster through scanning in an interval other than a discovery window **900** or **902**. The processor **600** may identify the existence of the second NAN cluster **970** based on information (e.g., attribute information of the second NAN cluster) included in a signal acquired from the electronic device of the second NAN cluster through scanning. For example, the scanning may include a series of operations to determine whether the signal broadcast by the electronic devices (e.g., the external electronic devices **521** and/or **522** of FIG. **5**A) included in the second NAN cluster different from the first NAN cluster including the electronic device **101** is detected (or received). For example, the interval other than the discovery window may include an interval between the discovery windows.

[0155] According to one embodiment, the processor **600** may receive the signal (e.g., a sync beacon of the second NAN cluster) broadcast by the electronic device of the second NAN cluster (e.g., the external electronic devices **521** and/or **522** of FIG. **5**A) in the discovery window. The processor **600** may identify the existence of the second NAN cluster **970** based on information (e.g., attribute information of the second NAN cluster) included in the signal acquired from the electronic device of the second NAN cluster through scanning.

[0156] According to various embodiments, in operation **707**, the electronic device (e.g., the electronic device **101**) or the processor (e.g., the processor **120** or **600**) may identify a second MC value and/or second CG of the second NAN cluster. According to one embodiment, the processor **600** may identify (or obtain) information related to the second MC value (e.g., about “8”) and/or the second CG (e.g., about “80”) of the second NAN cluster from the signal (e.g., a sync beacon and/or a discovery beacon of the second NAN cluster) received from the electronic device of the second NAN cluster (e.g., the external electronic devices **521** and/or **522** of FIG. **5**A).

[0157] According to various embodiments, in operation **709**, the electronic device (e.g., the electronic device **101**) or the processor (e.g., the processor **120** or **600**) may identify (or configure) a merging direction of the first NAN cluster and the second NAN cluster. According to one embodiment, when the electronic device **101** is an anchor master device **962** of the first NAN cluster, the processor **600** may identify (or determine) the merging direction of the first NAN cluster and the second NAN cluster based on the first MC value and first CG of the first NAN cluster **960** and the second MC value and second CG of the second NAN cluster **970**. For example, the processor **600** may determine that the second NAN cluster **970** is merged into the first NAN cluster **960** when the first MC value and first CG of the first NAN cluster **960** are greater than the second MC value and second CG of the second NAN cluster **970**.

[0158] For example, the processor **600** may determine that the first NAN cluster **960** is merged into the second NAN cluster **970** when the second MC value and second CG of the second NAN cluster **970** are greater than the first MC value and first CG of the first NAN cluster **960**.

[0159] For example, when the first MC value of the first NAN cluster **960** is greater than the second MC value of the second NAN cluster **970**, but the second CG of the second NAN cluster **970** is greater than the first CG of the first NAN cluster **960**, the processor **600** may update the first CG of the first NAN cluster **960** to a value (e.g., about “79”) **910** higher than the second CG of the second NAN cluster **970**. The processor **600** may determine that the second NAN cluster is merged into the first NAN cluster based on the determination that the first MC value and first CG of the first NAN cluster **960** are greater than the second MC value and second CG of the second NAN cluster **970**. For example, the update of the CG may include a series of operations that modify a master preference (MP) value of the electronic device **101** (e.g., an anchor master) and/or a random factor value associated with the CG.

[0160] For example, when the second MC value of the second NAN cluster **970** is greater than the first MC value of the first NAN cluster **960**, but the first CG of the first NAN cluster **960** is greater than the second CG of the second NAN cluster **970**, the processor **600** may update the first CG to a value lower than the second CG. The processor **600** may determine that the first NAN cluster **960** is merged into the second NAN cluster **970** based on the determination that the second MC value and second CG of the second NAN cluster **970** are greater than the first MC value and the first CG of the first NAN cluster **960**.

[0161] According to one embodiment, the processor **600** may determine (or identify) the merging direction of the first NAN cluster and the second NAN cluster based on the first MC value of the first NAN cluster **960** and the second MC value of the second NAN cluster **970**, when the electronic device **101** is not the anchor master device of the first NAN cluster **964** (e.g., a master electronic device, a non-master synchronous device, and/or a non-master asynchronous device). For example, the processor **600** may determine that the second NAN cluster **970** is merged into the first NAN cluster **960** when the first MC value of the first NAN cluster **960** is greater than the second MC value of the second NAN cluster **970**. For example, the processor **600** may determine that the first NAN cluster **960** is merged into the second NAN cluster **970** when the second MC value of the second NAN cluster **970** is greater than the first MC value of the first NAN cluster **960**.

[0162] According to various embodiments, in operation **711**, the electronic device (e.g., the electronic device **101**) or the processor (e.g., the processor **120** or **600**) may perform cluster merging based on the merging direction of the clusters. According to one embodiment, when the processor **600** determines to merge into the second NAN cluster, the processor **600** may control the communication circuit **610** to perform merging into the second NAN cluster. For example, when the electronic device **101** is the anchor master device **962** of the first NAN cluster **960**, the processor **600** may control the communication circuit **610** to transmit a signal **912** (e.g., a beacon signal or a synchronization signal) including information related to the second NAN cluster **970** (e.g., attribute information of the second NAN cluster) to another electronic device **964** included in the first NAN cluster **960** during a discovery window of the first NAN cluster **960**. After transmitting the signal **912** including the information related to the second NAN cluster **970**, the processor **600** may control the communication circuit **610** to perform merging **950** into the second NAN cluster **970**. For example, merging into the second NAN cluster may include at least one operation among clock synchronizing with the electronic devices included in the second NAN cluster, configuring of an address of the electronic device **101** based on an address of the anchor master device of the second NAN cluster, or reconfiguring of ID information of the NAN cluster of the electronic device **101**.

[0163] According to various embodiments, the electronic device **101** may determine not to perform merging of the NAN clusters when it determines that the second NAN cluster is merged into the first NAN cluster. According to one embodiment, the processor **101** may control not to perform a separate operation related to merging the NAN clusters when it determines that the second NAN cluster is merged into the first NAN cluster.

[0164] According to various embodiments, the other electronic devices **964** in the first NAN cluster **960** except for the anchor master device **962** may perform merging into the second NAN cluster **970** based on the signal including information related to the second NAN cluster **970** received from the electronic device **101** (e.g., attribute information of the second NAN cluster **970**).

[0165] According to various embodiments, an electronic device **972** (e.g., the anchor master device) of the second NAN cluster **970** may detect the first NAN cluster **960** through scanning. According to one embodiment, the electronic device **972** of the second NAN cluster **970** may detect the first NAN cluster **960** by receiving a signal **930** (e.g., a discovery beacon) of the first NAN cluster **960**) broadcast by the electronic device **101**. According to one embodiment, the electronic device **972** of the second NAN cluster **970** may identify (or determine) the merging direction of the first NAN cluster and the second NAN cluster based on the first MC value and the first CG of the first NAN cluster **960** and the second MC value and the second CG of the second NAN cluster **970**. For example, the electronic device **972** of the second NAN cluster **970** may update the second CG of the second NAN cluster **970** to a value (e.g., “101”) **940** higher than the first CG of the first NAN cluster **960**, when the second MC value of the second NAN cluster **970** is greater than the first MC value of the first NAN cluster **960**, but the first CG of the first NAN cluster **960** is greater than the second CG of the second NAN cluster **970**. The electronic device **972** of the second NAN cluster **970** may determine that the first NAN cluster **960** is merged into the second NAN cluster **970** based on determining that the second MC value and the second CG of the second NAN cluster **970** are greater than the first MC value and the first CG of the first NAN cluster **960**.

[0166] FIG. **8** is a flowchart **800** for configuring a merging direction of NAN clusters in an electronic device according to various embodiments. According to one embodiment, at least a portion of FIG. **8** may include details of operation **709** of FIG. **7**. In the following embodiments, the respective operations may be performed sequentially, but is not necessarily performed sequentially. For example, the order of the respective operations may be changed, and at least two operations may be performed in parallel. For example, the electronic device of FIG. **8** may be the electronic device **101** of FIG. **1**, FIG. **2**, FIG. **3**, FIG. **4**, FIG. **5**A, FIG. **5**B, or FIG. **6**.

[0167] According to various embodiments referring to FIG. **8**, in operation **801**, an electronic device (e.g., the electronic device **101** of FIG. **1**, FIG. **2**, FIG. **3**, FIG. **4**, FIG. **5**A, FIG. **5**B, or FIG. **6**) or a processor (e.g., the processor **120** of FIG. **1** or the processor **600** of FIG. **6**) may determine whether a second MC value of a second NAN cluster is greater than a first MC value of a first NAN cluster, when determining the second MC value and/or second CG of the second NAN cluster different from the first NAN cluster including the electronic device **101** (e.g., operation **707** of FIG. **7**).

[0168] According to various embodiments, in operation **803**, when the electronic device (e.g., the electronic device **101**) or the processor (e.g., the processor **120** or **600**) determines that the second MC value of the second NAN cluster is greater than the first MC value of the first NAN cluster (e.g., “YES” in operation **801**), the electronic device or the processor may determine whether the second CG of the second NAN cluster is greater than a first CG of the first NAN cluster.

[0169] According to various embodiments, in operation **805**, when the electronic device (e.g., the electronic device **101**) or the processor (e.g., the processor **120** or **600**) determines that the second CG of the second NAN cluster is greater than the first CG of the first NAN cluster (e.g., “YES” in operation **803**), the electronic devices included in the first NAN cluster may configure a merging direction of the NAN cluster such that the electronic devices are merged into the second NAN cluster. According to one embodiment, the processor **600** may determine that the first NAN cluster is merged into the second NAN cluster when the second MC value and second CG of the second NAN cluster are greater than the first MC value and first CG of the first NAN cluster.

[0170] According to various embodiments, in operation **807**, when determining that the second CG of the second NAN cluster is not greater than the first CG of the first NAN cluster (e.g., "NO" of operation **803**), the electronic device (e.g., the electronic device **101**) or the processor (e.g., the processor **120** or **600**) may determine whether the electronic device is configured as an anchor master device within the first NAN cluster. According to one embodiment, when determining that the second CG of the second NAN cluster is less than or equal to the first CG of the first NAN cluster, the processor **600** may determine whether the electronic device is configured as the anchor master device within the first NAN cluster.

[0171] According to various embodiments, in operation **805**, when the electronic device is not configured as the anchor master device within the first NAN cluster (e.g., "NO" in operation **807**), the electronic device (e.g., the electronic device **101**) or the processor (e.g., the processor **120** or **600**) may configure a merging direction of the NAN cluster such that the electronic devices included in the first NAN cluster are merged into the second NAN cluster. According to one embodiment, the processor **600** may identify (or determine) the merging direction of the first NAN cluster and the second NAN cluster based on the first MC value of the first NAN cluster and the second MC value of the second NAN cluster when the electronic device **101** is not the anchor master device of the first NAN cluster. For example, the processor **600** may determine that the first NAN cluster is merged into the second NAN cluster when the second MC value of the second NAN cluster is greater than the first MC value of the first NAN cluster (e.g., "YES" in operation **801**).

[0172] According to various embodiments, in operation **809**, when the electronic device is configured as the anchor master device within the first NAN cluster (e.g., "YES" in operation **807**), the electronic device (e.g., the electronic device **101**) or the processor (e.g., the processor **120** or **600**) may update the first CG of the first NAN cluster to a value lower than the second CG of the second NAN cluster. As an example, the update of the CG may include a series of operations that modify a master preference (MP) value of the electronic device **101** (e.g., the anchor master device) and/or a random factor value associated with the CG.

[0173] According to various embodiments, in operation **805**, the electronic device (e.g., electronic device **101**) or the processor (e.g., the processor **120** or **600**) may configure a merging direction of the NAN cluster such that the electronic devices included in the first NAN cluster are merged into the second NAN cluster. According to one embodiment, the processor **600** may determine that the first NAN cluster is merged into the second NAN cluster when the second MC value and second CG of the second NAN cluster are greater than the first MC value and first CG of the first NAN cluster based on the update of the first CG.

[0174] According to various embodiments, in operation **811**, when determining that the second MC value of the second NAN cluster is not greater than the first MC value of the first NAN cluster (e.g., "NO" in operation **801**), the electronic device (e.g., the electronic device **101**) or the processor (e.g., the processor **120** or **600**) may determine whether the first CG of the first NAN cluster is greater than the second CG of the second NAN cluster.

[0175] According to various embodiments, in operation **813**, when determining that the first CG of the first NAN cluster is greater than the second CG of the second NAN cluster (e.g., "YES" in operation **811**), the electronic device (e.g., the electronic device **101**) or the processor (e.g., the processor **120** or **600**) may configure the merging direction of the NAN cluster such that the electronic devices included in the second NAN cluster are merged into the first NAN cluster. According to one embodiment, when the first MC value and first CG of the first NAN cluster are greater than the second MC value and second CG of the second NAN cluster, the processor **600** may determine that the second NAN cluster is merged into the first NAN cluster.

[0176] According to various embodiments, in operation **815**, when determining that the first CG of the first NAN cluster is not greater than the second CG of the second NAN cluster (e.g., “NO” of operation **811**), the electronic device (e.g., the electronic device **101**) or the processor (e.g., the processor **120** or **600**) may determine whether the electronic device is configured as the anchor master device within the first NAN cluster. According to one embodiment, when determining that the first CG of the first NAN cluster is less than or equal to the second CG of the second NAN cluster, the processor **600** may determine whether the electronic device is configured as the anchor master device within the first NAN cluster.

[0177] According to various embodiments, in operation **813**, when the electronic device is not configured as the anchor master device within the first NAN cluster (e.g., “NO” in operation **815**), the electronic device (e.g., the electronic device **101**) or the processor (e.g., the processor **120** or **600**) may configure the merging direction of the NAN cluster such that the electronic devices included in the second NAN cluster are merged into the first NAN cluster. According to one embodiment, when the electronic device **101** is not the anchor master device of the first NAN cluster, the processor **600** may identify (or determine) the merging direction of the first NAN cluster and the second NAN cluster based on the first MC value of the first NAN cluster and the second MC value of the second NAN cluster. For example, when the first MC value of the first NAN cluster is greater than the second MC value of the second NAN cluster (e.g., “NO” in operation **801**), the processor **600** may determine that the second NAN cluster is merged into the first NAN cluster.

[0178] According to various embodiments, in operation **817**, when the electronic device is configured as the anchor master device within the first NAN cluster (e.g., “YES” in operation **815**), the electronic device (e.g., the electronic device **101**) or the processor (e.g., the processor **120** or **600**) may update the first CG of the first NAN cluster to a value higher than the second CG of the second NAN cluster. As an example, the update of the CG may include a series of operations that modify a master preference (MP) value of the electronic device **101** (e.g., the anchor master device) and/or a random factor value associated with the CG.

[0179] According to various embodiments, in operation **813**, the electronic device (e.g., the electronic device **101**) or the processor (e.g., the processor **120** or **600**) may configure the merging direction of the NAN cluster such that the electronic devices included in the second NAN cluster are merged into the first NAN cluster. According to one embodiment, the processor **600** may determine that the second NAN cluster is merged into the first NAN cluster when the first MC value and first CG of the first NAN cluster are greater than the second MC value and second CG of the second NAN cluster based on the update of the first CG.

[0180] According to various embodiments, when the first MC value of the first NAN cluster and the second MC value of the second NAN cluster are the same, the electronic device **101** may compare the first CG of the first NAN cluster and the second CG of the second NAN cluster. According to one embodiment, when it is determined that the first CG of the first NAN cluster is greater than the second CG of the second NAN cluster while the first MC value of the first NAN cluster and the second MC value of the second NAN cluster are the same, the electronic device **101** may configure the merging direction of the NAN cluster such that the electronic devices included in the second NAN cluster are merged into the first NAN cluster.

[0181] According to one embodiment, when it is determined that the second CG of the second NAN cluster is greater than the first CG of the first NAN cluster while the first MC value of the first NAN cluster and the second MC value of the second NAN cluster are the same, the electronic device **101** may configure the merging direction of the NAN cluster such that the electronic devices included in the first NAN cluster are merged into the second NAN cluster.

[0182] According to one embodiment, when the first MC value of the first NAN cluster and the second MC value of the second NAN cluster and the first CG of the first NAN cluster and the second CG of the second NAN cluster are the same, the electronic device **101** may configure the merging direction of the NAN cluster based on an anchor master rank (AMR) of the first cluster and the second cluster. For example, when it is determined that a first AMR of the first NAN cluster is greater than a second AMR of the second NAN cluster, the electronic device **101** may configure the merging direction of the NAN cluster such that the electronic devices included in the second NAN cluster are merged into the first NAN cluster. For example, when it is determined that the second AMR of the second NAN cluster is greater than the first AMR of the first NAN cluster, the electronic device **101** may configure the merging direction of the NAN cluster such that the electronic devices included in the first NAN cluster are merged into the second NAN cluster. For example, the AMR may be configured based on a master preference (MP), a random factor value, and a MAC address.

[0183] FIG. **10**A is a diagram illustrating an example for sharing a merging criterion value in an electronic device according to various embodiments.

[0184] According to various embodiments referring to FIG. **10**A, the electronic device **101**, the external electronic device **2 220**, and/or the external electronic device **3 230** may be included in one NAN cluster (e.g., the NAN cluster **200** of FIG. **2** or the first NAN cluster **510** of FIG. **5**A). The electronic devices **101**, **220**, and/or **230** included in one NAN cluster may operate according to a synchronized time clock.

[0185] According to various embodiments, the electronic device **101**, the external electronic device **2 220**, and/or the external electronic device **3 230** may transmit and/or receive various signals (e.g., a beacon signal and/or a sync signal) during a promised discovery window (e.g., the discovery window **450** of FIG. **4**) in the NAN cluster.

[0186] According to various embodiments, in operation **1001**, the electronic device **101** (e.g., the anchor master device) may identify the external electronic device **1 210** newly added to the NAN cluster based on the signal (e.g., a sync beacon) received during the discovery window (e.g., the discovery window **450** of FIG. **4**). According to one embodiment, the electronic device **101** may determine that the external electronic device **1 210** is newly added to the NAN cluster when an address other than an address synchronized in the NAN cluster is identified in the signal (e.g., a sync beacon) received during the discovery window.

[0187] According to various embodiments, in operation **1003**, the electronic device **101** may update a MC value of the NAN cluster based on the determination that the external electronic device **1 210** is newly added to the NAN cluster.

[0188] According to various embodiments, in operation **1005**, the electronic device **101** may transmit a signal (e.g., a beacon or NAF) including information related to the updated MC value to other electronic devices included in the NAN cluster (e.g., the external electronic device **1 210**, the external electronic device **2 220**, and/or the external electronic device **3 230**). For example, the information related to the updated MC value may be transmitted to the other electronic devices (e.g., the external electronic device **1 210**, the external electronic device **2 220**, and/or the external electronic device **3 230**) through the sync beacon or NAF of the discovery window.

[0189] According to various embodiments, the electronic device **101** may determine that the external electronic device **1 210** is newly added to the NAN cluster based on a signal (e.g., a discovery beacon) received from the external electronic device **1 210** in an interval other than the discovery window. The electronic device **101** may update the MC value of the NAN cluster based on the determination that the external electronic device **1 210** has been newly added to the NAN cluster.

[0190] FIG. **10**B is a diagram illustrating an example for sharing a merge reference value in an electronic device according to various embodiments.

[0191] According to various embodiments referring to FIG. **10**B, the electronic device **101**, the external electronic device **1 210**, the external electronic device **2 220**, and/or the external electronic device **3 230** may be included in one NAN cluster (e.g., the NAN cluster **200** of FIG. **2** or the first

NAN cluster **510** of FIG. **5**A). The electronic devices **101**, **210**, **220**, and/or **230** included in one NAN cluster may operate according to a synchronized time clock.

[0192] According to various embodiments, in operation **1021**, the electronic device **101** (e.g., the anchor master device) may transmit information related to configuring of a MC to electronic devices included in the NAN cluster (e.g., the external electronic device **1 210**, the external electronic device **2 220**, and/or the external electronic device **3 230**) based on the occurrence of an event of configuring the MC. For example, the information related to configuring of the MC may be transmitted (or broadcast) by being included in an SDF of a discovery window. For example, the event of configuring the MC may be generated based on at least one of a designated period, execution of a function or application program related to NAN communication, user input related to NAN communication, or reception of a control signal from an external electronic device related to NAN communication.

[0193] According to various embodiments, in operations **1023**, **1025**, and/or operation **1027**, the external electronic device **1 210**, the external electronic device **2 220**, and/or the external electronic device **3 230** may transmit a response signal corresponding to the information related to configuring of the MC received from the electronic device **100**, to the electronic device **101**. For example, the response signal corresponding to the information related to configuring of the MC may be transmitted (or broadcast) by being included in an SDF of the discovery window.

[0194] According to various embodiments, in operation **1029**, the electronic device **101** may update a MC value of the NAN cluster based on the response signal corresponding to the information related to configuring of the MC. According to one embodiment, the electronic device **101** may increase the MC value of the NAN cluster when a newly added external electronic device is identified in the NAN cluster based on the response signal corresponding to the information related to configuring of the MC. According to one embodiment, the electronic device **101** may decrease the MC value of the NAN cluster when an external electronic device outside the NAN cluster is identified based on the response signal corresponding to the information related to configuring of the MC. According to one embodiment, when there is no response signal corresponding to the information related to configuring of the MC, the electronic device **101** may determine that there is no external electronic device present in the NAN cluster, and update the MC value of the NAN cluster to a minimum value (e.g., about “0” or about “1”).

[0195] According to various embodiments, in operation **1031**, the electronic device **101** may transmit a signal (e.g., a beacon or a NAF) including information related to the updated MC value to the other electronic devices included in the NAN cluster (e.g., the external electronic device **1 210**, the external electronic device **2 220**, and/or the external electronic device **3 230**). For example, the information related to the updated MC value may be transmitted to the other electronic devices (e.g., the external electronic device **1 210**, the external electronic device **2 220**, and/or the external electronic device **3 230**) via a synchronization beacon or NAF of the discovery window.

[0196] FIG. **10**C is a diagram illustrating an example for sharing a merge reference value in an electronic device according to various embodiments.

[0197] According to various embodiments referring to FIG. **10**C, the electronic device **101**, the external electronic device **1 210**, the external electronic device **2 220**, and/or the external electronic device **3 230** may be included in one NAN cluster (e.g., the NAN cluster **200** of FIG. **2** or the first NAN cluster **510** of FIG. **5**A). The electronic devices **101**, **210**, **220**, and/or **230** included in one NAN cluster may operate according to a synchronized time clock.

[0198] According to various embodiments, in operation **1041**, the electronic device **101** (e.g., an anchor master device) may transmit information related to configuring of a MC to the electronic devices included in the NAN cluster (e.g., the external electronic device **1 210**, the external electronic device **2 220**, and/or the external electronic device **3 230**) based on the occurrence of an event of configuring the MC. For example, the information related to configuring of the MC may be transmitted (or broadcast) by being included in an SDF of a discovery window. For example, the

event of configuring the MC may be generated based on at least one of a designated period, execution of a function or application program related to NAN communication, user input related to NAN communication, or reception of a control signal from an external electronic device related to NAN communication.
[0199] According to various embodiments, in operation **1043**, the external electronic device **1 210**, the external electronic device **2 220**, and/or the external electronic device **3 230** may broadcast information related to configuring of the MC related to each external electronic device based on the information related to configuring of the MC received from the electronic device **101**. For example, the information related to configuring of the MC is information provided to allow the presence of the electronic device transmitting the information related to configuring of the MC of the electronic devices included in the NAN cluster to be recognized, and may be transmitted (or broadcast) by being included in a beacon, an SDF, and/or an NAF of the discovery window.
[0200] According to various embodiments, in operation **1045**, operation **1046**, or/and operation **1048**, the electronic device **101**, the external electronic device **1 210**, the external electronic device **2 220**, and/or the external electronic device **3 230** included in the NAN cluster may update a MC value of the NAN cluster based on the information related to configuring of the MC.
[0201] According to various embodiments, the electronic device **101** may initialize a bloom filter of the electronic device **101** based on the occurrence of an update event. The electronic device **101** may newly record (or store), in the bloom filter, information related to NMI or NDI received from external electronic devices for a designated period of time based on the initialization of the bloom filter. The electronic device **101** may also update (or generate) the MC value of the NAN cluster based on the newly recorded (or stored) information in the bloom filter based on the initialization of the bloom filter. For example, the update event may be generated based on at least one of a designated period, user input related to the update of the bloom filter, or the reception of a control signal from an external electronic device related to the update of the bloom filter.
[0202] According to various embodiments, an operation method of an electronic device (e.g., the electronic device **101** of FIG. **1**, FIG. **2**, FIG. **3**, FIG. **4**, FIG. **5**A, FIG. **5**B, or FIG. **6**) may include forming a first NAN cluster (e.g., the NAN cluster **200** of FIG. **2**, the first NAN cluster **510** of FIG. **5**A or FIG. **5**B, or the first NAN cluster **960** of FIG. **9**) with at least one first external electronic device. According to one embodiment, the operation method of the electronic device may include identifying a second merging criterion (MC) value and second cluster grade (CG) of a second NAN cluster based on discovery of the second NAN cluster (e.g., the NAN cluster **200** of FIG. **2**, the second NAN cluster **520** of FIG. **5**A or FIG. **5**B, or the second NAN cluster **970** of FIG. **9**) that is different from the first NAN cluster. According to one embodiment, the operation method of the electronic device may include updating a first CG of the first NAN cluster based on the second MC value and a first MC value of the first NAN cluster. According to one embodiment, the operation method of the electronic device may include identifying a merging direction of the first NAN cluster and the second NAN cluster based on the first MC value, the second MC value, the updated first CG, and/or the second CG.
[0203] According to various embodiments, the first MC value may be configured based on at least one of a cluster size of the first NAN cluster, the number of NAN data paths (NDPs) activated within the first NAN cluster, or the number of NAN data links (NDLs) activated within the first NAN cluster.
[0204] According to various embodiments, the second MC value may be configured based on at least one of a cluster size of the second NAN cluster, the number of NDPs activated within the second NAN cluster, or the number of NDLs activated within the second NAN cluster.
[0205] According to various embodiments, the at least one of the cluster size of the first NAN cluster, the number of NDPs activated within the first NAN cluster, or the number of NDLs activated within the first NAN cluster may be identified based on information stored in a bloom filter of the electronic device.

[0206] According to various embodiments, the operation method of the electronic device may include further identifying the second NAN cluster based on a signal of at least one second external electronic device included in the second NAN cluster received through scanning during an interval other than a discovery window (DW) of the first NAN cluster.
[0207] According to various embodiments, the updating of the first CG may include updating the first CG to be less than the second CG when the second MC value is greater than the first MC value and the first CG is greater than the second CG.
[0208] According to various embodiments, the updating of the first CG may include updating the first CG to be greater than the second CG when the first MC value is greater than the second MC value and the second CG is greater than the first CG.
[0209] According to various embodiments, the updating of the first CG may include updating the first CG by updating at least one of a master preference value of an anchor master device of the first NAN cluster or a random factor value associated with configuring of the first CG.
[0210] According to various embodiments, the identifying of the merging direction may include configuring the merging direction such that the first NAN cluster is merged into the second NAN cluster when the second MC value is greater than the first MC value and the second CG is greater than the updated first CG.
[0211] According to various embodiments, the operation method of the electronic device may further include transmitting information related to the second NAN cluster to at least one first external electronic device included in the first NAN cluster based on a determination that the first NAN cluster is merged into the second NAN cluster when the electronic device is an anchor master device of the first NAN cluster, and performing synchronization with the second NAN cluster.
[0212] According to various embodiments, the identifying of the merge direction may include configuring the merging direction such that the second NAN cluster is merged into the first NAN cluster when the first MC value is greater than the second MC value and the updated first CG is greater than the second CG.
[0213] The embodiments of the present disclosure disclosed in this specification and drawings are merely examples presented to explain the technical contents according to the embodiments of the present disclosure and to help understand the embodiments of the present disclosure, and are not intended to limit the scope of the embodiments of the present disclosure. Therefore, the scope of the various embodiments of the present disclosure should be interpreted as including all changes or modified forms derived based on the technical ideas of the various embodiments of the present disclosure in addition to the embodiments disclosed herein.

Claims

1. An electronic device comprising: a communication circuitry; at least one processor operatively connected to the communication circuitry; and memory storing instructions, wherein the instructions, when executed by the at least one processor individually or collectively, cause the electronic device to: form a first neighbor awareness network (NAN) cluster with at least one first external electronic device; identify a second merging criterion value of a second NAN cluster and a second cluster grade of the second NAN cluster that is different from the first NAN cluster, based on a discovery of the second NAN cluster; update a first cluster grade of the first NAN cluster based on the second merging criterion value and a first merging criterion value of the first NAN cluster; and identify a merging direction of the first NAN cluster and the second NAN cluster based on at least one of the first merging criterion value, the second merging criterion value, the updated first cluster grade, or the second cluster grade.
2. The electronic device of claim 1, wherein the first merging criterion value is configured based on at least one of a cluster size of the first NAN cluster, a number of NAN data paths (NDPs) activated within the first NAN cluster, or a number of NAN data links (NDLs) activated within the first NAN

cluster, and wherein the second merging criterion value is configured based on at least one of a cluster size of the second NAN cluster, a number of NDPs activated within the second NAN cluster, or a number of NDLs activated within the second NAN cluster.

3. The electronic device of claim 1, wherein the instructions, when executed by the at least one processor individually or collectively, cause the electronic device to, in a case that the second merging criterion value is greater than the first merging criterion value and the first cluster grade is greater than the second cluster grade, update the first cluster grade to be less than the second cluster grade.

4. The electronic device of claim 1, wherein the instructions, when executed by the at least one processor individually or collectively, cause the electronic device to, in a case that the first merging criterion value is greater than the second merging criterion value and the second cluster grade is greater than the first cluster grade, update the first cluster grade to be greater than the second cluster grade.

5. The electronic device of claim 1, wherein the instructions, when executed by the at least one processor individually or collectively, cause the electronic device to update the first cluster grade by updating at least one of a master preference value of an anchor master device of the first NAN cluster, or a random factor value associated with the first cluster grade.

6. The electronic device of claim 1, wherein the instructions, when executed by the at least one processor individually or collectively, cause the electronic device to, in a case that the second merging criterion value is greater than the first merging criterion value and the second cluster grade is greater than the updated first cluster grade, configure the merging direction such that the first NAN cluster is merged into the second NAN cluster.

7. The electronic device of claim 6, wherein the instructions, when executed by the at least one processor individually or collectively, cause the electronic device to: in a case that the electronic device is an anchor master device of the first NAN cluster, transmit, via the communication circuitry, information related to the second NAN cluster to at least one first external electronic device included in the first NAN cluster, based on the first NAN cluster being merged into the second NAN cluster; and perform, via communication circuitry, synchronization with the second NAN cluster.

8. The electronic device of claim 1, wherein the instructions, when executed by the at least one processor individually or collectively, cause the electronic device to, in a case that the first merging criterion value is greater than the second merging criterion value and the updated first cluster grade is greater than the second cluster grade, configure the merging direction such that the second NAN cluster is merged into the first NAN cluster.

9. An operation method of an electronic device, comprising: forming a first neighbor awareness network (NAN) cluster with at least one first external electronic device; identifying a second merging criterion value of a second NAN cluster and second cluster grade of the second NAN cluster based on a discovery of the second NAN cluster that is different from the first NAN cluster; updating a first cluster grade of the first NAN cluster based on the second merging criterion value and a first merging criterion value of the first NAN cluster; and identifying a merging direction of the first NAN cluster and the second NAN cluster based on at least one of the first merging criterion value, the second merging criterion value, the updated first cluster grade, or the second cluster grade.

10. The operation method of the electronic device of claim 9, wherein the first merging criterion value is configured based on at least one of a cluster size of the first NAN cluster, a number of NAN data paths (NDPs) activated within the first NAN cluster, or a number of NAN data links (NDLs) activated within the first NAN cluster, and wherein the second merging criterion value is configured based on at least one of a cluster size of the second NAN cluster, a number of NDPs activated within the second NAN cluster, or a number of NDLs activated within the second NAN cluster.

11. The operation method of the electronic device of claim 9, wherein the updating of the first cluster grade comprises, in a case that the second merging criterion value is greater than the first merging criterion value and the first cluster grade is greater than the second cluster grade, updating the first cluster grade to be less than the second cluster grade.

12. The operation method of the electronic device of claim 9, wherein the updating of the first cluster grade comprises, in a case that the first merging criterion value is greater than the second merging criterion value and the second cluster grade is greater than the first cluster grade, updating the first cluster grade to be greater than the second cluster grade.

13. The operation method of the electronic device of claim 9, wherein the updating of the first cluster grade comprises updating the first cluster grade by updating at least one of a master preference value of an anchor master device of the first NAN cluster, or a random factor value associated with the first cluster grade.

14. The operation method of the electronic device of claim 9, wherein the identifying of the merging direction comprises, in a case that the second merging criterion value is greater than the first merging criterion value and the second cluster grade is greater than the updated first cluster grade, configuring the merging direction such that the first NAN cluster is merged into the second NAN cluster.

15. The operation method of the electronic device of claim 14, further comprising; in a case that the electronic device is an anchor master device of the first NAN cluster, transmitting information related to the second NAN cluster to at least one first external electronic device included in the first NAN cluster, based on the first NAN cluster being merged into the second NAN cluster; and performing synchronization with the second NAN cluster.

16. The operation method of the electronic device of claim 9, wherein the identifying of the merging direction, in a case that the first merging criterion value is greater than the second merging criterion value and the updated first cluster grade is greater than the second cluster grade, comprises configuring the merging direction such that the second NAN cluster is merged into the first NAN cluster.