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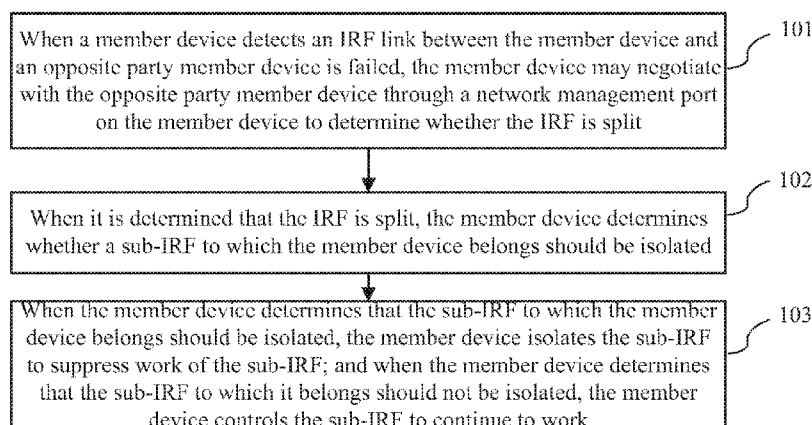


FIG.1

(57) Abstract: In an example, a method for preventing multiple stacks from conflicting is implemented on a member device in an intelligent resilient framework (IRF). When the member device detects that an IRF link between the member device and an opposite party member device is failed, the member device may negotiate with the opposite party member device through a network management port on the member device to determine whether the IRF is split. When it is determined that the IRF is split, the member device determines whether a sub-IRF to which the member device belongs should be isolated. The sub-IRF is one of IRFs split from the IRF. When it is determined that the sub-IRF should be isolated, the member device isolates the sub-IRF to suppress work of the sub-IRF. When it is determined that the sub-IRF should not be isolated, the member device controls the sub-IRF to continue to work.



PREVENTING MULTIPLE CONFLICTING STACKS

BACKGROUND

[0001] An IRF connects multiple devices together through IRF ports on the devices, and virtualizes the devices into a combined device. This combined device is referred to as an IRF, and the devices in the IRF are referred to as member devices. This combined device (i.e., IRF) is also sometimes called a stack.

[0002] The member devices in the IRF may elect one of the member devices as a master device, and the remaining member devices are standby devices.

BRIEF DESCRIPTION OF DRAWINGS

[0003] Various examples will be described below by referring to the following figures:

[0004] FIG.1 is a flowchart illustrating a method for preventing multiple conflicting stacks provided according to examples of the present disclosure;

[0005] FIG.2 is a schematic diagram illustrating an IRF in a method for preventing multiple conflicting stacks provided according to examples of the present disclosure;

[0006] FIG.3 is a flowchart illustrating a method for preventing multiple conflicting stacks provided according to examples of the present disclosure;

[0007] FIG.4 is a schematic diagram illustrating an IRF in a method for preventing multiple conflicting stacks provided according to examples of the present disclosure;

[0008] FIG.5 is a schematic diagram illustrating an IRF in a method for preventing multiple conflicting stacks provided according to examples of the present disclosure; and

[0009] FIG.6 is a schematic diagram illustrating a structure of an apparatus for preventing multiple conflicting stacks provided according to examples of the present disclosure.

DETAILED DESCRIPTION

[0010] In an IRF, multiple member devices in the IRF form a logic device. This logic device has a three-layer network configuration, e.g., an IP address. However, the IRF may be split into two new IRFs because a logic stack port on a member device of the IRF is abnormal, e.g., the logic stack port being down. Member devices in the two new IRFs will inherit configurations of the original logic device separately, and the two new IRFs may have a same three-layer network configuration, e.g., a same IP address. In such a case, two independent conflicting IRFs with the same three-layer network configuration are present in the network. Multiple independent conflicting IRFs present in the network can cause an abnormal network service, e.g., routing vibration.

[0011] In view of the foregoing, a method for preventing multiple stacks from conflicting is provided according to examples of the present disclosure, to detect multiple independent conflicting IRFs present in the network, and isolate redundant IRFs generated after splitting of an IRF from the network.

[0012] Fig.1 is a flowchart illustrating a method for preventing multiple conflicting stacks provided according to examples of the present disclosure. The flow may be applied for any member device in an IRF. As shown in Fig.1, the flow may include the following blocks.

[0013] In block 101, when a member device detects an IRF link between the member device and an opposite party member device is failed, the member device may negotiate with the opposite party member device through a network management port on the member device to determine whether the IRF is split.

[0014] Member devices in the IRF may be various kinds of network communication devices, e.g., switches. The opposite party member device for example may be another member device in the IRF that is directly connected with the member device through IRF ports. The IRF link is a link established between an IRF port on the member device and an IRF port on the opposite party member device. The IRF ports are used for IRF connection among the member devices, and are used to transmit data and protocol packets among the member devices in the IRF. An IRF port on a member device may take effect

after being bound to physical ports on the member device. One IRF port may be bound to multiple physical ports. Each member device may be configured with two IRF ports, e.g. IRF-Port1 and IRF-Port2. For example, a physical port bound to IRF-Port1 on a member device may be connected with a physical port bound to IRF-Port2 on a neighbouring member device. The physical ports may be Ethernet interfaces, optical interfaces, etc.

[0015] The network management port may also be a physical interface on the member device, e.g., a registered jack 45 (RJ45) interface, and may be used to communicate with network management software or update a version of software on the member device.

[0016] In the block 101, as an example, the IRF link between the member device and the opposite party member device may be failure under (but not limited to) the following two situations: situation 1, the IRF port on the member device is down; and situation 2, the IRF port on the opposite party member device directly connected with the IRF port on the member device is down. As an example, when all physical ports bound to the IRF port on the member device or bound to the IRF port on the opposite party member device are down, the IRF port on the member device or the IRF port on the opposite party member device is down.

[0017] How the member device negotiates with the opposite party member device through the network management port on the member device to determine whether the IRF is split will be described in detail in the following.

[0018] In block 102, when it is determined that the IRF is split, the member device determines whether a sub-IRF to which the member device belongs should be isolated.

[0019] In the present block 102, the sub-IRF to which the member device belongs is one of IRFs split from the IRF. How the member device determines whether the sub-IRF to which the member device belongs should be isolated will be described in detail in the following.

[0020] In block 103, when the member device determines that the sub-IRF to which

the member device belongs should be isolated, the member device isolates the sub-IRF to suppress work of the sub-IRF; and when the member device determines that the sub-IRF to which it belongs should not be isolated, the member device controls the sub-IRF to continue to work.

[0021] Providing the block 103, the method may ensure that one sub-IRF after splitting of the IRF may continue to work while remaining sub-IRFs are suppressed, which may prevent multiple conflicting stacks from being present in the network.

[0022] It is to be noted, that in the examples of the present disclosure, the network management ports on the member devices may be coupled to each other. For example, the network management ports on member devices may be connected to hubs respectively, and then communicate with each other through the hubs. Besides of this, they may be coupled to each other in other ways, as long as they can communicate with each other, which will not be elaborated herein.

[0023] In the following, the flow shown in Fig.1 will be described in detail by examples.

[0024] For example, the IRF may include two member devices in which one is a master device, and the other is a standby device. When the IRF operates properly, only a network management port on the master device operates properly (referred to as “up”), e.g., outputting IRF network topology information to a network management controller centre, and a network management port on the standby device in the IRF is in deactivated status (inactive status). The network management controller centre for example may be a computer that manages the member devices in the network.

[0025] Based on this, in the block 101 of Fig.1, the member device negotiates with the opposite party member device through the network management port on the member device to determine whether the IRF is split as follows, e.g., by a bidirectional forwarding detection (BFD) approach or an address resolution protocol (ARP) approach.

[0026] As an example, when the member device serves as the master device in the

IRF, the member device may initiate a BFD session through the network management port towards the network management port on the opposite party member device. If the initiated BFD session is successfully established, the member device determines that the IRF is split, or if the initiated BFD session is not established successfully, the member device determines that the IRF is not split.

[0027] BFD is a general-purpose, standard, medium-and-protocol-independent fast failure detection mechanism, used to detect connectivity of links in an IP network. The network management ports on the member devices are configured within a VLAN, and each of them is configured with a different IP address. Since if there are multiple member devices in an IRF, only one network management port on one member device is up, when a BFD session is triggered merely because of the IRF link between the member device and the opposite party member device being failed, because the network management port on the opposite party member device is down, the BFD session cannot be established between the two member devices. However, if the member device and the opposite party member device is split, both the network management ports on the two member devices will be up, and establishment of a BFD session can be completed. In this way, splitting between the two member devices is determined.

[0028] When the member device serves as the standby device of the IRF, the member device may activate the network management port, and initiate a BFD session through the activated network management port towards the network management port on the opposite party member device. If the initiated BFD session is established successfully, the member device determines that the IRF is split, and if the initiated BFD session cannot be established successfully, the member device determines that the IRF is not split.

[0029] Through the foregoing description for the block 101 regarding how the member device negotiates with the opposite party member device through the network management port on the member device to determine whether the IRF is split, it can be seen that no matter whether a member device in the IRF is the master device or is the standby device, the member device may automatically determine whether the IRF is split after the IRF link is failed.

[0030] As an example, in the block 102, the member device may determine whether the sub-IRF to which the member device belongs should be isolated as follows.

[0031] When the member device serves as the standby device of the IRF, the member device determines that the sub-IRF to which the member device belongs should be isolated; and when the member device serves as the master device of the IRF, the member device determines that the sub-IRF to which the member device belongs should not be isolated.

[0032] As an example, in the above block 103, the member device may isolate the sub-IRF to which it belongs to suppress work of the sub-IRF by blocking all ports on the member device, e.g., service ports with network traffics, except for the network management port on the member device.

[0033] In the block 103, the member device may control the sub-IRF to which the member device belongs to continue to work by continuing to work as the role of master device.

[0034] As is seen from the description for the block 101 through the block 103, finally one sub-IRF after splitting of the IRF will not be isolated, and can continue to work in the network, while remaining sub-IRFs should be isolated and cannot work in the network. In this way, multiple conflicting stacks may be prevented from being present in the network.

[0035] Fig.2 is a schematic diagram illustrating an IRF in a method for preventing multiple conflicting stacks according to examples of the present disclosure. For descriptive purpose, an IRF before splitting shown in Fig.2 is referred to as IRF 20. In the IRF 20, member device 1 is a master device of the IRF 20, and member device 2 is a standby device of the IRF 20. As is shown in Fig.2, the member device 1 is directly connected with an IRF port 221 on the member device 2 through an IRF port 211 on the member device 1. When the IRF 20 operates properly, a network management port 212 on the member device 1 operates properly, e.g., outputting network topology information

of the IRF 20 to a network management controller centre. A network management port 222 on the member device 2 is in deactivated status (also referred to as inactive).

[0036] When the IRF port 211 on the member device 1 is down (similar principle applies for a situation where the IRF port 221 on the member device 2 is down), since there is only one IRF port on the member device 1, i.e., the IRF port 211, the member device 1 may initiate a request for establishing a BFD session between the network management port 212 and the network management port 222 through the network management port 212. When the BFD session between the network management port 212 and the network management port 222 is established successfully, the member device 1 determines that the IRF 20 is split.

[0037] Because the IRF port 221 on the member device 2 is directly connected with the IRF port 211 on the member device 1, the member device 2 will know that the IRF port 211 on the member device 1 is down. When the member device 2 knows that the IRF port 211 is down, it will determine that the IRF port 221 is down accordingly. Based on this, the member device 2 may activate the network management port 222, and trigger establishment of a BFD session between the activated network management 222 on the member device 2 to the network management 212 on the member device 1 through the activated network management port 222. When the BFD session is established successfully, the member device 2 determines that the IRF 20 is split.

[0038] After the member device 1 and the member device 2 determine that the IRF 20 is split, for description purpose, here an IRF where the member device 1 is currently located is referred to as IRF 21 and an IRF where the member device 2 is currently located is referred to as IRF 22.

[0039] Because the member device 1 serves as a master device of the IRF 20 before splitting, then the member device 1 determines that the IRF 21 to which it currently belongs should not be isolated, and the member device 1 continues to work as the role of master device, e.g., forwarding packets to other member devices in the IRF 21, if any.

[0040] Because the member device 2 serves as a standby device of the IRF 20 before

splitting, the member device 2 determines that the IRF 22 to which it currently belongs should be isolated, and then the member device 2 blocks ports which are up on it except for the network management port 222 (this action is equivalent to isolating the member device 2 from the network to prohibit the member device 2 from forwarding packets).

[0041] As is seen from the foregoing example, even if the IRF 20 is split, the IRF 21 and the IRF 22 generated after splitting of the IRF 20 do not all continue to work, but only the IRF 21 is working. In this way, multiple independent conflicting IRFs will not be present in the network, and an abnormal network service, e.g., routing vibration, will not be caused.

[0042] According to an example, an IRF may include two or more member devices.

[0043] Before the IRF is split, respective member devices in the IRF should collect and store network topology information of the IRF. Network topology information may include the number of the member devices in the IRF, and may include bridge MAC addresses of the respective member devices in the IRF too, which is not the emphasis of the present example of the present disclosure and will not be elaborated here. In addition, in the present example, network topology information in the IRF may be collected for example by a member device exchanging Hello packets with a directly connected neighbouring member device, which will not be elaborated here.

[0044] Based on the foregoing, in the block 101, the process that the member device negotiates with the opposite party member device through the network management port on the member device to determine whether the IRF is split may include the process shown in Fig.3.

[0045] Fig.3 is a flowchart illustrating a method for preventing multiple conflicting stacks provided according to examples of the present disclosure. The method includes the following blocks.

[0046] In block c1, when the member device serves as a master device of the IRF, it may send an address resolution protocol (ARP) detection packet through a network management port, or when the member device serves as a standby device of the IRF, it

may activate a network management port and send an ARP detection packet through the activated network management port. Here, the ARP detection packet may be a gratuitous ARP, or other ARP packets, which will not be limited herein.

[0047] In block c2, the member device checks whether it receives an ARP detection response packet from an opposite member device before the IRF link is failed within a preset period of time after it sends out the ARP detection packet, and if not, then the member device determines that the IRF is not split, or if yes, then block c3 is performed.

[0048] Because an ARP packet is a broadcast packet, after one member device sends out an ARP packet, all other member devices whose network management ports are up within a same virtual local area network (VLAN) with the member device can receive the ARP packet. When the IRF has not been split, since only the network management port on the master device is up, and the network management ports on the standby devices are down, an ARP sent out from the master device will not be received by the standby devices. However, if the IRF is split, a standby device may become a master device, and a network management port on the standby device will be up, and the ARP packet sent out from the master device will be received by this new master device. Since both of the member devices have same configurations, and IP fields in the ARP packets sent from them are same, when the new master device receives the ARP packet, it will respond by an ARP response packet, to tell the original master device that there is IP collision. In this way, when the original master device receives the ARP response packet, it will determine that the IRF is split.

[0049] Here, if within the preset period of time after the member device sends out the ARP detection packet, the member device has not received an ARP detection response packet from the opposite party member device connected before failure of the IRF link, then this means that the opposite party member device may power down, and further means that the reason that the IRF link between the IRF port on the present member device and the IRF port on the opposite party member device is failed is power down of the opposite party member device. Therefore, if the member device detects that it has not received the ARP detection response packet sent from the opposite party member device connected before failure of the IRF link, the member device determines that the IRF is not split.

[0050] It is to be noted that in the present example, the preset period of time may be configured in advance according to network conditions, e.g., the preset period of time being set to 10 seconds.

[0051] In block c3, the member device re-collects network topology information in the IRF where it is currently located, and compares the number of member devices included in stored network topology information and the number of member devices included in re-collected network topology information. If they are not identical, then the member device determines that the IRF is split, or if they are identical, the member device determines that the IRF is not split.

[0052] The present block c3 is performed when the member device detects that it receives the ARP detection response packet from the opposite party member device connected before the IRF link is failure within the preset period of time after it sends out the ARP detection packet. If the member device receives the ARP detection response packet from the opposite party member device, this may be because the IRF is split, or not, for example, because the member devices in the IRF are connected from in a ring shape to in an IRF link shape. Therefore, the block c3 should be performed.

[0053] For example, in the block c3, if it is determined after comparison that the number of member devices included in stored network topology information is identical to the number of member devices included in network topology information re-collected, this means that the member devices in the IRF are connected from in a ring shape to in an IRF link shape, and the IRF is not split.

[0054] In the present example, for example, in the block 102, the member device may determine whether the sub-IRF to which it belongs should be isolated according to the following process.

[0055] The member device compares M which is the number of member devices included in re-collected network topology information and N which is one half of the number of member devices included in stored network topology information,

if after comparison, the member device determines that M is smaller than N, the member device determines that the sub-IRF to which it belongs should be isolated;

if after comparison, the member device determines that M is larger than N, the member device determines that the sub-IRF to which it belongs should not be isolated; or

if after comparison, the member device determines that M is equal to N, then the member device identifies whether a master device before splitting of IRF is present in the sub-IRF to which the member device belongs, and if not, the member device determines that the sub-IRF to which it belongs should be isolated, or if yes, the member device determines that the sub-IRF to which it belongs should not be isolated.

[0056] In the present example, for example, in the block 103, the member device may isolate the sub-IRF to which it belongs to suppress work of the sub-IRF by blocking all ports on the member device except for the network management port on the member device, and notifying all other member devices in the sub-IRF to which the member device belongs to block their ports except for network management ports on them.

[0057] In the present example, for example, in the block 103, the member device controls the sub-IRF to which it belongs to continue to work by the following operations.

[0058] When the member device determines that M is larger than N after comparison, the member device identifies whether a master device of the IRF before splitting is present in the sub-IRF to which the member device currently belongs. If yes, the member device controls all the member devices within the sub-IRF to which it belongs to work as same roles as they are before splitting of the IRF, and if no, the member device and the other member devices in the sub-IRF elect a master device, and work as their roles had after the election.

[0059] When the member device determines that M is equal to N after comparison, the member device controls all the member devices in the sub-IRF to which it belongs to work as same roles as they are before splitting of the IRF.

[0060] Here the member device controlling all the member devices in the sub-IRF to work as same roles as they are before splitting of the IRF includes:

when the member device is a master device of the IRF before splitting, the member device working as the master device, and notifying other member devices in the sub-IRF to work as standby devices; and

when the member device is a standby device of the IRF before splitting, the member device working as a standby device, notifying a master device of the IRF before splitting which is currently present in the sub-IRF to which the member device belongs to work as a master device, and notifies standby devices of the IRF before splitting which are currently present in the sub-IRF to which the member device belongs to work as standby devices.

[0061] As can be seen from the foregoing description, finally, one of the sub-IRFs after splitting of the IRF will not be isolated, and it may continue to work in the network, but remaining sub-IRFs should be isolated, and cannot work in the network, which prevents multiple conflicting stacks being present in the network.

[0062] Fig.4 is a schematic diagram illustrating an IRF in a method for preventing multiple conflicting stacks provided according to examples of the present disclosure. For description purpose, the IRF before splitting is referred to as IRF 40. The IRF 40 for example may include three member devices: member devices 1, 2, and 3. The member device 1 for example is a master device of the IRF 40, and the member devices 2 and 3 for example are standby devices of the IRF 40. In the IRF 40, an IRF port 411 on the member device 1 is directly connected with an IRF port 421 on the member device 2, and the IRF port 422 on the member device 2 is directly connected with an IRF port 431 on the member device 3. The member devices 1, 2, and 3 are located in a same VLAN, for example.

[0063] Before the IRF 40 is split, network topology information of the IRF 40 collected respectively by the member devices 1 through 3 are same. For example, network topology information includes information that the number of member devices in the network topology is 3, and the member devices are member devices 1 through 3.

[0064] When the IRF port 411 on the member device 1 is down (similar principle applies to situations where the IRF ports on other member devices are down), this means that an IRF link between the IRF port 411 on the member device 1 and the IRF port 421 on the member device 2 is down. According to the description for the block 101 in the present example, the member device 1 broadcasts an ARP detection packet through a network management port 412 within the VLAN.

[0065] Because the IRF port 421 on the member device 2 is directly connected with the IRF port 411 on the member device 1, the member device 2 will know that the IRF port 411 on the member device 1 is down. When the member device 2 knows that the IRF port 411 on the member device 1 is down, it will determine that the IRF port 421 directly connected with the IRF port 411 is down accordingly. When the member device 2 determines that the IRF port 421 is down, it will activate a network management port 423 according to the description for the block 101. After the member device 2 activates the network management port 423, on one hand, the member device 2 may broadcast an ARP detection packet within the VLAN through the activated network management port 423, and on the other hand, the member device will receive an ARP detection packet sent from the member device 1 through the activated network management port 423.

[0066] Since no IRF port on the member device 3 is down, and the member device 3 is not directly connected with the member device 1, the member device 3 will not know that the IRF port 411 is down. Therefore, according to the description for the block 101, the member device 3 will not activate a network management port, and will not send and receive an ARP detection packet either.

[0067] The member device 1 also receives an ARP detection packet from the member device 2 through the network management port 412.

[0068] Assume that the IRF port 411 is down not because of power down of the member device 1, but because of reasons such as instable network conditions. Then after the member device 1 or the member device 2 receives an ARP detection packet, it will return back an ARP detection response packet through the network management port 412 or 413 via a path from which the ARP detection packet is received.

[0069] If the member device 1 detects that it receives an ARP detection response packet within a preset period of time after it sends out an ARP detection packet, then the member device 1 re-collects network topology information of an IRF where it is located currently. Assume that network topology information re-collected shows that the number of member devices in the network topology is 1, which means that only the member device 1 itself is in the IRF.

[0070] If the member device 2 detects that it receives an ARP detection response packet within the preset period of time after it sends out the ARP detection packet, then it will re-collects network topology information of an IRF where it is located currently. If network topology information re-collected shows that the number of member devices in the network topology is 2, which means that the member devices are the member devices 2 and 3.

[0071] After comparison, the member device 1 determines that the number of the member devices in stored network topology information (being 3) is not identical to the number of the member devices in re-collected network topology information (being 1), and the member device 1 determines that the IRF 40 is split.

[0072] After comparison, the member device 2 determines that the number of the member devices in stored network topology information (being 3) is not identical to the number of the member devices in re-collected network topology information (being 2), the member device 1 determines that the IRF 40 is split.

[0073] When the member device 1 determines that the IRF 40 is split, for description purpose, the sub-IRF where the member device 1 is located after the IRF 40 is split is referred to as IRF 41, and the sub-IRF where the member devices 2 and 3 are located is referred to as IRF 42.

[0074] The member device 1 finds that the number of the member devices in network topology information of the IRF 41 re-collected is smaller than one half of the number of the member devices in network topology information of the IRF 40 stored, then the member device 1 determines that the IRF 41 should be isolated, and the member device 1 blocks all ports except for the network management port 412, which is equivalent to isolation of the IRF 41 from the network.

[0075] When the member device 2 finds that the number of member devices in network topology information of the IRF 42 re-collected is larger than one half of the number of the member devices in network topology information of the IRF 40 stored, the member device 2 determines that the IRF 42 should not be isolated. Then, the member device 2 identifies whether a master device of the IRF 40 before splitting is present in the IRF 42 where it is currently located. If the member device 2 finds that the master device

of the IRF 40 before splitting is not present in the IRF 42, then the member device 2 and the member device 3 in the IRF 42 elect to be master device. Assuming that the member device 2 is elected to be master device, then the member device 2 works as a master device, and the member device 2 notifies the member device 3 in the IRF42 to work as a standby device.

[0076] It can be seen that, though IRF 40 is split, IRF 41 and IRF 42 after splitting of the IRF 40 do not all continue to work, but only IRF 42 works. Therefore, there will not be multiple independent conflicting IRFs in the network, which further will not cause an abnormal network service, such as routing vibration.

[0077] Take the IRF shown in Fig.5 as an example. Fig.5 is a schematic diagram illustrating an IRF in a method for preventing multiple conflicting stacks according to examples of the present disclosure. For description purpose, the IRF before splitting in Fig.5 is referred to as IRF 50. For example, there are four member devices in the IRF 50: Member device 1 through member device 4.

[0078] The member device 1 is a master device of the IRF50, and the member devices 2 through 4 are standby devices of the IRF50. In the IRF50, an IRF port 511 on the member device 1 is directly connected with an IRF port 522 on the member device 2, and an IRF port 521 on the member device 2 is directly connected with an IRF port 532 on the member device 3, and an IRF port 531 on the member device 3 is directly connected with an IRF port 542 on the member device 4, and an IRF port 541 on the member device 4 is directly connected with an IRF port 512 on the member device 1.

[0079] Before splitting of IRF 50, network topology information of the IRF 50 collected by the member devices 1 to 4 are same, e.g., the number of member devices in the network topology being 4, and the member devices being member devices 1 to 4.

[0080] When the IRF port 511 on the member device 1 is down (similar principle applies for situations where IRF ports on other member devices are down), this means that an IRF link between the IRF port 511 on the member device 1 and the IRF port 522 on the member device 2 is failed. According to the description for the block 101 in the present example, the member device 1 may broadcast an ARP detection packet through a network management port 513.

[0081] Because the IRF port 522 on the member device 2 is directly connected with the IRF port 511 on the member device 1, the member device 2 will know that the IRF port 511 on the member device 1 is down. When the member device 2 knows that the IRF port 511 on the member device 1 is down, it will determine that the IRF port 522 is also down. When the member device 2 determines that the IRF port 522 is down, according to the description for the block 101, the member device 2 activates a network management port 523. After the member device 2 activates the network management port 523, the member device 2 on one hand will broadcast an ARP detection packet through this activated network management port 523, and on the other hand, will receive an ARP detection packet sent from the member device 1 through the activated network management port 523.

[0082] Because no IRF port on the member device 3 and the member device 4 is down, and because IRF ports on them are not directly connected with the IRF port 511, then they will not know that the IRF port 511 is down. Therefore, according to the description for the block 101, the member device 3 and the member device 4 will neither activate network management ports on them, nor send and receive an ARP detection packet.

[0083] The member device 1 will also receive an ARP detection packet from the member device 2 through the network management port 513.

[0084] Assume that the IRF port 511 on the member device 1 being down is not because of power down of the member device 1, but because of reasons such as network instability. Then, after the member device 1 or the member device 2 receives an ARP detection packet, it will return an ARP detection response packet following a transmission path of the received ARP detection packet through the network management port 513 or 523.

[0085] If the member device 1 detects that it receives an ARP detection response packet within a preset period of time after it sends the ARP detection packet, then the member device 1 may re-collect network topology information of an IRF where it is located currently. Assume that re-collected network topology information indicates that the number of member devices in the network topology is 4, and the member devices are

the member devices 1 to 4.

[0086] If the member device 2 detects that it receives an ARP detection response packet within a preset period of time after it sends the ARP detection packet, then the member device 2 may re-collect network topology information of an IRF where it is located currently. Assume that the number of member devices in re-collected network topology information is 4, and the member devices are the member devices 1 to 4.

[0087] After comparison, the member device 1 or the member device 2 may find that the number of member devices in network topology information stored (being 4) and the number of member devices in re-collected network topology information are same. Then the member device 1 or the member device 2 determines that the IRF 50 is not split, but the member devices in IRF 50 is connected from in a ring shape to in an IRF link shape such as the IRF 51 in Fig.5.

[0088] With respect to the IRF 51 shown in Fig.5, assume that the IRF port 542 on the member device 4 is down, which means that the IRF link between the IRF port 542 on the member device 4 and the IRF port 531 on the member device 3 is down. Then according to the description for the block 102 in the present example, the member device 4 activates the network management port 543, and broadcasts an ARP detection packet through the activated network management port 543.

[0089] Because the IRF port 531 on the member device 3 is directly connected with the IRF port 542 on the member device 4, the member device 3 will know that the IRF port 542 on the member device 4 is down. When the member device 3 knows that the IRF port 542 on the member device 4 is down, it determines that the IRF port 531 which is directly connected with the IRF port 542 is down. When the member device 3 determines that the IRF port 531 is down, according to the description for the block 101 in the present example, the member device 3 activates the network management port 533. After the member device 3 activates the network management port 533, on one hand, it may broadcast an ARP detection packet through the activated network management port 533, and on the other hand, it may receive an ARP detection packet from the member device 4 through the activated network management port 533. The member device 4 will also receive the ARP detection packet broadcasted by the member device 3.

[0090] As is described in the foregoing, since the member device 1 is a master device of the IRF 51, the network management port 513 is always up, and since when the member device 2 knows that the IRF port 511 on the member device 1 is down, the network management port 523 is also activated, i.e., being up. Thus, the member devices 1 and 2 also receive ARP detection packets from the member device 3 and the member device 4, and return ARP detection response packets following paths in which the ARP detection packets are received.

[0091] Assume that the IRF port 542 is down not because of power down of the member device 4, but because of reasons such as network instability. Then after the member device 3 or the member device 4 receives an ARP detection packet, it will return an ARP detection response packet through the network management port 543 or 533 following a path in which the ARP detection packet is received.

[0092] After the member device 4 detects that it receives an ARP detection response packet within a preset period of time after it sends the ARP detection packet, then the member device re-collects network topology information of an IRF where it is located currently. Assume that the number of member devices in network topology information re-collected by the member device 4 is 2, and the member devices are the member device 1 and the member device 4.

[0093] After the member device 3 detects that it receives an ARP detection response packet within a preset period of time after it sends the ARP detection packet, it will re-collect network topology information of an IRF where it is located currently. Assume that the number of member devices in network topology information re-collected by the member device 3 is 2, and the member devices are the member device 2 and the member device 3.

[0094] After comparison, the member device 4 or the member device 3 may find that the number of member devices in network topology information stored (is 4) and the number of member devices in network topology information re-collected (is 2) are not identical, the member device 4 or the member device 3 will determine that the IRF 51 shown in Fig.5 is split.

[0095] After the member device 4 determines that the IRF 51 is split, for description

purpose, an IRF where the member device 4 is currently located after splitting of IRF 51 is referred to as IRF 52. The IRF 52 also includes the member device 1. An IRF where the member device 3 is currently located is referred to as IRF 53, and the IRF 53 also includes the member device 2.

[0096] The member device 4 finds that the number of member devices in network topology information of the IRF 52 re-collected is equal to one half the number of member devices in network topology information of the IRF 51 stored; and the member device 3 also finds that the number of member devices in the network topology information of the IRF 53 re-collected is equal to one half of the number of the member devices in the network topology information of the IRF 51 stored.

[0097] According to the foregoing description, the member device 4 identifies whether a master device of the IRF 51 before splitting is present in the IRF 52 where the member device 4 is currently located, and then the member device 4 finds that the master device of the IRF 51 before splitting, i.e., the member device 1, is present in the IRF 52. Then the member device 4 determines that the IRF 52 should not be isolated, and controls all the member devices in the IRF 52 to work as roles as they are before the IRF 51 is split. That is, because the member device 1 is a master device in the IRF 51, then the member device 1 will work as a master device, and because the member device 4 is a standby device in the IRF 51, the member device 4 will work as a standby device.

[0098] The member device 3 identifies whether a master device of the IRF 51 before splitting is present in the IRF 53 where the member device 3 is currently located, and the member device 3 finds that no master device of the IRF 51 before splitting is present in the IRF 53. Then, the member device 3 determines that the IRF 53 should be isolated. Thus, the member device 3 blocks all ports on it except for the network management port 533, and blocks all ports on the member device 2 except for the network management port 523 in the IRF 53 where it is currently located, i.e., isolating the IRF 53 from the network.

[0099] It can be seen from the foregoing, though the IRF 51 is split, the IRF 52 and IRF 53 generated from splitting of the IRF 51 do not all work, but only the IRF 52 works. Thus, there will not be multiple independent conflicting IRFs present in the network,

which will not cause an abnormal network service, such as routing vibration.

[00100] It is to be specified that in the foregoing example, after a member device that determines splitting of an IRF determines that the IRF is split, it will replace previously stored network topology information with re-collected network topology information. After an IRF port which was down restores to be normal, an IRF before splitting IRF is restored. This way of restoration is similar to initial establishment of the IRF.

[00101] The method provided according to the embodiments of the present disclosure has been introduced in the foregoing. In the following, corresponding apparatus provided according to the embodiments of the present disclosure will be described.

[00102] Fig.6 is a schematic diagram illustrating a structure of an apparatus for preventing multiple conflicting stacks provided according to examples of the present disclosure. The apparatus is implemented on a member device in an IRF. As shown in Fig.6, the apparatus 60 may include a processor 70 and a memory 80. The processor 70 and the memory 80 for example are connected and communicate with each other through a bus. The memory 80 for example, is a non-transitory storage medium. On the memory 70, the following instructions executable by the processor 70 are stored.

[00103] Negotiation instruction 61 is to negotiate with an opposite party member device through a network management port on the member device to determine whether the IRF is split, in response to detecting that an IRF link between the member device and the opposite party member device is failed.

[00104] A determination instruction 62 is to determine whether a sub-IRF to which the member device belongs should be isolated in response to the negotiation instruction determining that the IRF is split; the sub-IRF is one of IRFs split from the IRF.

[00105] A processing instruction 63 is to isolate a sub-IRF to suppress work of the sub-IRF in response to the determination instruction determining that the sub-IRF should be isolated; and control the sub-IRF to continue to work in response to the determination instruction determining that the sub-IRF should not be isolated.

[00106] For example, the IRF may include two member devices.

[00107] The negotiation instruction 61 negotiates with the opposite member device through the network management port on the member device to determine whether the IRF is split by the following procedures, e.g., using a BFD approach or an ARP approach.

[00108] When the member device is a master device of the IRF, the negotiation instruction 61 may initiate a BFD session through the network management port on the member device to a network management port on the opposite party member device. In response to determining that the initiated BFD session is established successfully, the negotiation instruction 61 determines that the IRF is split, and in response to determining that the initiated BFD session is not established successfully, the negotiation instruction determines that the IRF is not split.

[00109] When the member device is a standby device of the IRF, the negotiation instruction 61 may activate the network management port on the member device, and initiate the BFD session through the activated network management port to the network management port on the opposite party member device. In response to determining that the initiated BFD is established successfully, the negotiation instruction 61 determines that the IRF is split, and in response to determining that the initiated BFD is not established successfully, the negotiation instruction 61 determines that the IRF is not split.

[00110] For example, the determination instruction 62 determines whether the sub-IRF should be isolated by the following procedures.

[00111] When the member device is a standby device of the IRF, the determination instruction 62 determines that the sub-IRF should be isolated.

[00112] When the member device is a master device of the IRF, the determination instruction 62 determines that the sub-IRF should not be isolated.

[00113] The processing instruction 63 may isolate the sub-IRF to suppress work of the sub-IRF by blocking all ports on the member device except for the network management port on the member device.

[00114] The processing instruction 63 may control the sub-IRF to continue to work by controlling the member device to continue to work as a master device.

[00115] For example, the apparatus 60 may further include:

a collection instruction 64 to collect network topology information of the IRF, and network topology information includes the number of member devices in the IRF; and

a storage instruction 65 to store network topology information of the IRF collected by the collection instruction 64.

[00116] For example, the negotiation instruction 61 may negotiate with the opposite party member device through the network management port on the member device to determine whether the IRF is split by the following procedures:

the member device being a master device of the IRF, the negotiation instruction 61 sending an ARP detection packet through the network management port on the member device, or the member device being a standby device of the IRF, the negotiation instruction 61 activating the network management port on the member device, and sending the ARP detection packet through the activated network management port on the member device; and

in response to detecting that the member device does not receive an ARP detection response from the opposite party member device before the IRF link is failed within a preset period of time after the member device sends the ARP detection packet, the negotiation instruction 61 determining that the IRF is not split, or in response to detecting that the member device receives an ARP detection response packet from the opposite party member device before the IRF link is failed within the preset period of time after the member device sends the ARP detection packet, then the negotiation instruction 61 triggering the collection instruction 64 to re-collect network topology information of an IRF to which the member device currently belongs, comparing the number of member devices in stored network topology information and the number of member devices in re-collected network topology information, in response to determining that the number of the member devices in stored network topology information and the number of the member devices in re-collected network topology information are not identical, determining that the IRF is split, and in response to determining that the number of the member devices in stored network topology information and the number of the member devices in re-collected network topology information are identical, determining that the IRF is not split.

[00117] For example, the determination instruction 62 determining whether the sub-IRF should be isolated includes:

comparing the number of the member devices included in re-collected network topology information, M, and N, where N is one half of the number of the member devices included in stored network topology information,

in response to determining that M is smaller than N by comparison, determining that the sub-IRF should be isolated;

in response to determining that M is larger than N by comparison, determining that the sub-IRF should not be isolated; and

in response to determining that M is equal to N by comparison, identifying whether a master device of the IRF before splitting is present in the sub-IRF, in response to identifying that the master device of the IRF before splitting is not present in the sub-IRF, determining that the sub-IRF should be isolated, and in response to identifying that the master device of the IRF before splitting is present in the sub-IRF, determining that the sub-IRF should not be isolated.

[00118] For example, the processing instruction 63 isolating the sub-IRF to suppress work of the sub-IRF may include:

blocking all ports on the member device except for the network management port on the member device, and notifying other member devices in the sub-IRF to block all ports on the member devices except for network management ports on the member devices.

[00119] For example, the processing instruction controlling the sub-IRF to continue to work includes:

in response to determining that M is larger than N by comparison, identifying whether the master device of the IRF before splitting before splitting is present in the sub-IRF, in response to identifying that the master device of the IRF is present in the sub-IRF, controlling all member devices in the sub-IRF to continue to work as roles as the member devices are before splitting of the IRF, and in response to identifying that the master device of the IRF is not present in the sub-IRF, controlling the member device and other member devices in the sub-IRF to elect a master device, and continue to work as roles as the member device and the other member devices are after the election; and

in response to determining that M is equal to N by comparison, controlling all the member devices in the sub-IRF to work as roles as all the member devices are before splitting of the IRF.

[00120] Till then, the description for the Fig.6 is completed.

[00121] As described in the foregoing, the examples of the present disclosure may be implemented by software together with necessary hardware platforms, and may be implemented by hardware. Based on this, the examples of the present disclosure may be embodied as a software product. The software product may be stored in a storage medium, and may include some instructions to enable a computing device (may be a personal computer, a server, a network device, etc.) to execute the methods in the examples of the present disclosure.

[00122] The non-transitory storage medium for example may be a U disk, hard disk, ROM, RAM, EPROM, EEPROM, flash or other solid memory, CD-ROM, DVD, HD-DVD, Blue-Ray or other optic storage device, magnetic disk, disk memory or other magnetic storage device, or other medium that may store information and may be accessed by a computer.

[00123] The “processor” may include a processing unit, an application specific integrated circuit (ASIC), a logic unit, or a programmable gate array, etc.

[00124] The drawings are illustrative, the modules or blocks contained therein may be not necessary to implement the present disclosure.

[00125] What is described in the foregoing are only examples of the present disclosure, and should not be construed as limitations to the present disclosure. Any changes, equivalent replacements, modifications made without departing from the scope and spirit of the present disclosure are intended to be included within the protecting scope of the present disclosure.

CLAIMS

WHAT IS CLAIMED IS:

1. A method for preventing multiple conflicting stacks, implemented on a member device in an intelligent resilient framework (IRF), the method comprising:

in response to the member device detecting an IRF link between the member device and an opposite party member device is failed, the member device negotiating with the opposite party member device through a network management port on the member device to determine whether the IRF is split;

in response to determining that the IRF is split, the member device determining whether a sub-IRF to which the member device belongs should be isolated; wherein the sub-IRF is one of IRFs split from the IRF;

in response to determining that the sub-IRF should be isolated, the member device isolating the sub-IRF to suppress work of the sub-IRF; and

in response to determining that the sub-IRF should not be isolated, the member device controlling the sub-IRF to continue to work.

2. The method of claim 1, wherein the IRF comprises two member devices; and the member device negotiating with the opposite party member device through the network management port on the member device to determine whether the IRF is split comprises:

as a master device of the IRF, the member device initiating a bi-directional forwarding detection (BFD) session through the network management port on the member device to a network management port on the opposite party member device, in response to determining that the initiated BFD session is established successfully, determining that the IRF is split, and in response to determining that the initiated BFD session is not established successfully, determining that the IRF is not split; or

as a standby device of the IRF, the member device activating the network management port on the member device, initiating the BFD session through the activated network management port to the network management port on the opposite party member device, in response to

determining that the initiated BFD is established successfully, determining that the IRF is split, and in response to determining that the initiated BFD is not established successfully, determining that the IRF is not split.

3. The method of claim 2, wherein the member device determining whether the sub-IRF should be isolated comprises:

as the standby device of the IRF, the member device determining that the sub-IRF should be isolated; or

as the master device of the IRF, the member device determining that the sub-IRF should not be isolated; and

the member device isolating the sub-IRF to suppress work of the sub-IRF comprises: blocking all ports on the member device except for the network management port on the member device; and

the member device controlling the sub-IRF to continue to work comprises: the member device continuing to work as a master device.

4. The method of claim 1, further comprising: collecting and storing network topology information of the IRF, wherein the network topology information comprises the number of member devices in the IRF; and

the member device negotiating with the opposite party member device through the network management port on the member device to determine whether the IRF is split comprises:

as a master device of the IRF, the member device sending an address resolution protocol (ARP) detection packet through the network management port on the member device, or as a standby device of the IRF, the member device activating the network management port on the member device, and sending the ARP detection packet through the activated network management port on the member device; and

in response to the member device detecting that the member device does not receive an ARP detection response from the opposite party member device before the IRF link is failed within a preset period of time after the member device sends the ARP detection packet, the member device determining that the IRF is not split, or in response to the member device detecting that the member device receives an ARP detection response packet from the opposite party member device before the IRF link is failed

within the preset period of time after the member device sends the ARP detection packet, then the member device re-collecting network topology information of an IRF to which the member device currently belongs, comparing the number of member devices in stored network topology information and the number of member devices in re-collected network topology information, and in response to determining that the number of the member devices in the stored network topology information and the number of the member devices in the re-collected network topology information are not identical, determining that the IRF is split, and in response to determining that the number of the member devices in the stored network topology information and the number of the member devices in the re-collected network topology information are identical, determining that the IRF is not split.

5. The method of claim 4, wherein the member device determining whether the sub-IRF should be isolated comprises:

the member device comparing the number of the member devices included in the re-collected network topology information, M , and N , where N is one half of the number of the member devices included in the stored network topology information,

in response to determining that M is smaller than N by comparison, the member device determining that the sub-IRF should be isolated;

in response to determining that M is larger than N by comparison, the member device determining that the sub-IRF should not be isolated; and

in response to determining that M is equal to N by comparison, the member device identifying whether a master device of the IRF before splitting is present in the sub-IRF, in response to identifying that the master device of the IRF before splitting is not present in the sub-IRF, determining that the sub-IRF should be isolated, and in response to identifying that the master device of the IRF before splitting is present in the sub-IRF, determining that the sub-IRF should not be isolated.

6. The method of claim 5, wherein the member device isolating the sub-IRF to suppress work of the sub-IRF comprises:

the member device blocking all ports on the member device except for the network management port on the member device, and notifying other member devices in the sub-IRF to block all ports on the member devices except for network management ports on the member devices.

7. The method of claim 5, wherein the member device controlling the sub-IRF to continue to work comprises:

in response to determining that M is larger than N by comparison, the member device identifying whether the master device of the IRF before splitting before splitting is present in the sub-IRF, in response to identifying that the master device of the IRF is present in the sub-IRF, the member device controlling all member devices in the sub-IRF to continue to work as roles as the member devices are before splitting of the IRF, and in response to identifying that the master device of the IRF is not present in the sub-IRF, the member device and other member devices in the sub-IRF electing a master device, and continuing to work as roles as the member device and the other member devices are after the election; and

in response to determining that M is equal to N by comparison, the member device controlling all the member devices in the sub-IRF to work as roles as all the member devices are before splitting of the IRF.

8. The method of claim 7, wherein the member device controlling all the member devices in the sub-IRF to work as the roles of all the member devices are before splitting of the IRF comprises:

as a master device of the IRF, the member device working as the master device, and notifying other member devices in the sub-IRF to work as standby devices; or

as a standby device of the IRF, the member device working as the standby device, notifying a master device of the IRF before splitting to work as a master device, and notifying standby devices of the IRF before splitting which are present in the sub-IRF to work as standby devices.

9. An apparatus for preventing multiple conflicting stacks, implemented on a member device in an intelligent resilient framework (IRF), the apparatus comprising:

a processor; and

a non-transitory storage medium to store machine readable instructions that are executable by the processor, wherein the instructions comprise:

a negotiation instruction to negotiate with an opposite party member device through a network management port on the member device to determine whether the IRF is split in response to determining that an IRF link between the member device and the opposite party member device is failed;

a determination instruction to determine whether a sub-IRF where the member device is located should be isolated in response to the negotiation instruction determining that the IRF is split; wherein the sub-IRF is one of IRFs split from the IRF; and

a processing instruction to isolate the sub-IRF to suppress work of the sub-IRF in response to the determination instruction determining that the sub-IRF should be isolated; and control the sub-IRF to continue to work in response to the determination instruction determining that the sub-IRF should not be isolated.

10. The apparatus of claim 9, wherein the IRF comprises two member devices;

and

the negotiation instruction negotiating with the opposite party member device through the network management port on the member device to determine whether the IRF is split comprises:

the member device being a master device of the IRF, the negotiation instruction initiating a bi-directional forwarding detection (BFD) session through the network management port on the member device to a network management port on the opposite party member device, in response to determining that the initiated BFD session is established successfully, determining that the IRF is split, and in response to determining that the initiated BFD session is not established successfully, determining that the IRF is not split; or

the member device being a standby device of the IRF, the negotiation instruction activating the network management port on the member device, initiating the BFD session through the activated network management port to the network management port on the opposite party member device, in

response to determining that the initiated BFD is established successfully, determining that the IRF is split, and in response to determining that the initiated BFD is not established successfully, determining that the IRF is not split.

11. The apparatus of claim 10, wherein the determination instruction determining whether the sub-IRF should be isolated comprises:

the member device being a standby device of the IRF, the determination instruction determining that the sub-IRF should be isolated; or
the member device being a master device of the IRF, the determination instruction determining that the sub-IRF should not be isolated; and
the processing instruction isolating the sub-IRF to suppress work of the sub-IRF comprises: blocking all ports on the member device except for the network management port on the member device; and
the processing instruction controlling the sub-IRF to continue to work comprises: the processing instruction controlling the member device to continue to work as a master device.

12. The apparatus of claim 9, wherein the apparatus further comprises:

a collection instruction to collect network topology information of the IRF, wherein the network topology information comprises the number of member devices in the IRF;
a storage instruction to store the network topology information of the IRF collected by the collection instruction; and
the negotiation instruction negotiating with the opposite party member device through the network management port on the member device to determine whether the IRF is split comprises:
the member device being a master device of the IRF, the negotiation instruction sending an address resolution protocol (ARP) detection packet through the network management port on the member device, or the member device being a standby device of the IRF, the negotiation instruction activating the network management port on the member device, and sending the ARP detection packet through the activated network management port on the member device; and

in response to detecting that the member device does not receive an ARP detection response from the opposite party member device before the IRF link is failed within a preset period of time after the member device sends the ARP detection packet, the negotiation instruction determining that the IRF is not split, or in response to detecting that the member device receives an ARP detection response packet from the opposite party member device before the IRF link is failed within the preset period of time after the member device sends the ARP detection packet, then the negotiation instruction triggering the collection instruction to re-collect network topology information of an IRF to which the member device currently belongs, comparing the number of member devices in stored network topology information and the number of member devices in re-collected network topology information, in response to determining that the number of the member devices in the stored network topology information and the number of the member devices in the re-collected network topology information are not identical, determining that the IRF is split, and in response to determining that the number of the member devices in the stored network topology information and the number of the member devices in the re-collected network topology information are identical, determining that the IRF is not split.

13. The apparatus of claim 12, wherein determining whether the sub-IRF should be isolated comprises:

comparing the number of the member devices included in the re-collected network topology information, M, and N, where N is one half of the number of the member devices included in the stored network topology information, in response to determining that M is smaller than N by comparison, determining that the sub-IRF should be isolated;

in response to determining that M is larger than N by comparison, determining that the sub-IRF should not be isolated; and

in response to determining that M is equal to N by comparison, identifying whether a master device of the IRF before splitting is present in the sub-IRF, in response to identifying that the master device of the IRF before splitting is not present in the sub-IRF, determining that the sub-IRF

should be isolated, and in response to identifying that the master device of the IRF before splitting is present in the sub-IRF, determining that the sub-IRF should not be isolated.

14. The apparatus of claim 13, wherein the processing instruction isolating the sub-IRF to suppress work of the sub-IRF comprises:

blocking all ports on the member device except for the network management port on the member device, and notifying other member devices in the sub-IRF to block all ports on the member devices except for network management ports on the member devices.

15. The apparatus of claim 13, wherein the processing instruction controlling the sub-IRF to continue to work comprises:

in response to determining that M is larger than N by comparison, identifying whether the master device of the IRF before splitting before splitting is present in the sub-IRF, in response to identifying that the master device of the IRF is present in the sub-IRF, controlling all member devices in the sub-IRF to continue to work as roles as the member devices are before splitting of the IRF, and in response to identifying that the master device of the IRF is not present in the sub-IRF, controlling the member device and other member devices in the sub-IRF to elect a master device, and continue to work as roles as the member device and the other member devices are after the election; and

in response to determining that M is equal to N by comparison, controlling all the member devices in the sub-IRF to work as roles as all the member devices are before splitting of the IRF.

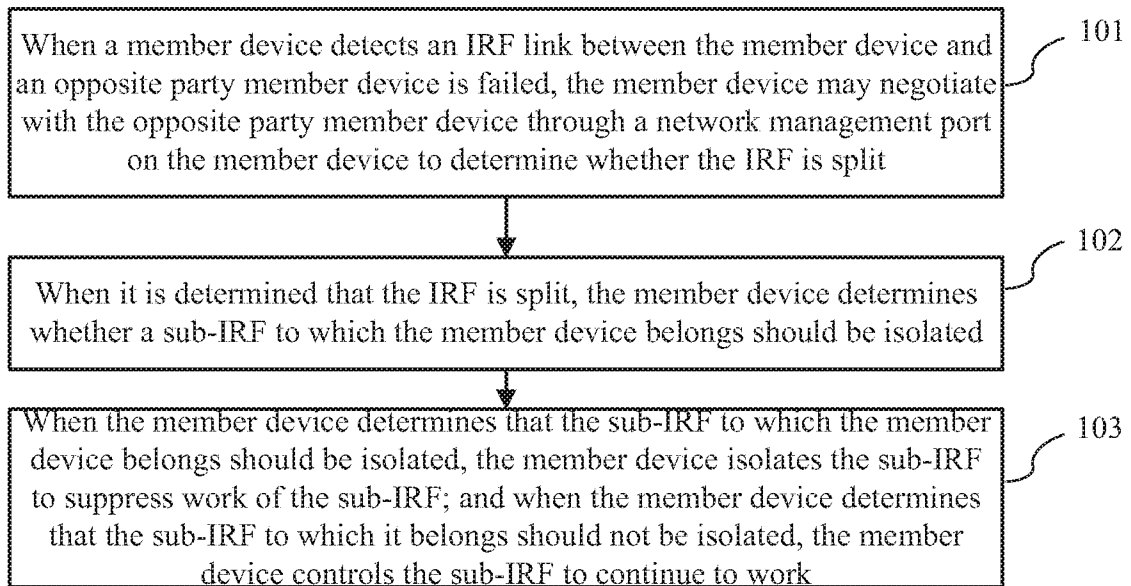


FIG.1

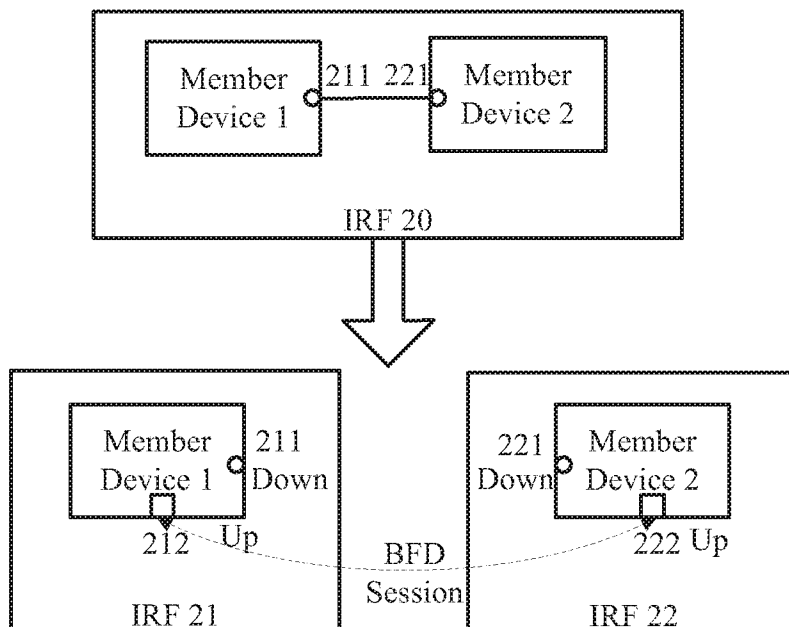


FIG. 2

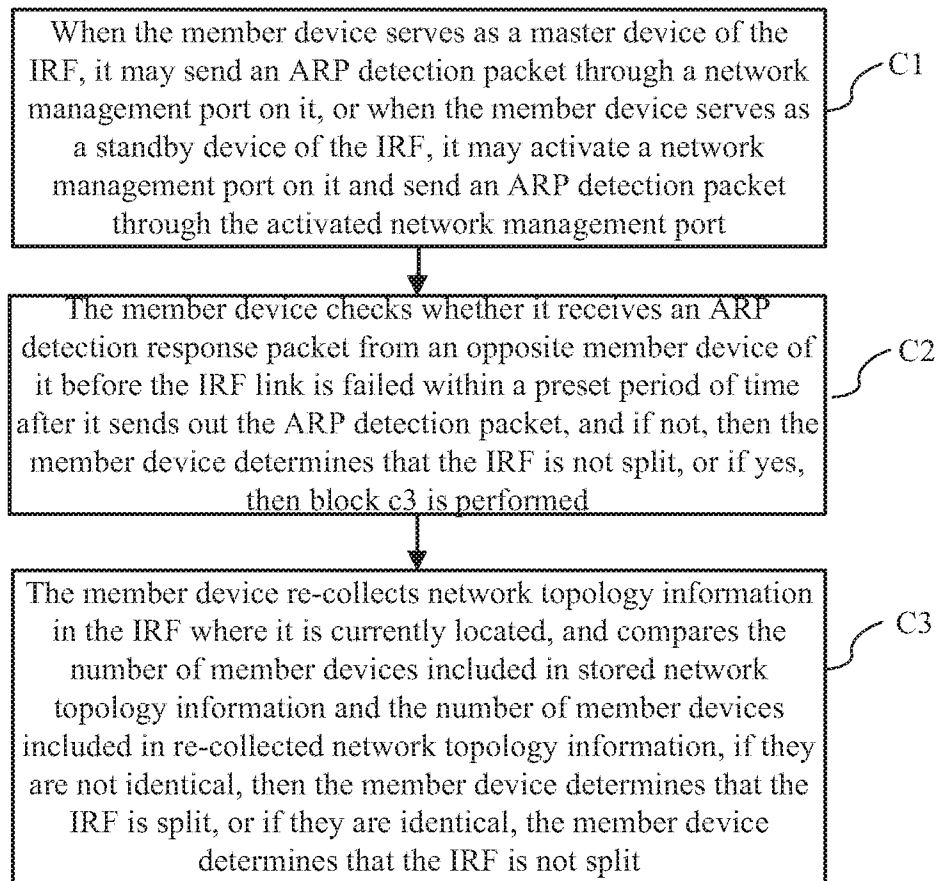


FIG. 3

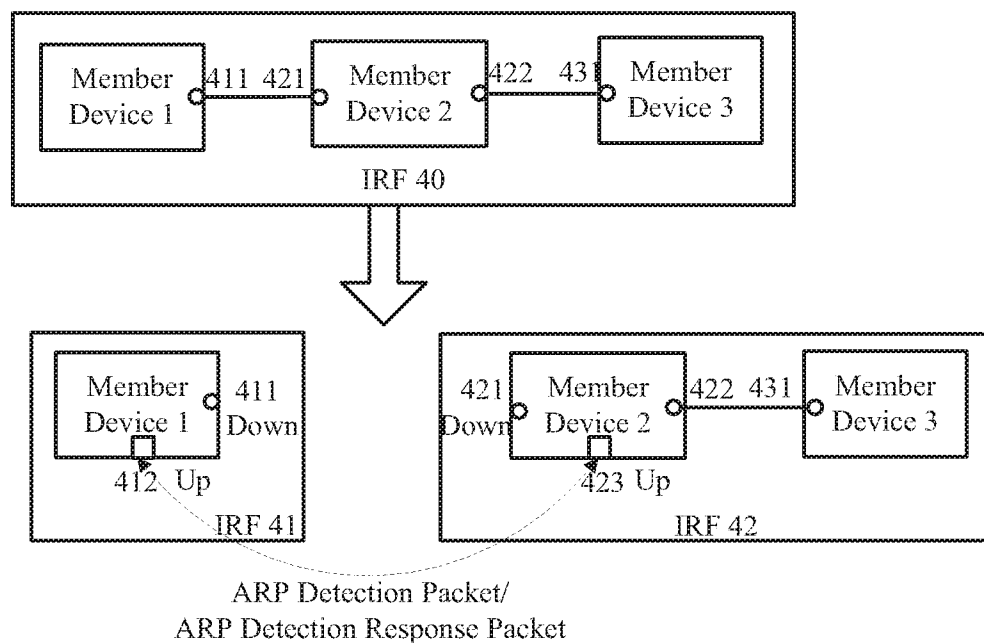


FIG. 4

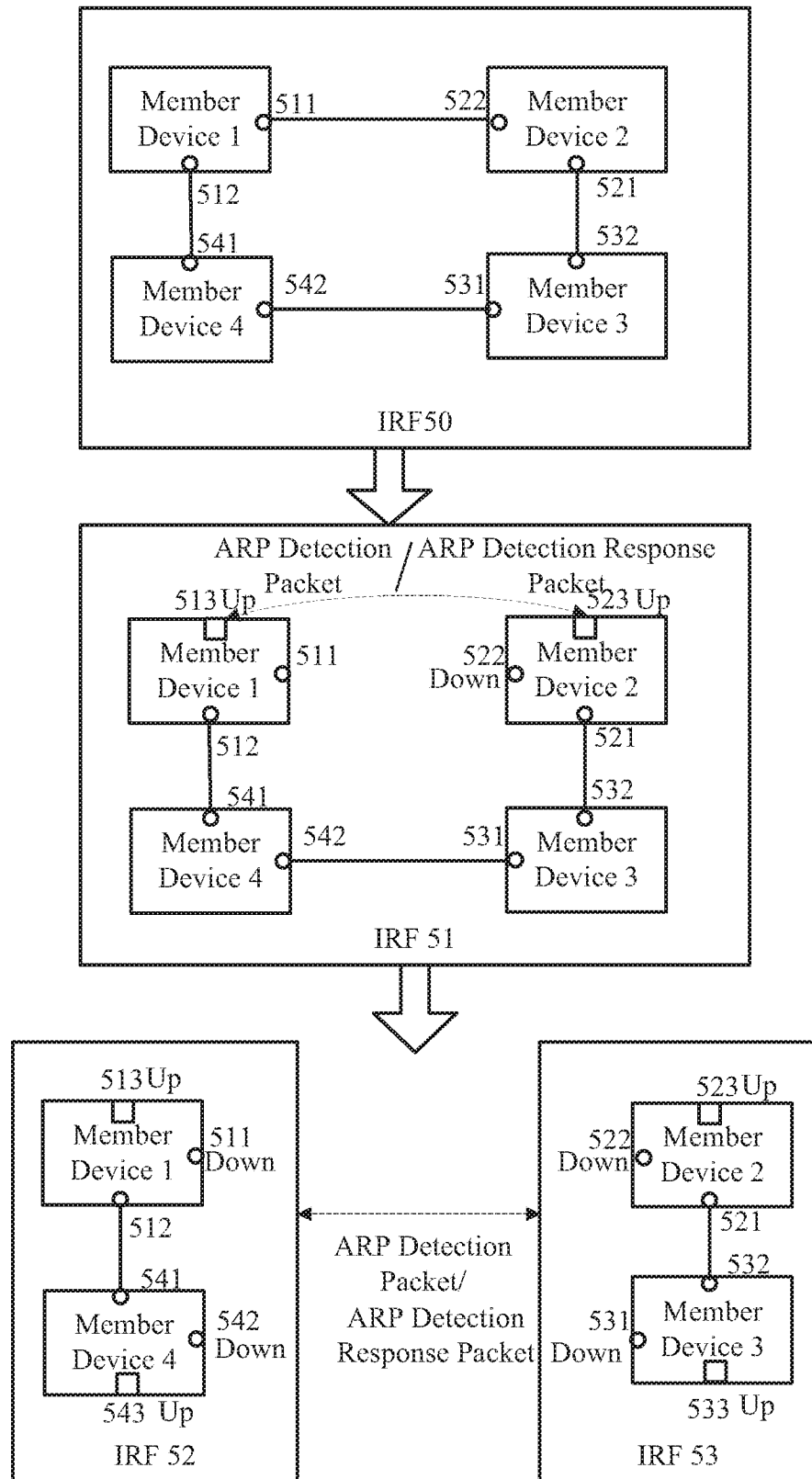


FIG. 5

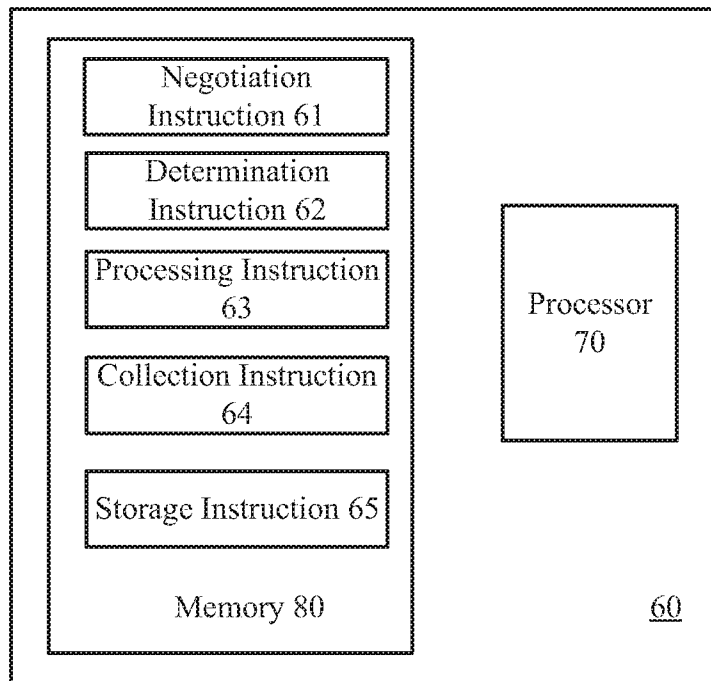


FIG. 6

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2016/076117

A. CLASSIFICATION OF SUBJECT MATTER

H04L 12/24(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

H04L

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

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

CNPAT, CNKI, WPI, EPODOC: intelligent resilient framework, IRF, split, isolated, suppress+, link, master, standby, port, bi-directional forwarding detection, BFD, active

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	CN 102957565 A (HANGZHOU H3C TECHNOLOGIES CO., LTD.) 06 March 2013 (2013-03-06) description, paragraphs [0008]-[0030]	1-15
Y	CN 101695036 A (HANGZHOU H3C TECHNOLOGIES CO., LTD.) 14 April 2010 (2010-04-14) description, paragraphs [0004]-[0009]	1-15
A	CN 103973560 A (HANGZHOU H3C TECHNOLOGIES CO., LTD.) 06 August 2014 (2014-08-06) the whole document	1-15
A	CN 101714932 A (HANGZHOU H3C TECHNOLOGIES CO., LTD.) 26 May 2010 (2010-05-26) the whole document	1-15
A	CN 102347867 A (HANGZHOU H3C TECHNOLOGIES CO., LTD.) 08 February 2012 (2012-02-08) the whole document	1-15

☐ Further documents are listed in the continuation of Box C.
 ☒ See patent family annex.

* Special categories of cited documents:

“A” document defining the general state of the art which is not considered to be of particular relevance

“E” earlier application or patent but published on or after the international filing date

“L” document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

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“P” document published prior to the international filing date but later than the priority date claimed

“T” later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

“X” document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

“Y” document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

“&” document member of the same patent family

Date of the actual completion of the international search

13 May 2016

Date of mailing of the international search report

27 May 2016

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.

PCT/CN2016/076117

Patent document cited in search report			Publication date (day/month/year)	Patent family member(s)			Publication date (day/month/year)
CN	102957565	A	06 March 2013	None			
CN	101695036	A	14 April 2010	None			
CN	103973560	A	06 August 2014	US	2014219289	A1	07 August 2014
CN	101714932	A	26 May 2010	None			
CN	102347867	A	08 February 2012	None			