

METHOD FOR COLLECTING NETWORK TOPOLOGY INFORMATION

Field of the Invention

The present invention relates to network management,
5 particularly to a method for collecting network topology
information.

Background of the Invention

Topology information collection is the basis of network
10 trunk management, and it requires the devices within the
topology collection coverage to have stored the information of
their adjacent devices. The process of topology collection is
as follows: converge adjacency relation information of all
devices supporting topology collection in the topology
15 collection coverage to the device that initiates the topology
collection.

The methods in prior art can be classified into L2-based
topology collection methods and L3-based topology collection
methods. According to L2-based topology collection, all
20 topology collection messages are carried on L2 protocol;
however, L2 protocol itself doesn't provide network routing
function; as a result, all of the existing methods perform
topology collection on the basis of tree network, i.e., through
sending topology reports to the root node (i.e., in uplink
25 direction), they summarize topology of the entire network at
the root node. Such topology collection methods are not
applicable to other topologies, e.g., mesh topology, other than
tree structure.

L3-based topology collection mainly refers to IP-based
30 (Internet Protocol) topology collection. All topology report

messages are forwarded to the device that initiates topology collection through standard routing protocol on network layer and form topology of the entire network. However, such topology collection methods results in complicated routing algorithms
5 at every node in the entire topology coverage, which is impossible for low-end products without router capability.

In addition, the existing topology collection technology can't ensure completeness of the collected topology information and therefore is usually compensated with periodical topology
10 updating so that the topology collection will not affect the network for a long time even it is unsuccessful. However, for management of network devices, the immediate consequence of incomplete topology collection is: the network manager is unable to detect a few of network devices, resulting in
15 management flaws.

In addition, to solve the cycle problem in topology collection, the existing technology employs a spanning tree algorithm in tree structure; however, since the spanning tree algorithm has to be performed at every network device in the
20 topology coverage, the topology collection process becomes more complexed.

Summary of the Invention

It is an object of the present invention to provide a
25 simple method of collecting complete network topology information.

To attain said object, a method for collecting network topology information according to the present invention comprising the following steps: the topology information
30 collecting device sending a topology information collection

request message containing a field restricting the number of message forwarding operations from the local node to adjacent nodes according to the information of the adjacent nodes, and then repeating the following steps:

5 The node that receives said request message returning a response message containing the local node's information and information of connections to its adjacent nodes to said topology information collecting device;

10 determining whether the number of message forwarding operations reaches to the threshold value; if so, ending the process; otherwise going to the following step:

 the node that receives said request message forwarding said request message to all of its adjacent nodes.

15 With above method, in a given topology collection coverage, each device in the network can receive the topology information collection request messages and responds to the topology collecting device; the response message contains information of the present device and information of connections to all adjacent devices. Therefore, the topology
20 collecting device can obtain information of all devices and inter-connection relation information between them to achieve network topology information collection, so that the network manager can construct the network topology diagram, which will serve as the basis of trunk management.

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Brief Description of the Drawings

 Fig.1 is a general flow chart of a method according to the present invention;

 Fig.2 shows an application of the present invention.

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Detailed Description of the Embodiments

A method of present invention will be described in further detail with reference to the embodiments and the attached drawings.

5 As shown in Fig.1, the topology information collecting device sending a topology information collection request message containing a field restricting the number of message forwarding operations from the local node to adjacent nodes according to the information of the adjacent nodes, and then
10 repeating the following steps:

 The node that receives said request message sending a response message containing the local node's information and information of connections to its adjacent nodes to said topology information collecting device;

15 determining whether the number of message forwarding operations reaches to the threshold value; if so, ending the process; otherwise going to the following step:

 The node that receives said request message forwarding said request message to all of its adjacent nodes. The field
20 restricting the number of message forwarding operations is designed to control the topology collection coverage, and it may be an integer; after the initial value is set, each device decreases the value of the field by 1 when forwarding the request message; when the value reaches to 0, the request message will
25 not be forwarded any more.

 Said request message contains a Source Path field which is used to record the message sending sequence; said response message contains a Response Path field which is used to decide the message sending sequence; whenever the request message is
30 sent, the device identifier of the present node is written into

the Source Path field; the value of said Response Path field is obtained from said Source Path field through reverse operation. A path refers to a series of identifiers of all devices therethrough in sequence. Before forwarding the request message to its adjacent devices, the device adds its own device identifier at the end of Source Path field of the request message; when a device responds to the received request message, it reverses the sequence of content of Source Path field of the request message as the path of response message. In the embodiment shown in Fig.2, when device A sends topology request message 1 to device B, the Source Path field of the message comprises only 1 device identifier, i.e., A. Before forwarding the request message to its adjacent devices, device B adds its own device identifier at the end of the Source Path of the request message; therefore, the Source Path field of request message 2 or 3 is A and B; when a device responds to the received request message, it reverses the sequence of the content of Source Path field of the request message as the Response Path field, i.e., the Response Path field of response message 4 or 5 of device D or E is B and A.

To further prevent cycled message forwarding, when a device receives a topology information collection request message, if the Source Path field thereof already contains device identifier of the present device, the request message will be discarded. If the destination address of the request message, i.e., the last address in the Source Path field, is not that of the present device, the device will forward the request messages to its adjacent devices according to path indication.

During dissemination of the topology request messages in

the network, a device may receive the request messages forwarded from multiple of adjacent devices. To prevent the device from sending the response messages repeatedly, said request message contains a Topology Collection Identifier field, the value of which is generated by the topology information collecting device when it initiates the topology information collection request, whenever a collection process is finished, the value of said field is increased by 1 and then serves as the Topology Collection Identifier for the next collection process; said response message contains a Topology Collection Identifier field, the value of which comes from Topology Collection Identifier field of the corresponding request message, whenever a request message is received, the device compares the Topology Collection Identifier with that in the previous response message; if they are identical, discards the request message; otherwise processes the request message.

During dissemination of the topology request messages in the network, a great number of network devices may receive the topology request messages and send response messages simultaneously, which may result in network congestion and topology collecting device busy. To avoid said problems, each device may wait for a certain time period before sending the topology request message. In the embodiment, suppose that the time interval from sending the response message to forwarding the request messages is T_1 ; the request message is forwarded port by port in the sequence identical to sending the response message to adjacent nodes. For example, suppose that $T_1 = (x + \Delta) \text{ms}$, herein x is a given value, Δ is a random number, said topology collection request message contains the maximum value

of Δ and the time interval between request message forwarding operations port by port. In the embodiment, x may be set to 200ms, said time interval may be set to 20ms.

To further ensure completeness of topology collection,
5 whenever the topology information collecting device receives a response message, it records the node that returns the message, marks the node as a past node, and marks the nodes that are adjacent to said node and haven't responded as pending nodes; then, the topology information collecting device will wait for
10 a certain time period and then perform designated topology information collection operation for the pending nodes. If the topology information collecting device detects no response message from some device, it will collect topology information of said device through designated topology collection operation.
15 In this case, since the topology information collecting device already knows the route to said device according to the collected inter-device connection relation, it can perform source route addressing instead of above broadcasting level by level so as to reduce network congestion and enhance collecting
20 efficiency.

Claims

1. A method for collecting network topology information, wherein the topology information collecting device sends a
5 topology information collection request message containing a field restricting the number of message forwarding operations from the local node to adjacent nodes according to the information of the adjacent nodes, and then repeats the following steps:

10 The node receives said request message returns a response message containing the local node's information and information of connections to its adjacent nodes to said topology information collecting device;

 determines whether the number of message forwarding
15 operations reaches to the threshold value; if so, ends the process; otherwise goes to the following step:

 the node that receives said request message forwards said request message to all of its adjacent nodes.

2. A method for collecting network topology information
20 according to claim 1, wherein said request message contains a Source Path field which is used to record the message sending sequence; said response message contains a Response Path field which is used to decide the message sending sequence; whenever the request message is sent, the device identifier of the
25 present node is written into the Source Path field; the value of said Response Path field is obtained from said Source Path field through reverse operation.

3. A method for collecting network topology information according to claim 2, wherein when a device receives a topology
30 information collection request message, if the Source Path

field already contains device identifier of the present device, it will discard said request message.

4. A method for collecting network topology information according to claim 1 or 2, wherein said request message contains
5 a Topology Collection Identifier field, the value of which is generated by the topology information collecting device when it initiates the topology information collection request, whenever a collection process is finished, the value of said field is increased by 1 and then serves as the Topology
10 Collection Identifier for the next collection process; said response message contains a Topology Collection Identifier field, the value of which comes from Topology Collection Identifier field of the corresponding request message, whenever a request message is received, the device compares the Topology
15 Collection Identifier with that in the previous response message; if they are identical, discards the request message; otherwise processes the request message.

5. A method for collecting network topology information according to claim 2 or 3, wherein suppose that the time interval
20 from sending the response message to forwarding the request messages is T_1 ; the request message is forwarded port by port in the sequence identical to sending the response message to adjacent nodes.

6. A method for collecting network topology information
25 according to claim 5, wherein the time $T_1 = (x + \Delta) \text{ms}$, herein x is a given value, Δ is a random number, said topology collection request message contains the maximum value of Δ and the time interval between request message forwarding operations port by port.

7. A method for collecting network topology information according to claim 1, wherein whenever the topology information collecting device receives a response message, it records the node that returns the message, marks said node as a past node,
5 and marks the nodes that are adjacent to said node and haven't responded as pending nodes; then, the topology information collecting device will wait for a certain time period and then perform designated topology information collection operation for the pending nodes.