METHOD AND APPARATUS FOR TRAFFIC MANAGEMENT

[0001] The present disclosure claims the priority to Chinese Patent Application No. 202311843710.6 filed with the China National Intellectual Property Administration on December 28, 2023 and entitled "METHOD AND APPARATUS FOR TRAFFIC MANAGEMENT", which is incorporated herein in its entirety by reference.

TECHNICAL FIELD

[0002] The present disclosure relates to the technical field of computers, and in particular, to a method and an apparatus for traffic management.

BACKGROUND

[0003] At present, there are various traffic steering clients on the market (for example, redirection software for redirecting traffic), for example, a virtual private network (VPN), antivirus software, and acceleration software. Users can install traffic steering clients on their own terminals and activate the traffic steering clients on the terminals. The traffic steering clients can steer the traffic of the terminals.

[0004] However, sometimes, the user may run a plurality of traffic steering clients on the terminal simultaneously. For example, the antivirus software and the VPN are activated on the terminal simultaneously.

[0005] However, the inventor finds that when the plurality of traffic steering clients are run on the terminal simultaneously, some traffic steering clients cannot steer the traffic that needs to be steered according to an expected traffic steering manner, and cannot satisfy expectations of the user for such traffic steering clients either. Abnormal services involved in such traffic steering clients are likely to occur.

SUMMARY

[0006] The present disclosure shows a method and an apparatus for traffic management.

[0007] In a first aspect, the present disclosure shows a method for traffic management. The method is applied to an electronic device, where a first traffic steering client is activated in the electronic device, and a kernel-mode traffic steering policy and a user-mode traffic steering policy are built in the first traffic steering client. The method includes: detecting whether a second traffic steering client is activated in the electronic device, where the kernel-mode traffic steering policy is built in the second traffic steering client; and setting a traffic steering policy of the first traffic steering client as the user-mode traffic steering policy in a case that the second traffic steering client is activated in the electronic device, to enable the first traffic steering client to steer traffic

based on the user-mode traffic steering policy.

[0008] In a second aspect, the present disclosure shows a method for traffic management. The method is applied to an electronic device, where a first traffic steering client is activated in the electronic device, and a kernel-mode traffic steering policy and a user-mode traffic steering policy are built in the first traffic steering client. The method includes: detecting whether a second traffic steering client is activated in the electronic device, where the kernel-mode traffic steering policy is built in the second traffic steering client; deactivating the second traffic steering client in a case that the second traffic steering client is activated in the electronic device; and setting a traffic steering policy of the first traffic steering client as the kernel-mode traffic steering policy, to enable the first traffic steering client to steer traffic based on the kernel-mode traffic steering policy.

[0009] In a third aspect, the present disclosure shows an apparatus for traffic management. The apparatus is applied to an electronic device, where a first traffic steering client is activated in the electronic device, and a kernel-mode traffic steering policy and a user-mode traffic steering policy are built in the first traffic steering client. The apparatus includes: a first detection module, configured to detect whether a second traffic steering client is activated in the electronic device, where the kernel-mode traffic steering policy is built in the second traffic steering client; and a first setting module, configured to set a traffic steering policy of the first traffic steering client as the user-mode traffic steering policy in a case that the second traffic steering client is activated in the electronic device, to enable the first traffic steering client to steer traffic based on the user-mode traffic steering policy.

[0010] In a fourth aspect, the present disclosure shows an apparatus for traffic management. The apparatus is applied to an electronic device, where a first traffic steering client is activated in the electronic device, and a kernel-mode traffic steering policy and a user-mode traffic steering policy are built in the first traffic steering client. The apparatus includes: a third detection module, configured to detect whether a second traffic steering client is activated in the electronic device, where the kernel-mode traffic steering policy is built in the second traffic steering client; a second deactivation module, configured to deactivate the second traffic steering client in a case that the second traffic steering client is activated in the electronic device; and a third setting module, configured to set a traffic steering policy of the first traffic steering client as the kernel-mode traffic steering policy, to enable the first traffic steering client to steer traffic based on the kernel-mode traffic steering policy.

[0011] In a fifth aspect, the present disclosure shows an electronic device. The electronic device includes: a processor; and a memory configured to store processor-executable instructions, where the processor is configured to perform the method in any aspect described above.

[0012] In a sixth aspect, the present disclosure shows a non-transitory computer-readable storage medium. When executed by a processor of an electronic device, instructions in the storage medium enable the electronic device to perform the method in any aspect described above.

[0013] In a seventh aspect, the present disclosure shows a computer program product. When executed by a processor of an electronic device, instructions in the computer program product enable the electronic device to perform the method in any aspect described above.

[0014] Compared with the prior art, the present disclosure has the following advantages.

[0015] In the present disclosure, whether the second traffic steering client is activated in the electronic device is detected. The kernel-mode traffic steering policy is built in the second traffic steering client. In a case that the second traffic steering client is activated in the electronic device, the traffic steering policy of the first traffic steering client is set as the user-mode traffic steering policy, to enable the first traffic steering client to steer the traffic based on the user-mode traffic steering policy.

[0016] In the case that the second traffic steering client is activated in the electronic device, the second traffic steering client intercepts the traffic in the kernel mode and processes the traffic (for example, content adding or traffic steering). In addition, if a priority with which the second traffic steering client processes the traffic in the kernel mode is higher than a priority with which the first traffic steering client processes the traffic in the kernel mode, the first traffic steering client is affected by the second traffic steering client in a scenario of steering the traffic of a terminal. For example, after the second traffic steering client processes particular traffic in the kernel mode, the first traffic steering client does not steer the traffic in the kernel mode, to prevent the traffic from entering an infinite loop in the kernel mode.

[0017] However, after the second traffic steering client processes particular traffic in the kernel mode, the second traffic steering client transfers the particular traffic to the user mode. After the traffic is transferred to the user mode, steering of the traffic in the user mode by the user-mode traffic steering client does not make the traffic enter the infinite loop in the user mode, and the steering of the traffic in the user mode by the user-mode traffic steering client will not be affected by the second traffic steering client. Thus, the user-mode traffic steering client can still continue to steer the traffic in the user mode.

[0018] In addition, in a scenario where the priority with which the second traffic steering client processes the traffic in the kernel mode is higher than the priority with which the first traffic steering client processes the traffic in the kernel mode, when the second traffic steering client intercepts the traffic and processes the traffic in the kernel mode, sometimes the second traffic steering client does not perform traffic steering, but performs content adding on the traffic. For

example, the second traffic steering client is not interested in the traffic, and detects that the traffic is not traffic that needs to be steered by the second traffic steering client. However, after the second traffic steering client intercepts the traffic in the kernel mode, the second traffic steering client may perform content adding on the traffic sometimes, for example, adding some information/parameters to the traffic (some information/parameters may be used to indicate an identity of the second traffic steering client or to indicate content of the traffic that is intercepted by the second traffic steering client). After the second traffic steering client simply processes the traffic, the first traffic steering client is not affected when subsequently steering the traffic in the user mode according to a traffic steering manner expected by the first traffic steering client. That is, the first traffic steering client can steer the traffic in the user mode according to the traffic steering manner expected by the first traffic steering client.

[0019] In this way, the first traffic steering client can try to steer the traffic in the user mode. That is, even if the traffic cannot be steered by the first traffic steering client in the kernel mode due to the impact of the second traffic steering client with the higher priority, a chance that the first traffic steering client steers the traffic in the user mode can be increased, so as to increase a chance that the traffic can be steered by the first traffic steering client, and further increase a probability that the traffic can be steered by the first traffic steering client according to the traffic steering manner expected by the first traffic steering client. Abnormality of a service involved in the first traffic steering client can be avoided to the greatest extent, and compatibility between the first traffic steering client and the second traffic steering client can be improved.

BRIEF DESCRIPTION OF THE DRAWINGS

[0020] FIG. 1 is a flowchart of steps of a method for traffic management of the present disclosure.

[0021] FIG. 2 is a flowchart of steps of a method for traffic management of the present disclosure.

[0022] FIG. 3 is a flowchart of steps of a method for traffic management of the present disclosure.

[0023] FIG. 4 is a flowchart of steps of a method for traffic management of the present disclosure.

[0024] FIG. 5 is a flowchart of steps of a method for traffic management of the present disclosure.

[0025] FIG. 6 is a structural block diagram of an apparatus for traffic management of the present disclosure.

[0026] FIG. 7 is a structural block diagram of an apparatus for traffic management of the present

disclosure.

[0027] FIG. 8 is a structural block diagram of an apparatus of the present disclosure.

DETAILED DESCRIPTION

[0028] To make the above objectives, features and advantages of the present disclosure clearer and more comprehensible, the present disclosure will be further described below in detail with reference to the accompanying drawings and in conjunction with specific implementations.

[0029] In the following description, numerous specific details are set forth for the convenience of full understanding of the description. However, the description can be implemented in many other manners different from those described herein, and those of ordinary skill in the art can make similar promotion without violating the connotation of the description, such that the description is not limited by the specific implementations disclosed below.

[0030] Terms used in one or more embodiments of the description are merely used for describing specific embodiments rather than limiting one or more embodiments of the description. As used in one or more embodiments and the appended claims of the description, the singular forms such as “a”, “an”, “the”, and “this” are also intended to include plural forms, unless otherwise clearly stated in the context. It should also be understood that the term “and/or” used in one or more embodiments of the description indicates and includes any or all possible combinations of one or more of associated listed items.

[0031] Before the solutions of the present disclosure are introduced, the technical terms that may be involved in the solutions of the present disclosure are explained at first.

[0032] Operating system: a set of interrelated system software programs that take charge of and control computer operation, apply and run hardware and software resources, and provide public services to organize user interaction. According to the running environment, the operating systems may be divided into a desktop operating system, a mobile phone operating system, a server operating system, an embedded operating system, etc. For example, the operating systems may include a Windows operating system, a macOS operating system, a Linux operating system, etc. Operating modes of the operating system include a user mode and a kernel mode.

[0033] User mode: a CPU (Central Processing Unit) in the user mode may merely access restricted resources, may not directly access hardware devices such as a memory, and should enter a kernel through “system invoking”, to access these privileged resources.

[0034] Kernel mode: the CPU in the kernel mode may access any data, including peripheral devices, such as a network interface card and a hard disk. The CPU in the kernel mode may switch from one program to another program without CPU preemption. Generally, a mode in a privilege level 0 is referred to as the kernel mode.

[0035] WFP (Windows Filtering Platform): a network data packet processing framework in the Windows operating system of the Microsoft. The WFP allows developers to filter, modify, and redirect network packets, to achieve network security and management functions.

[0036] NE (Network Extension): a network packet processing framework in the macOS operating system of Apple Inc. The NE allows developers to filter, modify, and redirect network packets, to achieve network security and management functions.

[0037] Netfilter: a subsystem introduced by Linux2.4.x, as a general and abstract framework, for providing a set of management mechanisms of hook functions, to make it possible to perform packet filtering, network address translation (NAT), and connection tracking based on protocol types.

[0038] Virtual network interface card: a virtual network interface card in a computer system. The virtual network interface card may be used to simulate functions of a plurality physical network interface cards, such that computers can connect to a plurality of networks simultaneously or implement network isolation.

[0039] Routing table: a table used to store and manage network routing information of a router (or the operating system). The routing table records destinations and next hop information of IP (Internet Protocol) address segments in the network, and is used to determine a transmission path of data packets. The routing table may redirect and manage data traffic by adding, deleting, and modifying entries.

[0040] Traffic steering: traffic guiding or traffic controlling. The traffic steering aims to guide the network traffic from a source address to a target address or control the network traffic according to a target processing manner according to a specific policy.

[0041] Redirect: various types of network requests are redirected to other locations through various methods (for example, redirection of web pages, redirection of domain names, and changes in routing are also redirection of data messages through paths).

[0042] VPN (Virtual Private Network): a technology to establish a secure connection between private networks through a public network. Through encryption and tunneling technology, the VPN enables users to access private network resources through the public network, and ensures confidentiality and integrity of data simultaneously.

[0043] Antivirus software: also referred to as anti-virus software or virus defense software, a type of software used to eliminate computer threats such as computer viruses, Trojan horses, and malware. The antivirus software usually integrates functions of detection and recognition, virus scanning and removal, automatic upgrading, active defense, etc. Some antivirus software also has functions of data recovery, hacker intrusion prevention, network traffic control, etc. The antivirus

software is an important part of a computer defense system (including antivirus software, firewalls, programs for scanning for and removing Trojan horses and malware, intrusion prevention system, etc.).

[0044] Domain name system (DNS): a service of Internet. As a distributed database that maps domain names and IP addresses, the DNS may allow people to access the Internet more conveniently. The DNS uses a UDP (User Datagram Protocol) port 53. At present, the length of each level of the domain name is limited to 63 characters, and the total length of domain name may not exceed 253 characters.

[0045] The inventor finds that current traffic steering clients on the market include a kernel-mode traffic steering client. The kernel-mode traffic steering client may steer the traffic of a terminal in the kernel mode through a kernel-mode traffic steering framework of the operating system of the terminal.

[0046] Sometimes, two or more kernel-mode traffic steering clients may be run on the terminal simultaneously. The kernel-mode traffic steering clients have a priority order for traffic processing (for example, content adding or traffic steering) in the kernel mode. The kernel-mode traffic steering clients have different traffic steering manners for steering of the traffic of the terminal in the kernel mode (for example, redirecting to different destination addresses).

[0047] In an example, for any traffic of the terminal, in the kernel mode, the kernel-mode traffic steering client with a highest priority often intercepts the traffic first, and then the kernel-mode traffic steering client with the highest priority may determine whether it is necessary to process the traffic (for example, content adding or traffic steering). If the kernel-mode traffic steering client with the highest priority determines that it is necessary to process the traffic in the kernel mode, the kernel-mode traffic steering client with the highest priority processes the traffic in the kernel mode in a built-in processing manner (which may be traffic steering, or addition of some relevant parameters about the kernel-mode traffic steering client with the highest priority to the payload of the traffic). After the kernel-mode traffic steering client with the highest priority processes the traffic in the kernel mode, in normal cases, other kernel-mode traffic steering clients (the kernel-mode traffic steering clients with non-highest priorities) may not steer the traffic in the kernel mode (the other kernel-mode traffic steering clients filter out the traffic), to prevent the traffic from entering an infinite loop in the kernel mode.

[0048] However, the inventor finds that sometimes there is a case that the traffic is not expected to be processed by the kernel-mode traffic steering client with the highest priority, but the traffic is expected to be steered by a kernel-mode traffic steering client with a non-highest priority.

[0049] However, based on the foregoing description, it can be seen that after the kernel-mode

traffic steering client with the highest priority processes the traffic in the kernel mode, to prevent the traffic from entering the infinite loop in the kernel mode, the other kernel-mode traffic steering clients do not steer the traffic in the kernel mode again. For example, the kernel-mode traffic steering clients with the non-highest priorities do not steer the traffic in the kernel mode again. Thus, the purpose of "the traffic being expected to be steered by a kernel-mode traffic steering client with a non-highest priority" cannot be achieved, and abnormality of a service involved in this kernel-mode traffic steering client with the non-highest priority may be probably caused.

[0050] To sum up, due to interference of the other traffic steering clients, the traffic "expected to be steered by a traffic steering client" cannot be steered by this traffic steering client, and abnormality of a service involved in this traffic steering client may probably be caused.

[0051] In this way, to avoid the abnormality of the service involved in this traffic steering client, in a manner, it is necessary to enable the traffic "expected to be steered by this traffic steering client" to be steered by this traffic steering client to the greatest extent.

[0052] To enable the traffic "expected to be steered by this traffic steering client" to be steered by this traffic steering client to the greatest extent, the inventor finds that sometimes there is a probability that a particular traffic steering client may steer the traffic in the kernel mode, and may also steer the traffic in the user mode. That is, the particular traffic steering client has a kernel-mode traffic steering policy and a user-mode traffic steering policy.

[0053] The traffic steering in the user mode may be understood as steering of traffic of the terminal in the user mode based on the user-mode traffic steering framework of the operating system of the terminal. For example, the traffic of the terminal is steered through a routing table in the user mode.

[0054] In this way, in a case that the particular traffic steering client is activated on the terminal, and other kernel-mode traffic steering clients are not activated on the terminal, for the particular traffic steering client, the traffic may be steered in the kernel mode. For example, the kernel-mode traffic steering policy of the particular traffic steering client may be activated, and the traffic may be steered based on the kernel-mode traffic steering policy.

[0055] In this case, since the other traffic steering clients are not activated in the kernel mode, there are no other kernel-mode traffic steering clients that intercept and process the traffic (for example, content adding or traffic steering) in the kernel mode, and merely the one particular client steers the traffic in the kernel mode. As a result, no traffic "expected to be processed by other kernel-mode traffic steering clients in the kernel mode" exists, and merely the traffic "expected to be steered by the particular traffic steering client" exists.

[0056] In this way, for the traffic of the terminal, there are no other kernel-mode traffic steering

clients that intercept and process the traffic of the terminal. The traffic of the terminal in the kernel mode will be merely intercepted by the particular traffic steering client and be steered according to the traffic steering manner expected by the particular traffic steering client. It can be seen that the steering of the traffic of the terminal by the particular traffic steering client is not affected by the other kernel-mode traffic steering clients. Thus, the traffic "expected to be steered by the particular traffic steering client" can be steered by the particular traffic steering client, and the abnormality of the service involved in the particular traffic steering client can be avoided.

[0057] Alternatively, in another case that the particular traffic steering client is activated on the terminal, if other kernel-mode traffic steering clients are activated on the terminal, and the priorities with which the other activated kernel-mode traffic steering clients process the traffic in the kernel mode are higher than the priority with which the particular traffic steering client processes the traffic in the kernel mode, the user-mode traffic steering policy of the particular traffic steering client may be activated, and the kernel-mode traffic steering policy of the particular client may be deactivated for the particular traffic steering client. That is, the particular client may not steer the traffic in the kernel mode, but may steer the traffic in the user mode. For example, the particular client may steer the traffic based on the user-mode traffic steering policy.

[0058] In this case, the other kernel-mode traffic steering clients intercept traffic and process the traffic (for example, content adding or traffic steering) in the kernel mode, and the priorities with which the other kernel-mode traffic steering clients process the traffic in the kernel mode is higher than the priority with which the particular traffic steering client processes the traffic in the kernel mode. Thus, the particular traffic steering client may be affected by the other kernel-mode traffic steering clients in the scenario of the steering of the traffic of the terminal. For example, after the other kernel-mode traffic steering clients with the high priorities process particular traffic in the kernel mode, to prevent the traffic from entering the infinite loop in the kernel mode, the particular traffic steering client does not steer the traffic in the kernel mode again.

[0059] However, after the other kernel-mode traffic steering clients with the high priorities process particular traffic in the kernel mode, the other kernel-mode traffic steering clients with the high priorities transfer the traffic to the user mode. After the traffic is transferred to the user mode, steering of the traffic in the user mode by the user-mode traffic steering client does not make the traffic enter the infinite loop in the user mode, and the steering of the traffic in the user mode by the particular traffic steering client will not be affected by the other kernel-mode traffic steering clients. Thus, the particular traffic steering client can still continue to steer the traffic in the user mode based on the user-mode traffic steering policy.

[0060] In addition, in a scenario where the priorities with which the other kernel-mode traffic

steering clients process the traffic in the kernel mode is higher than the priority with which the particular traffic steering client processes the traffic in the kernel mode, when the other kernel-mode traffic steering clients process the traffic in the kernel mode, sometimes the other kernel-mode traffic steering clients do not perform traffic steering, but perform content adding on the traffic. For example, the other kernel-mode traffic steering clients are not interested in the traffic, and detect that the traffic is not traffic that needs to be steered by the other kernel-mode traffic steering clients. However, after the other kernel-mode traffic steering clients intercept the traffic in the kernel mode, the other kernel-mode traffic steering clients may simply process the traffic sometimes, for example, adding some information/parameters to the traffic (some information/parameters may be used to indicate identities of the other kernel-mode traffic steering clients or to indicate content of the traffic that is intercepted by the other kernel-mode traffic steering clients). After the other kernel-mode traffic steering clients simply process the traffic, the particular traffic steering client is not affected when subsequently steering the traffic in the user mode according to a traffic steering manner expected by the particular traffic steering client. That is, the particular traffic steering client can steer the traffic in the user mode according to the traffic steering manner expected by the particular traffic steering client.

[0061] In this way, the particular traffic steering client can try to steer the traffic in the user mode. That is, even if the traffic cannot be steered by the particular traffic steering client in the kernel mode due to the impact of the other kernel-mode traffic steering clients with the higher priorities, a chance that the particular traffic steering client steers the traffic in the user mode can be increased, so as to increase a chance that the traffic can be steered by the particular traffic steering client, and further increase a probability that the traffic can be steered by the particular traffic steering client according to the traffic steering manner expected by the particular traffic steering client. Abnormality of a service involved in the particular traffic steering client can be avoided to the greatest extent, and compatibility between the particular traffic steering client and the other kernel-mode traffic steering clients can be improved.

[0062] For example, in an embodiment, with reference to FIG. 1, a method for traffic management of the present disclosure is shown. The method is applied to an electronic device, and a first traffic steering client is activated in the electronic device.

[0063] The traffic steering client may include traffic steering applications, such as virtual private network (VPN), acceleration software, and antivirus software.

[0064] A kernel-mode traffic steering policy and a user-mode traffic steering policy are built in the first traffic steering client. That is, the first traffic steering client may select the kernel-mode traffic steering policy to steer the traffic, or may select the user-mode kernel policy to steer the

traffic.

[0065] The kernel-mode traffic steering policy includes a policy of guiding and controlling traffic in the kernel mode of the operating system, for example, a policy of guiding and controlling traffic through WFP in a Windows operating system, a policy of guiding and controlling traffic through Network Extension in a macOS operating system, and a policy of guiding and controlling traffic through Netfilter in a Linux operating system.

[0066] The user-mode traffic steering policy includes a policy of guiding and controlling traffic in the user mode of the operating system, for example, a policy of guiding and controlling traffic through a routing table and the like of the operating system.

[0067] The electronic device may include a terminal and a server, etc. The terminal may include a physical machine and a virtual machine, etc. The physical machine may include a desktop computer, a tablet computer, a mobile phone, a notebook computer, a PDA (Personal Digital Assistant) or the like, and the server may include an ECS (Elastic Compute Service) or the like.

[0068] The method includes the following steps.

[0069] In step S101, whether a second traffic steering client is activated in the electronic device is detected. A kernel-mode traffic steering policy is built in the second traffic steering client.

[0070] The second traffic steering client and the first traffic steering client are different traffic steering clients.

[0071] In the present disclosure, in a case that the kernel-mode traffic steering policy is built in the second traffic steering client, other traffic steering policies are not built in the second traffic steering client. For example, a user-mode traffic steering policy or the like is not built in the second traffic steering client. In this case, the second traffic steering client may steer traffic based on the kernel-mode traffic steering policy, but not steer the traffic based on the user-mode traffic steering policy.

[0072] In an embodiment of the present disclosure, in a scenario where the first traffic steering client is activated in the electronic device, whether the second traffic steering client is activated in the electronic device may be periodically (per a period not limited by the present disclosure) detected, or whether the second traffic steering client is activated in the electronic device may be continuously detected in real time, and correspondingly step S102 or step S103 is performed according to a detection result.

[0073] Reference can be made to the embodiment shown in FIG. 2 below for a specific detection manner for detecting whether the second traffic steering client is activated in the electronic device, which is not described in detail herein.

[0074] In a case that the second traffic steering client is activated in the electronic device, in

step S102, the traffic steering policy of the first traffic steering client is set as the user-mode traffic steering policy, to enable the first traffic steering client to steer the traffic based on the user-mode traffic steering policy.

[0075] In the case that the second traffic steering client is activated in the electronic device, the second traffic steering client often steers the traffic based on the kernel-mode traffic steering policy. If the traffic steering policy of the first traffic steering client is set as the kernel-mode traffic steering policy, the second traffic steering client may affect "the first traffic steering client steering the traffic in the kernel mode". As a result, the first traffic steering client may fail to steer the traffic that needs to be steered according to a traffic steering manner expected by the first traffic steering client, and abnormality of a service involved in the first traffic steering client may be further caused.

[0076] In this way, to avoid the abnormality of the service involved in the first traffic steering client, the traffic steering policy of the first traffic steering client may be set as the user-mode traffic steering policy, to enable the first traffic steering client to steer the traffic based on the user-mode traffic steering policy.

[0077] It should be noted that reference can be made to an existing traffic steering manner for the specific traffic steering manner for the first traffic steering client to perform traffic steering based on the user-mode traffic steering policy, which is not described in detail in the present disclosure.

[0078] In a case that the second traffic steering client is not activated in the electronic device, in step S103, the traffic steering policy of the first traffic steering client is set as the kernel-mode traffic steering policy, to enable the first traffic steering client to steer the traffic based on the kernel-mode traffic steering policy.

[0079] The traffic may include data, information or the like, such as a data packet or a message.

[0080] The traffic may include data, information or the like that is sent by the electronic device to the outside, or may also include data, information or the like that is received by the electronic device and sent by the outside to the electronic device.

[0081] The traffic may include traffic involving the request, or may include traffic involving the response (the response corresponding to the request, etc.).

[0082] In the present disclosure, whether the second traffic steering client is activated in the electronic device is detected. The kernel-mode traffic steering policy is built in the second traffic steering client. In the case that the second traffic steering client is activated in the electronic device, the traffic steering policy of the first traffic steering client is set as the user-mode traffic steering policy, to enable the first traffic steering client to steer the traffic based on the user-mode traffic steering policy.

[0083] In the case that the second traffic steering client is activated in the electronic device, the second traffic steering client intercepts the traffic and processes the traffic (for example, content adding or traffic steering) in the kernel mode. In addition, if a priority with which the second traffic steering client processes the traffic in the kernel mode is higher than a priority with which the first traffic steering client processes the traffic in the kernel mode, the first traffic steering client is affected by the second traffic steering client in a scenario of steering the traffic of a terminal. For example, after the second traffic steering client processes particular traffic in the kernel mode, the first traffic steering client does not steer the traffic in the kernel mode, to prevent the traffic from entering an infinite loop in the kernel mode.

[0084] However, after the second traffic steering client processes particular traffic in the kernel mode, the second traffic steering client transfers the particular traffic to the user mode. After the traffic is transferred to the user mode, steering of the traffic in the user mode by the user-mode traffic steering client does not make the traffic enter the infinite loop in the user mode, and the steering of the traffic in the user mode by the user-mode traffic steering client will not be affected by the second traffic steering client. Thus, the user-mode traffic steering client can still continue to steer the traffic in the user mode.

[0085] In addition, in a scenario where the priority with which the second traffic steering client processes the traffic in the kernel mode is higher than the priority with which the first traffic steering client processes the traffic in the kernel mode, when the second traffic steering client intercepts the traffic and processes the traffic in the kernel mode, sometimes the second traffic steering client does not perform traffic steering, but performs content adding on the traffic. For example, the second traffic steering client is not interested in the traffic, and detects that the traffic is not traffic that needs to be steered by the second traffic steering client. However, after the second traffic steering client intercepts the traffic in the kernel mode, the second traffic steering client may perform content adding on the traffic sometimes, for example, adding some information/parameters to the traffic (some information/parameters may be used to indicate an identity of the second traffic steering client or to indicate content of the traffic that is intercepted by the second traffic steering client). After the second traffic steering client simply processes the traffic, the first traffic steering client is not affected when subsequently steering the traffic in the user mode according to a traffic steering manner expected by the first traffic steering client. That is, the first traffic steering client can steer the traffic in the user mode according to the traffic steering manner expected by the first traffic steering client.

[0086] In this way, the first traffic steering client can try to steer the traffic in the user mode. That is, even if the traffic cannot be steered by the first traffic steering client in the kernel mode

due to the impact of the second traffic steering client with the higher priority, a chance that the first traffic steering client steers the traffic in the user mode can be increased, so as to increase a chance that the traffic can be steered by the first traffic steering client, and further increase a probability that the traffic can be steered by the first traffic steering client according to the traffic steering manner expected by the first traffic steering client. Abnormality of a service involved in the first traffic steering client can be avoided to the greatest extent, and compatibility between the first traffic steering client and the second traffic steering client can be improved.

[0087] In another embodiment of the present disclosure, the first traffic steering client is already activated in the electronic device, and in this case, the first traffic steering client may activate the traffic steering function or may not activate the traffic steering function. The first traffic steering client may steer the traffic only in a case that the first traffic steering client activates the traffic steering function, or the first traffic steering client may not steer the traffic in a case that the first traffic steering client does not activate the traffic steering function.

[0088] Since "the first traffic steering client may not steer the traffic in a case that the first traffic steering client does not activate the traffic steering function", in this case, no matter whether the second traffic steering client is activated in the electronic device, there is no case that the second traffic steering client affects "the first traffic steering client steering the traffic in the kernel mode". Thus, there is no case that "the first traffic steering client cannot steer the traffic that needs to be steered according to the traffic steering manner expected by the first traffic steering client", and there is no case that "the abnormality of the service involved in the first traffic steering client is caused". Thus, it is unnecessary to detect whether the second traffic steering client is activated in the electronic device, otherwise the system resources of the electronic device are wasted.

[0089] In this way, to save the system resources of the electronic device, in another embodiment of the present disclosure, whether the second traffic steering client is activated in the electronic device is detected only when an activation operation for activating the traffic steering function of the first traffic steering client is received. Through this embodiment, whether the second traffic steering client is activated in the electronic device is not detected in an unnecessary case, such that the system resources of the electronic device can be saved.

[0090] Alternatively, in yet another embodiment of the present disclosure, in a process of using the electronic device by the user, other clients may be activated sometimes in the electronic device according to actual needs, so as to use the other clients, and the other activated clients may be traffic steering clients or may not be traffic steering clients. If the other activated clients are traffic steering clients with the built-in kernel-mode traffic steering policy, the other clients may affect "the first traffic steering client steering the traffic in the kernel mode". As a result, the first traffic

steering client cannot steer the traffic that needs to be steered according to the traffic steering manner expected by the first traffic steering client, and the abnormality of the service involved in the first traffic steering client may be caused. Thus, to avoid the abnormality of the service involved in the first traffic steering client, it is necessary to detect whether the second traffic steering client is activated in the electronic device. For example, whether the second traffic steering client is activated in the electronic device is detected only when a client is newly activated in the electronic device. Through this embodiment, whether the second traffic steering client is activated in the electronic device is not detected in an unnecessary case, such that the system resources of the electronic device can be saved.

[0091] Alternatively, in yet another embodiment of the present disclosure, whether the second traffic steering client is activated in the electronic device is detected only when an activated client is deactivated in the electronic device. Through this embodiment, whether the second traffic steering client is activated in the electronic device is not detected in an unnecessary case, such that the system resources of the electronic device can be saved.

[0092] In addition, in another embodiment, in the case that the second traffic steering client is not activated in the electronic device, the traffic steering policy of the first traffic steering client may be set as the kernel-mode traffic steering policy, to enable the first traffic steering client to steer the traffic based on the kernel-mode traffic steering policy. The traffic steering policy of the first traffic steering client may alternatively be set as the user-mode traffic steering policy, to enable the first traffic steering client to steer the traffic based on the user-mode traffic steering policy.

[0093] However, compared with the traffic steering based on the user-mode traffic steering policy, granularity of the traffic steering based on the kernel-mode traffic steering policy is finer and more accurate. For example, based on the kernel-mode traffic steering policy, the traffic steering client may obtain more relevant information of the traffic, such as information of a traffic process. In this way, based on the kernel-mode traffic steering policy, the traffic steering client may steer traffic of the information of a specified process. Compared with the method that the kernel-mode-based traffic steering policy merely steer traffic of a specified network segment (a network segment may involve a plurality of processes), the granularity of the traffic steering is finer and more accurate.

[0094] In this way, in an optional embodiment, in the case that the second traffic steering client is not activated in the electronic device, the traffic steering policy of the first traffic steering client may be set as the kernel-mode traffic steering policy, to enable the first traffic steering client to steer the traffic based on the kernel-mode traffic steering policy.

[0095] It should be noted that reference can be made to an existing traffic steering manner for

the specific traffic steering manner for the first traffic steering client to perform traffic steering based on the kernel-mode traffic steering policy, which is not described in detail in the present disclosure.

[0096] In an embodiment of the present disclosure, with reference to FIG. 2, step S101 includes:

[0097] in step S201, identifier information of activated clients in the electronic device is obtained, and a first client list set in the first traffic steering client is obtained, where the first client list includes identifier information of traffic steering clients in which the kernel-mode traffic steering policy is built.

[0098] The identifier information of the client may include a name of the client, etc., and the identifier information of different clients is different.

[0099] In the present disclosure, a developer of the first traffic steering client may count the traffic steering clients in which the kernel-mode traffic steering policy is built on the market in advance (in a case, only the kernel-mode traffic steering policy is built in the counted traffic steering clients, and no other traffic steering policies are built in, for example, the user-mode traffic steering policy is not built in the counted traffic steering clients). The identifier information of the counted traffic steering clients in which the kernel-mode traffic steering policy is built is collected in a set, and the set is stored in a cloud corresponding to the first traffic steering client.

[0100] In a case that the user installs the first traffic steering client in the electronic device subsequently, and the first traffic steering client is activated in the electronic device, the first traffic steering client may establish a connection to the cloud corresponding to the first traffic steering client, then the cloud corresponding to the first traffic steering client may push the set to the first traffic steering client, and then the first traffic steering client may store the identifier information of the clients in the set into the first client list. Thus, the first client list has the identifier information of the traffic steering clients in which the kernel-mode traffic steering policy is built.

[0101] In step S202, it is determined that the second traffic steering client is activated in the electronic device in a case that the identifier information of at least one activated client in the electronic device is in the first client list.

[0102] It indicates that at least one second traffic steering client is activated in the electronic device in the case that the identifier information of at least one activated client in the electronic device is in the first client list.

[0103] In step S203, it is determined that the second traffic steering client is not activated in the electronic device in a case that none of the identifier information of the activated clients in the electronic device is in the first client list.

[0104] It indicates that not a single second traffic steering client is activated in the electronic

device in the case that none of the identifier information of the activated clients in the electronic device is in the first client list.

[0105] In another embodiment of the present disclosure, subsequent updating of the first client list may be supported according to the actual needs. For example, subsequently, the cloud corresponding to the first traffic steering client may push update information to the first traffic steering client. The update information carries the identifier information of a traffic steering client to be updated, and the kernel-mode traffic steering policy is built in the traffic steering client to be updated.

[0106] The first traffic steering client may receive the update information pushed to the first traffic steering client by the cloud corresponding to the first traffic steering client, and update the first client list according to the identifier information of the traffic steering client to be updated in the update information.

[0107] For example, in an example, the developer of the first traffic steering client may further continue to count new traffic steering clients in which the kernel-mode traffic steering policy is built on the market. For example, a new traffic steering client in which the kernel-mode traffic steering policy is built may be a traffic steering client newly manufactured by another manufacturer.

[0108] In this case, the majority of users may often use the new traffic steering client in which the kernel-mode traffic steering policy is built. Thus, the new traffic steering client in which the kernel-mode traffic steering policy is built is probably "installed and activated in the electronic device".

[0109] In this way, after the new traffic steering client in which the kernel-mode traffic steering policy is built is activated in the electronic device, the new traffic steering client in which the kernel-mode traffic steering policy is built may affect "the first traffic steering client steering the traffic in the kernel mode". As a result, the first traffic steering client cannot steer the traffic that needs to be steered according to the traffic steering manner expected by the first traffic steering client, and the abnormality of the service involved in the first traffic steering client may be further caused.

[0110] In this way, to avoid the abnormality of the service involved in the first traffic steering client, it is necessary to achieve the purpose of "detecting whether the new traffic steering client in which the kernel-mode traffic steering policy is built is activated in the electronic device" when "detecting whether the second traffic steering client is activated in the electronic device".

[0111] To achieve the purpose of "detecting whether the new traffic steering client in which the kernel-mode traffic steering policy is built is activated in the electronic device" when "detecting whether the second traffic steering client is activated in the electronic device", it is necessary to

make the first client list have the identifier information of the new traffic steering client in which the kernel-mode traffic steering policy is built.

[0112] To make the first client list have the identifier information of the new traffic steering client in which the kernel-mode traffic steering policy is built, it is necessary to newly add the identifier information of the new traffic steering client in which the kernel-mode traffic steering policy is built into the first client list.

[0113] For example, in an embodiment, the update information is used to indicate to newly add the identifier information of the new traffic steering client in which the kernel-mode traffic steering policy is built into the first client list. Thus, the first traffic steering client may store the identifier information of the new traffic steering client in which the kernel-mode traffic steering policy is built into the first client list, to achieve the purpose of newly adding the identifier information of the new traffic steering client in which the kernel-mode traffic steering policy is built into the first client list.

[0114] Alternatively, for example, in yet another example, the developer of the first traffic steering client may still continue to count old traffic steering clients in which the kernel-mode traffic steering policy is built and that exist before but no longer exist on the market. For example, an old traffic steering client in which the kernel-mode traffic steering policy is built may be a traffic steering client that another manufacturer no longer opens to the public and that no longer provides a traffic steering service.

[0115] In this case, the majority of users often no longer use the old traffic steering client in which the kernel-mode traffic steering policy is built. In this way, the old traffic steering client in which the kernel-mode traffic steering policy is built may no longer be “installed and activated in the electronic device”. In this way, the identifier information of the old traffic steering client in which the kernel-mode traffic steering policy is built no longer works, and the first client list may be simplified. For example, the identifier information of the old traffic steering client in which the kernel-mode traffic steering policy is built is not stored in the first client list any longer. Thus, the storage resources of the electronic device are saved, and efficiency of detecting whether the second traffic steering client is activated in the electronic device through the embodiment shown in FIG. 2 subsequently can be improved.

[0116] For example, in an embodiment, the update information is used to indicate to delete the identifier information of the old traffic steering client in which the kernel-mode traffic steering policy is built from the first client list. Thus, the first traffic steering client may delete the identifier information of the old traffic steering client in which the kernel-mode traffic steering policy is built from the first client list.

[0117] In the present disclosure, after the traffic steering policy of the first traffic steering client is set as the user-mode traffic steering policy, the first traffic steering client may steer the traffic based on the user-mode traffic steering policy. However, the second traffic steering client may be manually deactivated in the electronic device since the user no longer needs to use the second traffic steering client, or the second traffic steering client may be automatically deactivated in the electronic device due to a high occupancy rate of the system resources of the electronic device.

[0118] If the second traffic steering client is deactivated in the electronic device, the electronic device no longer runs the second traffic steering client, and then the case that "the second traffic steering client steers the traffic based on the kernel-mode traffic steering policy" does not occur. In this way, the case that the second traffic steering client affects "the first traffic steering client steering the traffic in the kernel mode" does not exist, and then the first traffic steering client is prevented from failing to steer the traffic that needs to be steered according to the traffic steering manner expected by the first traffic steering client due to the second traffic steering client. As a result, the abnormality of the service involved in the first traffic steering client will not be caused.

[0119] In addition, as mentioned above, the traffic steering based on the kernel-mode traffic steering policy by the first traffic steering client has the advantages of finer granularity and more accuracy compared with the traffic steering based on the user-mode traffic steering policy by the first traffic steering client.

[0120] In this way, in another embodiment of the present disclosure, after the traffic steering policy of the first traffic steering client is set as the user-mode traffic steering policy, whether the second traffic steering client is deactivated in the electronic device may be detected in real time. In a case that the second traffic steering client is deactivated in the electronic device, the traffic steering policy of the first traffic steering client may be switched from the user-mode traffic steering policy to the kernel-mode traffic steering policy, to enable the first traffic steering client to steer traffic based on the kernel-mode traffic steering policy.

[0121] "The case that the second traffic steering client is deactivated in the electronic device" may be understood as that all traffic steering clients in which the kernel-mode traffic steering policy is built are deactivated in the electronic device, and any traffic steering client in which the kernel-mode traffic steering policy is built is no longer run in the electronic device.

[0122] In addition, based on a large number of experimental statistics, through the embodiment shown in FIG. 1, in most cases, the first traffic steering client may steer the traffic that needs to be steered in the user mode according to the traffic steering manner expected. That is, in most cases, the abnormality of the service involved in the first traffic steering client may be avoided (for example, the services involved in the first traffic steering client are normal in most cases), and in

most cases, the first traffic steering client and the second traffic steering client may be compatible.

[0123] However, occasionally, the service involved in the first traffic steering client is abnormal, and it is found by statistics that some particular clients in which the user-mode traffic steering policy is built and that are activated in the electronic device may affect the traffic steering in the user mode by the first traffic steering client.

[0124] Thus, to further improve the possibility that the services involved in the first traffic steering client remain normal based on the embodiment shown in FIG. 1, and further improve the compatibility between the first traffic steering client and the second traffic steering client, based on the embodiment shown in FIG. 1, in another embodiment of the present disclosure, with reference to FIG. 3, the method further includes the following steps.

[0125] In the case that the second traffic steering client is activated in the electronic device, in step S301, whether a third traffic steering client is activated in the electronic device is detected. The user-mode traffic steering policy is built in the third traffic steering client.

[0126] The third traffic steering client is different from the first traffic steering client and the second traffic steering client.

[0127] In the present disclosure, in a scenario where the user-mode traffic steering policy is built in the third traffic steering client, no other traffic steering policies is built in the third traffic steering client. For example, the kernel-mode traffic steering policy or the like is not built in the third traffic steering client. In this case, the third traffic steering client may steer the traffic based on the user-mode traffic steering policy, but not steer the traffic based on the kernel-mode traffic steering policy.

[0128] Reference can be made to the embodiment shown in FIG. 4 below for detecting whether the third traffic steering client is activated in the electronic device, which is not described in detail herein.

[0129] In a case that the third traffic steering client is not activated in the electronic device, step S102 is performed: the traffic steering policy of the first traffic steering client is set as the user-mode traffic steering policy.

[0130] In a case that the third traffic steering client is activated in the electronic device, in step S302, the third traffic steering client is deactivated in the electronic device, and then step S102 is performed: the traffic steering policy of the first traffic steering client is set as the user-mode traffic steering policy.

[0131] After the third traffic steering client is deactivated in the electronic device, the third traffic steering client no longer runs in the electronic device. Thus, not a single traffic steering client in which the user-mode traffic steering policy is built is activated in the electronic device, and then, the case that “the third traffic steering client steers traffic based on the user-mode traffic

steering policy" does not occur.

[0132] In this way, there is no case that the third traffic steering client affects "the first traffic steering client steering the traffic in the user mode", and then the first traffic steering client is prevented from failing to steer the traffic that needs to be steered according to the traffic steering manner expected by the first traffic steering client due to the third traffic steering client. As a result, the abnormality of the service involved in the first traffic steering client will not be caused. That is, after the traffic steering policy of the first traffic steering client is set as the user-mode traffic steering policy, the traffic steering by the first traffic steering client based on the user-mode traffic steering policy will not be affected.

[0133] In the present disclosure, in the case that the third traffic steering client is activated in the electronic device, if the third traffic steering client is directly deactivated in the electronic device, the user may feel awkward, and the user does not know the reason for deactivating the third traffic steering client in the electronic device. For example, the user may not know that the electronic device deactivates the third traffic steering client in the electronic device for the first traffic steering client (to enable the first traffic steering client to steer the traffic based on the user-mode traffic steering policy without impact from the third traffic steering client). The user may mistakenly think that the electronic device is faulty or the third traffic steering client is faulty, and user experience may be reduced.

[0134] Further, the user may manually control the electronic device to re-activate the third traffic steering client, and then the third traffic steering client may affect "the first traffic steering client steering the traffic in the user mode". As a result, the first traffic steering client cannot steer the traffic that needs to be steered according to the traffic steering manner expected by the first traffic steering client, and the abnormality of the service involved in the first traffic steering client may be further caused.

[0135] Then, to avoid the abnormality of the service involved in the first traffic steering client, the electronic device deactivates the third traffic steering client again, and then the user manually controls the electronic device to re-activate the third traffic steering client. The loop continues, and the user experience is reduced continuously.

[0136] Thus, to avoid continuously reducing the user experience, in another embodiment of the present disclosure, in the case that the third traffic steering client is activated in the electronic device, deactivation prompt information may be displayed. The deactivation prompt information is used to prompt whether to deactivate the third traffic steering client in the electronic device for the first traffic steering client. The phrase "for the first traffic steering client" may be understood as for the first traffic steering client being not affected by the third traffic steering client when

steering the traffic based on the user-mode traffic steering policy.

[0137] The user may see the displayed deactivation prompt information. If the user decides that the third traffic steering client may be deactivated in the electronic device, the user may input a confirmation operation of the deactivation prompt information, or if the user decides not to deactivate the third traffic steering client in the electronic device, the user may input a cancellation operation of the deactivation prompt information.

[0138] In this case, only when the electronic device receives the confirmation operation of the deactivation prompt information, step S302 is performed: the third traffic steering client is deactivated in the electronic device.

[0139] Alternatively, in this case, when the electronic device receives the cancellation operation of the deactivation prompt information, step S302 is not performed. For example, the third traffic steering client is not deactivated in the electronic device, and the third traffic steering client is kept running in the electronic device (that is, the third traffic steering client is kept in an activated state in the electronic device).

[0140] According to the present disclosure, whether to deactivate the third traffic steering client in the electronic device is left to the user, and the user is informed of such a case. Thus, the continuous reduction of user experience is avoided.

[0141] In an embodiment of the present disclosure, with reference to FIG. 4, step S301 includes the following steps.

[0142] In step S401, the identifier information of the activated clients in the electronic device is obtained, and a second client list set in the first traffic steering client is obtained. The second client list includes identifier information of traffic steering clients in which the user-mode traffic steering policy is built.

[0143] In the present disclosure, a developer of the first traffic steering client may count the traffic steering clients in which the user-mode traffic steering policy is built on the market in advance (in a case, only the user-mode traffic steering policy is built in the counted traffic steering clients, and no other traffic steering policies are built in, for example, the kernel-mode traffic steering policy is not built in the counted traffic steering clients). The identifier information of the counted traffic steering clients in which the user-mode traffic steering policy is built is collected in a set, and the set is stored in a cloud corresponding to the first traffic steering client.

[0144] In a case that the user installs the first traffic steering client in the electronic device subsequently, and the first traffic steering client is activated in the electronic device, the first traffic steering client establish a connection to the cloud corresponding to the first traffic steering client, then the cloud corresponding to the first traffic steering client may push the set to the first traffic

steering client, and then the first traffic steering client may store the identifier information of the clients in the set into the second client list. Thus, the second client list has the identifier information of the traffic steering clients in which the user-mode traffic steering policy is built.

[0145] In step S402, it is determined that the third traffic steering client is activated in the electronic device in a case that the identifier information of at least one activated client in the electronic device is in the second client list.

[0146] It indicates that at least one third traffic steering client is activated in the electronic device in the case that the identifier information of at least one activated client in the electronic device is in the second client list.

[0147] In step S403, it is determined that the third traffic steering client is not activated in the electronic device in a case that none of the identifier information of the activated clients in the electronic device is in the second client list.

[0148] It indicates that not a single third traffic steering client is activated in the electronic device in the case that none of the identifier information of the activated clients in the electronic device is in the second client list.

[0149] In another embodiment of the present disclosure, subsequent updating of the second client list may be supported according to the actual needs. For example, subsequently, the cloud corresponding to the first traffic steering client may push update information to the first traffic steering client. The update information carries the identifier information of a traffic steering client to be updated, and the user-mode traffic steering policy is built in the traffic steering client to be updated.

[0150] The first traffic steering client may receive the update information pushed to the first traffic steering client by the cloud corresponding to the first traffic steering client, and update the second client list according to the identifier information of the traffic steering client to be updated in the update information.

[0151] For example, in an example, the developer of the first traffic steering client may further continue to count new traffic steering clients in which the user-mode traffic steering policy is built on the market. For example, a new traffic steering client in which the user-mode traffic steering policy is built may be a traffic steering client newly manufactured by another manufacturer.

[0152] In this case, the majority of users may often use the new traffic steering client in which the user-mode traffic steering policy is built. Thus, the new traffic steering client in which the user-mode traffic steering policy is built is probably “installed and activated in the electronic device”.

[0153] In this way, after the new traffic steering client in which the user-mode traffic steering policy is built is activated in the electronic device, the new traffic steering client in which the user-

mode traffic steering policy is built may affect "the first traffic steering client steering the traffic in the user mode". As a result, the first traffic steering client cannot steer the traffic that needs to be steered according to the traffic steering manner expected by the first traffic steering client, and the abnormality of the service involved in the first traffic steering client may be further caused.

[0154] In this way, to avoid the abnormality of the service involved in the first traffic steering client, it is necessary to achieve the purpose of "detecting whether the new traffic steering client in which the user-mode traffic steering policy is built is activated in the electronic device" when "detecting whether the third traffic steering client is activated in the electronic device".

[0155] To achieve the purpose of "detecting whether the new traffic steering client in which the user-mode traffic steering policy is built is activated in the electronic device" when "detecting whether the third traffic steering client is activated in the electronic device", it is necessary to make the second client list have the identifier information of the new traffic steering client in which the user-mode traffic steering policy is built.

[0156] To make the second client list have the identifier information of the new traffic steering client in which the user-mode traffic steering policy is built, it is necessary to newly add the identifier information of the new traffic steering client in which the user-mode traffic steering policy is built into the second client list.

[0157] For example, in an embodiment, the update information is used to indicate to newly add the identifier information of the new traffic steering client in which the user-mode traffic steering policy is built into the second client list. Thus, the first traffic steering client may store the identifier information of the new traffic steering client in which the user-mode traffic steering policy is built into the second client list, to achieve the purpose of newly adding the identifier information of the new traffic steering client in which the user-mode traffic steering policy is built into the second client list.

[0158] Alternatively, for example, in yet another example, the developer of the first traffic steering client may still continue to count old traffic steering clients in which the user-mode traffic steering policy is built and that exist before but no longer exist on the market. For example, an old traffic steering client in which the user-mode traffic steering policy is built may be a traffic steering client that another manufacturer no longer opens to the public and that no longer provides a traffic steering service.

[0159] In this case, the majority of users often no longer use the old traffic steering client in which the user-mode traffic steering policy is built. In this way, the old traffic steering client in which the user-mode traffic steering policy is built may no longer be "installed and activated in the electronic device". In this way, the identifier information of the old traffic steering client in

which the user-mode traffic steering policy is built no longer works, and the second client list may be simplified. For example, the identifier information of the old traffic steering client in which the user-mode traffic steering policy is built is not stored in the second client list any longer. Thus, the storage resources of the electronic device are saved, and efficiency of detecting whether the third traffic steering client is activated in the electronic device through the embodiment shown in FIG. 4 subsequently can be improved.

[0160] For example, in an embodiment, the update information is used to indicate to delete the identifier information of the old traffic steering client in which the user-mode traffic steering policy is built from the second client list. Thus, the first traffic steering client may delete the identifier information of the old traffic steering client in which the user-mode traffic steering policy is built from the second client list.

[0161] Or, in another embodiment, with reference to FIG. 5, a method for traffic management of the present disclosure is shown. The method is applied to an electronic device, and a first traffic steering client is activated in the electronic device. A kernel-mode traffic steering policy and a user-mode traffic steering policy are built in the first traffic steering client.

[0162] The method includes the following steps.

[0163] In step S501, whether a second traffic steering client is activated in the electronic device is detected. The kernel-mode traffic steering policy is built in the second traffic steering client.

[0164] Reference can be made to the description of step S101 for this step, which is not be described in detail herein.

[0165] In a case that the second traffic steering client is activated in the electronic device, step S502 may be performed, or in a case that the second traffic steering client is not activated in the electronic device, step S503 may be directly performed.

[0166] In the case that the second traffic steering client is activated in the electronic device, in step S502, the second traffic steering client is deactivated in the electronic device.

[0167] In the case that the second traffic steering client is activated in the electronic device, the second traffic steering client often steers the traffic based on the kernel-mode traffic steering policy. If the traffic steering policy of the first traffic steering client is set as the kernel-mode traffic steering policy, the second traffic steering client may affect “the first traffic steering client steering the traffic in the kernel mode”. As a result, the first traffic steering client may fail to steer the traffic that needs to be steered according to a traffic steering manner expected by the first traffic steering client, and abnormality of a service involved in the first traffic steering client may be further caused.

[0168] In this way, to avoid the abnormality of the service involved in the first traffic steering client, the second traffic steering client may be deactivated in the electronic device.

[0169] After the second traffic steering client is deactivated in the electronic device, the second traffic steering client no longer runs in the electronic device. Thus, not a single traffic steering client in which the kernel-mode traffic steering policy is built is activated in the electronic device, and then, the case that "the second traffic steering client steers traffic in the kernel mode based on the kernel-mode traffic steering policy" does not occur.

[0170] In this way, there is no case that the second traffic steering client may affect "the first traffic steering client steering the traffic in the kernel mode". In this way, after the traffic steering policy of the first traffic steering client is set as the kernel-mode traffic steering policy, the first traffic steering client may steer the traffic based on the kernel-mode traffic steering policy, and the second traffic steering client does not cause the first traffic steering client to fail to steer the traffic that needs to be steered according to the traffic steering manner expected by the first traffic steering client. As a result, the abnormality of the service involved in the first traffic steering client will not be caused.

[0171] In this way, after the second traffic steering client is deactivated in the electronic device, step S503 may be performed.

[0172] In the case that the second traffic steering client is not activated in the electronic device, in step S503, the traffic steering policy of the first traffic steering client is set as the kernel-mode traffic steering policy, to enable the first traffic steering client to steer the traffic based on the kernel-mode traffic steering policy.

[0173] It should be noted that reference can be made to an existing traffic steering manner for the specific traffic steering manner for the first traffic steering client to perform traffic steering based on the kernel-mode traffic steering policy, which is not described in detail in the present disclosure.

[0174] In the present disclosure, whether the second traffic steering client is activated in the electronic device is detected. The kernel-mode traffic steering policy is built in the second traffic steering client. In the case that the second traffic steering client is activated in the electronic device, the second traffic steering client is deactivated. The traffic steering policy of the first traffic steering client is set as the kernel-mode traffic steering policy, to enable the first traffic steering client to steer traffic based on the kernel-mode traffic steering policy.

[0175] Through the present disclosure, after the second traffic steering client is deactivated in the electronic device, the second traffic steering client no longer runs in the electronic device. Thus, not a single traffic steering client in which the kernel-mode traffic steering policy is built is activated in the electronic device, and then, the case that "the second traffic steering client steers traffic in the kernel mode based on the kernel-mode traffic steering policy" does not occur.

[0176] In this way, there is no case that the second traffic steering client may affect "the first traffic steering client steering the traffic in the kernel mode". In this way, after the traffic steering policy of the first traffic steering client is set as the kernel-mode traffic steering policy, the first traffic steering client may steer the traffic based on the kernel-mode traffic steering policy, and the second traffic steering client does not cause the first traffic steering client to fail to steer the traffic that needs to be steer according to the traffic steering manner expected by the first traffic steering client. Thus, the traffic can be steered by the first traffic steering client according to the traffic steering manner expected by the first traffic steering client. For example, the traffic "expected to be steered by the first traffic steering client" can be steered by the first traffic steering client in the kernel mode (for example, redirected in the kernel mode), and the abnormality of the service involved in the first traffic steering client will not be caused.

[0177] In the present disclosure, in the case that the second traffic steering client is activated in the electronic device, if the second traffic steering client is directly deactivated in the electronic device, the user may feel awkward, and the user does not know the reason for deactivating the second traffic steering client in the electronic device. For example, the user may not know that the electronic device deactivates the second traffic steering client in the electronic device for the first traffic steering client (to enable the first traffic steering client to steer the traffic based on the kernel-mode traffic steering policy without impact from the second traffic steering client). The user may mistakenly think that the electronic device is faulty or the second traffic steering client is faulty, and user experience may be reduced.

[0178] Further, the user may manually control the electronic device to re-activate the second traffic steering client, and then the second traffic steering client may affect "the first traffic steering client steering the traffic in the kernel mode". As a result, the first traffic steering client cannot steer the traffic that needs to be steered according to the traffic steering manner expected by the first traffic steering client, and the abnormality of the service involved in the first traffic steering client may be further caused.

[0179] Then, to avoid the abnormality of the service involved in the first traffic steering client, the electronic device deactivates the second traffic steering client again, and then the user manually controls the electronic device to re-activate the second traffic steering client. The loop continues, and the user experience is reduced continuously.

[0180] Thus, to avoid continuously reducing the user experience, in another embodiment of the present disclosure, in the case that the second traffic steering client is activated in the electronic device, deactivation prompt information may be displayed. The deactivation prompt information is used to prompt whether to deactivate the second traffic steering client in the electronic device

for the first traffic steering client. The phrase "for the first traffic steering client" may be understood as for the first traffic steering client being not affected by the second traffic steering client when steering the traffic based on the kernel-mode traffic steering policy.

[0181] The user may see the displayed deactivation prompt information. If the user decides that the second traffic steering client may be deactivated in the electronic device, the user may input a confirmation operation of the deactivation prompt information, or if the user decides not to deactivate the second traffic steering client in the electronic device, the user may input a cancellation operation of the deactivation prompt information.

[0182] In this case, only when the electronic device receives the confirmation operation of the deactivation prompt information, step S502 is performed: the second traffic steering client is deactivated in the electronic device.

[0183] Alternatively, in this case, when the electronic device receives the cancellation operation of the deactivation prompt information, step S502 is not performed. For example, the second traffic steering client is not deactivated in the electronic device, and the second traffic steering client is kept running in the electronic device (that is, the second traffic steering client is kept in an activated state in the electronic device).

[0184] According to the present disclosure, whether to deactivate the second traffic steering client in the electronic device is left to the user, and the user is informed of such a case. Thus, the continuous reduction of user experience is avoided.

[0185] In another embodiment of the present disclosure, after the traffic steering policy of the first traffic steering client is set as the kernel-mode traffic steering policy, in a process of using the electronic device by the user, sometimes the electronic device may receive an activation request for activation of the second traffic steering client in the electronic device. For example, the user may trigger an icon of the second traffic steering client, to submit to the electronic device the activation request for activation of the second traffic steering client in the electronic device. Alternatively, in a process of using some functions of other clients in the electronic device, the user automatically triggers an event of activating the second traffic steering client, and the activation request for activation of the second traffic steering client in the electronic device is submitted to the electronic device automatically.

[0186] However, after the second traffic steering client is activated in the electronic device, the second traffic steering client may affect "the first traffic steering client steering the traffic in the kernel mode". As a result, the first traffic steering client cannot steer the traffic that needs to be steered according to the traffic steering manner expected by the first traffic steering client, and the abnormality of the service involved in the first traffic steering client may be further caused.

[0187] In this way, to avoid the abnormality of the service involved in the first traffic steering client, in an embodiment of the present disclosure, in a case that the activation request for activation of the second traffic steering client in the electronic device is received, an action of "activating the second traffic steering client in the electronic device according to the activation request" may be intercepted, such that the electronic device does not process the activation request. That is, the second traffic steering client is not activated in the electronic device according to the activation request, such that the second traffic steering client is not activated in the electronic device.

[0188] In the present disclosure, in the case that the activation request for activation of the second traffic steering client in the electronic device is received, if the action of "activating the second traffic steering client in the electronic device according to the activation request" is directly intercepted without activating the second traffic steering client in the electronic device, the user may feel awkward, and the user does not know the reason why the second traffic steering client is not activated in the electronic device. For example, the user may not know that the electronic device does not activate the second traffic steering client in the electronic device for the first traffic steering client (to enable the first traffic steering client to steer the traffic based on the kernel-mode traffic steering policy without impact from the second traffic steering client). The user may mistakenly think that the electronic device is faulty or the second traffic steering client is faulty, and user experience may be reduced.

[0189] Further, the user may manually control the electronic device to re-activate the second traffic steering client, and then the second traffic steering client may affect "the first traffic steering client steering the traffic in the kernel mode". As a result, the first traffic steering client cannot steer the traffic that needs to be steered according to the traffic steering manner expected by the first traffic steering client, and the abnormality of the service involved in the first traffic steering client may be further caused.

[0190] Then, to avoid the abnormality of the service involved in the first traffic steering client, the electronic device intercepts the action of "activating the second traffic steering client in the electronic device according to the activation request" again, and then the user manually controls the electronic device to re-activate the second traffic steering client. The loop continues, and the user experience is reduced continuously.

[0191] Thus, to avoid continuously reducing the user experience, in another embodiment of the present disclosure, in the case that the activation request for activation of the second traffic steering client in the electronic device is received, cancellation prompt information is displayed. The cancellation prompt information is used to prompt whether to cancel activation of the second

traffic steering client in the electronic device for the first traffic steering client. The phrase "for the first traffic steering client" may be understood as for the first traffic steering client being not affected by the second traffic steering client when steering the traffic based on the kernel-mode traffic steering policy.

[0192] The user may see the displayed cancellation prompt information. If the user decides that activation of the second traffic steering client may be canceled in the electronic device, the user may input a confirmation operation of the cancellation prompt information, or if the user decides to activate the second traffic steering client in the electronic device, the user may input a cancellation operation of the cancellation prompt information.

[0193] In this case, only when the electronic device receives the confirmation operation of the cancellation prompt information, the action of "activating the second traffic steering client in the electronic device according to the activation request" is intercepted.

[0194] Alternatively, in this case, when the electronic device receives the cancellation operation of the cancellation prompt information, the action of "activating the second traffic steering client in the electronic device according to the activation request" may be not intercepted, and the action of "activating the second traffic steering client in the electronic device according to the activation request" may be performed. Thus, the second traffic steering client is activated in the electronic device.

[0195] According to the present disclosure, whether to cancel activation of the second traffic steering client in the electronic device is left to the user, and the user is informed of such a case. Thus, the continuous reduction of user experience is avoided.

[0196] It should be noted that for simple description of the method embodiments, the method embodiments are expressed as a series of action combinations, but those of ordinary skill in the art should know that the present disclosure is not limited by the action order described since some steps can be performed in other orders or at the same time according to the present disclosure. In addition, those of ordinary skill in the art should also know that the embodiments described in the description are all optional embodiments, and the actions involved may not be necessary for the present disclosure.

[0197] With reference to FIG. 6, a structural block diagram of an apparatus for traffic management of the present disclosure is shown. The apparatus is applied to an electronic device. A first traffic steering client is activated in the electronic device, and a kernel-mode traffic steering policy and a user-mode traffic steering policy are built in the first traffic steering client. The apparatus includes: a first detection module 11 configured to detect whether a second traffic steering client is activated in the electronic device, where the kernel-mode traffic steering policy

is built in the second traffic steering client; and a first setting module 12 configured to set, a traffic steering policy of the first traffic steering client as the user-mode traffic steering policy in a case that the second traffic steering client is activated in the electronic device, to enable the first traffic steering client to steer traffic based on the user-mode traffic steering policy.

[0198] In an optional implementation, the first detection module includes: a first obtaining unit configured to obtain identifier information of activated clients in the electronic device, and obtain a first client list set in the first traffic steering client, where the first client list includes identifier information of traffic steering clients in which the kernel-mode traffic steering policy is built; a first determination unit configured to determine that the second traffic steering client is activated in the electronic device in a case that the identifier information of at least one activated client in the electronic device is in the first client list; or a second determination unit configured to determine that the second traffic steering client is not activated in the electronic device in a case that none of the identifier information of the activated clients in the electronic device is in the first client list.

[0199] In an optional implementation, the first detection module further includes: a first receiving unit configured to receive update information pushed by a cloud corresponding to the first traffic steering client to the first traffic steering client, where the update information carries identifier information of a traffic steering client to be updated, and the kernel-mode traffic steering policy is built in the traffic steering client to be updated; and a first update unit configured to update the first client list according to the identifier information of the traffic steering client to be updated in the update information.

[0200] In an optional implementation, the first detection module is specifically configured to detect whether the second traffic steering client is activated in the electronic device in a case that an activation operation for activating a traffic steering function of the first traffic steering client is received; or the first detection module is specifically configured to detect whether the second traffic steering client is activated in the electronic device in a case that a client is newly activated in the electronic device; or the first detection module is specifically configured to detect whether the second traffic steering client is activated in the electronic device in a case that an activated client is deactivated in the electronic device.

[0201] In an optional implementation, the apparatus further includes: a second setting module configured to set the traffic steering policy of the first traffic steering client as the kernel-mode traffic steering policy in a case that the second traffic steering client is not activated in the electronic device, to enable the first traffic steering client to steer traffic based on the kernel-mode traffic steering policy.

[0202] In an optional implementation, the apparatus further includes a switch module configured to: after the traffic steering policy of the first traffic steering client is set as the user-mode traffic steering policy, switch the traffic steering policy of the first traffic steering client from the user-mode traffic steering policy to the kernel-mode traffic steering policy in a case that the second traffic steering client is deactivated in the electronic device, to enable the first traffic steering client to steer the traffic based on the kernel-mode traffic steering policy.

[0203] In an optional implementation, the apparatus further includes: a second detection module configured to detect, in the case that the second traffic steering client is activated in the electronic device, whether a third traffic steering client is activated in the electronic device, where the user-mode traffic steering policy is built in the third traffic steering client. The first setting module is further configured to set the traffic steering policy of the first traffic steering client as the user-mode traffic steering policy in a case that the third traffic steering client is not activated in the electronic device. Alternatively, a first deactivation module is configured to deactivate the third traffic steering client in the electronic device in a case that the third traffic steering client is activated in the electronic device, and the first setting module is further configured to set the traffic steering policy of the first traffic steering client as the user-mode traffic steering policy.

[0204] In an optional implementation, the apparatus further includes a first display module configured to display deactivation prompt information in the case that the third traffic steering client is activated in the electronic device, and the deactivation prompt information is used for prompting whether to deactivate the third traffic steering client in the electronic device for the first traffic steering client. The first deactivation module is further configured to deactivate the third traffic steering client in the electronic device in a case that a confirmation operation of the deactivation prompt information is received.

[0205] In an optional implementation, the second detection module includes: a second obtaining unit configured to obtain the identifier information of the activated clients in the electronic device, and obtain a second client list set in the first traffic steering client, where the second client list includes identifier information of traffic steering clients in which the user-mode traffic steering policy is built; a third determination unit configured to determine that the third traffic steering client is activated in the electronic device in a case that the identifier information of at least one activated client in the electronic device is in the second client list; or a fourth determination unit configured to determine that the third traffic steering client is not activated in the electronic device in a case that none of the identifier information of the activated clients in the electronic device is in the second client list.

[0206] In an optional implementation, the second detection module further includes: a second

receiving unit configured to receive update information pushed by a cloud corresponding to the first traffic steering client to the first traffic steering client, where the update information carries identifier information of a traffic steering client to be updated, and the user-mode traffic steering policy is built in the traffic steering client to be updated; and a second update unit configured to update the second client list according to the identifier information of the traffic steering client to be updated in the update information.

[0207] In the present disclosure, whether the second traffic steering client is activated in the electronic device is detected. The kernel-mode traffic steering policy is built in the second traffic steering client. In the case that the second traffic steering client is activated in the electronic device, the traffic steering policy of the first traffic steering client is set as the user-mode traffic steering policy, to enable the first traffic steering client to steer the traffic based on the user-mode traffic steering policy.

[0208] In the case that the second traffic steering client is activated in the electronic device, the second traffic steering client intercepts the traffic in the kernel mode and processes the traffic (for example, content adding or traffic steering). In addition, if a priority with which the second traffic steering client processes the traffic in the kernel mode is higher than a priority with which the first traffic steering client processes the traffic in the kernel mode, the first traffic steering client is affected by the second traffic steering client in a scenario of steering the traffic of a terminal. For example, after the second traffic steering client processes particular traffic in the kernel mode, the first traffic steering client does not steer the traffic in the kernel mode, to prevent the traffic from entering an infinite loop in the kernel mode.

[0209] However, after the second traffic steering client processes particular traffic in the kernel mode, the second traffic steering client transfers the particular traffic to the user mode. After the traffic is transferred to the user mode, steering of the traffic in the user mode by the user-mode traffic steering client does not make the traffic enter the infinite loop in the user mode, and the steering of the traffic in the user mode by the user-mode traffic steering client will not be affected by the second traffic steering client. Thus, the user-mode traffic steering client can still continue to steer the traffic in the user mode.

[0210] In addition, in a scenario where the priority with which the second traffic steering client processes the traffic in the kernel mode is higher than the priority with which the first traffic steering client processes the traffic in the kernel mode, when the second traffic steering client intercepts the traffic and processes the traffic in the kernel mode, sometimes the second traffic steering client does not perform traffic steering, but performs content adding on the traffic. For example, the second traffic steering client is not interested in the traffic, and detects that the traffic

is not traffic that needs to be steered by the second traffic steering client. However, after the second traffic steering client intercepts the traffic in the kernel mode, the second traffic steering client may perform content adding on the traffic sometimes, for example, adding some information/parameters to the traffic (some information/parameters may be used to indicate an identity of the second traffic steering client or to indicate content of the traffic that is intercepted by the second traffic steering client). After the second traffic steering client simply processes the traffic, the first traffic steering client is not affected when subsequently steering the traffic in the user mode according to a traffic steering manner expected by the first traffic steering client. That is, the first traffic steering client can steer the traffic in the user mode according to the traffic steering manner expected by the first traffic steering client.

[0211] In this way, the first traffic steering client can try to steer the traffic in the user mode. That is, even if the traffic cannot be steered by the first traffic steering client in the kernel mode due to the impact of the second traffic steering client with the higher priority, a chance that the first traffic steering client steers the traffic in the user mode can be increased, so as to increase a chance that the traffic can be steered by the first traffic steering client, and further increase a probability that the traffic can be steered by the first traffic steering client according to a traffic steering manner expected by the first traffic steering client. Abnormality of a service involved in the first traffic steering client can be avoided to the greatest extent, and compatibility between the first traffic steering client and the second traffic steering client can be improved.

[0212] With reference to FIG. 7, a structural block diagram of an apparatus for traffic management of the present disclosure is shown. The apparatus is applied to an electronic device. A first traffic steering client is activated in the electronic device, and a kernel-mode traffic steering policy and a user-mode traffic steering policy are built in the first traffic steering client. The apparatus includes: a third detection module 21 configured to detect whether a second traffic steering client is activated in the electronic device, where the kernel-mode traffic steering policy is built in the second traffic steering client; a second deactivation module 22 configured to deactivate the second traffic steering client in a case that the second traffic steering client is activated in the electronic device; and a third setting module 23 configured to set a traffic steering policy of the first traffic steering client as the kernel-mode traffic steering policy, to enable the first traffic steering client to steer traffic based on the kernel-mode traffic steering policy.

[0213] In an optional implementation, the apparatus further includes a second display module configured to display deactivation prompt information in the case that the second traffic steering client is activated in the electronic device, and the deactivation prompt information is used for prompting whether to deactivate the second traffic steering client in the electronic device for the

first traffic steering client. The second deactivation module is further configured to deactivate the second traffic steering client in the electronic device in a case that a confirmation operation of the deactivation prompt information is received.

[0214] In an optional implementation, the apparatus further includes: an interception module configured to intercept, in a case that an activation request for activation of the second traffic steering client in the electronic device is received after the traffic steering policy of the first traffic steering client is set as the kernel-mode traffic steering policy, an action of "activating the second traffic steering client in the electronic device according to the activation request".

[0215] In an optional implementation, the apparatus further includes: a third display module configured to display cancellation prompt information in a case that the activation request for activation of the second traffic steering client in the electronic device is received. The cancellation prompt information is used for prompting whether to cancel activation of the second traffic steering client in the electronic device for the first traffic steering client. The interception module is further configured to intercept the action of "activating the second traffic steering client in the electronic device according to the activation request" in a case that a confirmation operation of the cancellation prompt information is received.

[0216] In the present disclosure, whether the second traffic steering client is activated in the electronic device is detected. The kernel-mode traffic steering policy is built in the second traffic steering client. In the case that the second traffic steering client is activated in the electronic device, the second traffic steering client is deactivated. The traffic steering policy of the first traffic steering client is set as the kernel-mode traffic steering policy, to enable the first traffic steering client to steer traffic based on the kernel-mode traffic steering policy.

[0217] Through the present disclosure, after the second traffic steering client is deactivated in the electronic device, the second traffic steering client no longer runs in the electronic device. Thus, not a single traffic steering client in which the kernel-mode traffic steering policy is built is activated in the electronic device, and then, the case that "the second traffic steering client steers traffic in the kernel mode based on the kernel-mode traffic steering policy" does not occur.

[0218] In this way, there is no case that the second traffic steering client may affect "the first traffic steering client steering the traffic in the kernel mode". In this way, after the traffic steering policy of the first traffic steering client is set as the kernel-mode traffic steering policy, the first traffic steering client may steer the traffic based on the kernel-mode traffic steering policy, and the second traffic steering client does not cause the first traffic steering client to fail to steer the traffic that needs to be steered according to the traffic steering manner expected by the first traffic steering client. Thus, the traffic can be steered by the first traffic steering client according to the traffic

steering manner expected by the first traffic steering client. For example, the traffic "expected to be steered by the first traffic steering client" can be steered by the first traffic steering client in the user mode (for example, redirected in the user mode), and the abnormality of the service involved in the first traffic steering client will not be caused. Compatibility between the first traffic steering client and the second traffic steering client can be improved.

[0219] The embodiments of the present disclosure further provide a non-volatile readable storage medium. The storage medium stores one or more programs. When applied to a device, the one or more programs may cause the device to execute instructions of steps of the methods in the embodiments of the present disclosure.

[0220] The embodiments of the present disclosure provide one or more machine-readable media. The machine-readable media store instructions. When executed by one or more processors, the instructions cause an electronic device to perform one or more methods in the embodiments described above. In the embodiments of the present disclosure, the electronic device includes a server, a gateway, a sub-device, etc., and the sub-device is a device such as Internet of Things device.

[0221] The embodiments of the present disclosure may be implemented as an apparatus that uses any appropriate hardware, firmware, software, or their any combination to perform a desired configuration. The apparatus may include electronic devices such as a server (cluster) and a terminal device (such as an IoT device).

[0222] FIG. 8 illustratively shows an illustrative apparatus 1300 that may be used to implement the embodiments in the present disclosure.

[0223] For an embodiment, FIG. 8 shows an illustrative apparatus 1300. The apparatus has one or more processors 1302, a control module (chipset) 1304 coupled to at least one of the (one or more) processors 1302, a memory 1306 coupled to the control module 1304, a non-volatile memory (NVM)/storage device 1308 coupled to the control module 1304, one or more input/output devices 1310 coupled to the control module 1304, and a network interface 1312 coupled to the control module 1304.

[0224] The processor 1302 may include one or more single-core or multi-core processors, and the processors 1302 may include any combination of a general-purpose processor or a special-purpose processor (for example, a graphics processor, an application processor, and a baseband processor). In some embodiments, the apparatus 1300 may be used as a server device such as a gateway in the embodiments of the present disclosure.

[0225] In some embodiments, the apparatus 1300 may include one or more computer-readable media (for example, the memory 1306 or NVM/storage device 1308) having instructions 1314 and

one or more processors 1302 that are combined with the one or more computer-readable media and configured to execute the instructions 1314 to implement modules to perform actions in the present disclosure.

[0226] For an embodiment, the control module 1304 may include any suitable interface controller to provide any suitable interface for at least one of the (one or more) processors 1302 and/or any suitable device or component in communication with the control module 1304.

[0227] The control module 1304 may include a memory controller module, to provide an interface for the memory 1306. The memory controller module may be a hardware module, a software module, and/or a firmware module.

[0228] The memory 1306 may be used, for example, to load and store data and/or instructions 1314 for the apparatus 1300. For an embodiment, the memory 1306 may include any suitable volatile memory, such as a suitable DRAM. In some embodiments, the memory 1306 may include a double-data-rate fourth generation synchronous dynamic random access memory (DDR4SDRAM).

[0229] For an embodiment, the control module 1304 may include one or more input/output controllers, to provide an interface for the NVM/storage device 1308 and the (one or more) input/output devices 1310.

[0230] For example, the NVM/ storage device 1308 may be configured to store data and/or instructions 1314. The NVM/ storage device 1308 may include any suitable non-volatile memory (for example, a flash memory) and/or may include any suitable (one or more) non-volatile storage devices (for example, one or more hard disk drives (HDDs), one or more compact disk (CD) drives, and/or one or more digital versatile disk (DVD) drives).

[0231] The NVM/storage device 1308 may include storage resources that are physically part of the device on which the apparatus 1300 is installed, or may be accessible by the device but need not be part of the device. For example, the NVM/storage device 1308 may be accessed via the (one or more) input/output devices 1310 through a network.

[0232] The (one or more) input/output devices 1310 may provide an interface for the apparatus 1300, to communicate with any other suitable device, and the input/output devices 1310 may include a communication component, an audio component, a sensor component, etc. The network interface 1312 may provide an interface for the apparatus 1300 to communicate through one or more networks, and the apparatus 1300 may wirelessly communicate with one or more components of a wireless network according to any one of one or more wireless network standards and/or protocols, such as accessing a wireless network based on a communication standard, such as WiFi, 2G, 3G, 4G, 5G and the like, or their combinations.

[0233] For an embodiment, at least one of the (one or more) processors 1302 may be packaged with the logic of one or more controllers (for example, a memory controller module) of the control module 1304. For an embodiment, at least one of the (one or more) processors 1302 may be packaged with the logic of one or more controllers of the control module 1304 to form a system in package (SiP). For an embodiment, at least one of the (one or more) processors 1302 may be integrated with the logic of one or more controllers of the control module 1304 on the same die. For an embodiment, at least one of the (one or more) processors 1302 may be integrated with the logic of one or more controllers of the control module 1304 on the same die to form a system on chip (SoC).

[0234] In the embodiments, the apparatus 1300 may be, but is not limited to, a server, a terminal device such as a desktop computing device or a mobile computing device (for example, a laptop computing device, a handheld computing device, a tablet computer, and a netbook). In the embodiments, the apparatus 1300 may have more or fewer components and/or different architectures. For example, in some embodiments, the apparatus 1300 includes one or more cameras, a keyboard, a liquid crystal display (LCD) screen (including a touch screen display), a non-volatile memory port, a plurality of antennas, a graphics chip, an application specific integrated circuit (ASIC), and a speaker.

[0235] The embodiments of the present disclosure provide an electronic device. The electronic device includes one or more processors, and one or more machine-readable media storing instructions. When executed by one or more processors, the instructions cause an electronic device to perform one or more methods in the present disclosure.

[0236] The embodiments of the present disclosure provide a computer program product. When instructions in the computer program product are executed by a processor of an electronic device, the electronic device is caused to perform one or more methods of the present disclosure.

[0237] As for the apparatus embodiments, since they are basically similar to the method embodiments, description is relatively simple, and reference can be made to partial description of the method embodiments for relevant contents.

[0238] The embodiments of the description are described in a progressive mode, each embodiment focuses on the difference from other embodiments, and the same and similar parts between the examples can refer to each other.

[0239] The embodiments of the present disclosure are described with reference to the flowcharts and/or block diagrams of the methods, the terminal devices (systems), and the computer program products according to the embodiments of the present disclosure. It should be understood that each flow and/or block in the flowcharts and/or block diagrams and a combination of the flows and/or

blocks in the flowcharts and/or block diagrams can be implemented through computer program instructions. These computer program instructions may be provided for a processor of a general-purpose computer, a special-purpose computer, an embedded processing machine, or other programmable information processing terminal devices to produce a machine, such that instructions executed by the processor of the computer or other programmable information processing terminal devices generate an apparatus configured to implement a function or functions specified in one or more flows of the flowcharts and/or one or more blocks of the block diagrams.

[0240] These computer program instructions may alternatively be stored in a computer-readable memory that may guide the computer or other programmable information processing terminal devices to operate in a specific mode, such that the instructions stored in the computer-readable memory produce an article of manufacture including an instruction apparatus, and the instruction apparatus implements the function or functions specified in one or more flows of the flowcharts and/or one or more blocks in the block diagrams.

[0241] These computer program instructions may further be loaded onto the computer or other programmable information processing terminal devices, such that a series of operation steps are performed on the computer or other programmable terminal devices to generate computer-implemented processing, and the instructions executed on the computer or other programmable terminal devices provide steps for implementing the function or functions specified in the one or more flows of the flowcharts and/or one or more blocks in the block diagrams.

[0242] Although the preferred embodiments of the embodiments of the present disclosure have been described, additional alterations and modifications can be made to those embodiments by those of ordinary skill in the art once the basic inventive concepts are learned. Thus, the appended claims are intended to be constructed to include the preferred embodiments and all alterations and modifications that fall within the scope of the embodiments of the present disclosure.

[0243] In the end, it should be further noted that in the description, relational terms such as first and second are merely used to distinguish one entity or one operation from another entity or another operation, and do not necessarily require or imply any such actual relation or order among these entities or operations. In addition, the terms “comprise”, “include” or their any variations are intended to be non-exclusive, such that a process, method, article, or terminal device that includes a series of elements not only includes those elements, but includes other elements not listed clearly, or further includes elements inherent to such process, method, article, or terminal device. In a case of no more limitation, an element limited with the phrase “comprise a/an/one ...” or “include a/an/one...” does not exclude other identical elements existing in the process, method, product, or terminal device including the element.

[0244] The methods and apparatuses for traffic management according to the present disclosure are described in detail above. Specific instances are used herein to explain the principles and implementations of the present disclosure. The description above of the embodiments merely intends to help understand the methods of the present disclosure and their core ideas. Modifications may be made by those of ordinary skill in the art to specific implementations and the application scope in accordance with the ideas of the present disclosure. To sum up, the contents of the description should not be understood as limitation to the present disclosure.