CLAIMS

What is claimed is:

1. A method for obtaining a compensation delay upper limit, wherein the method is applied to a first node connected to a second node through a target path group including multiple paths, and the method comprises:

sending a request packet to the second node through a first path in the target path group, and obtaining a first time point when the first node sends the request packet;

receiving a reply packet sent by the second node through each path in the target path group, and constructing metadata corresponding to each reply packet; wherein the metadata corresponding to each reply packet includes a second time point when the first node receives the reply packet, a request delay and a reply delay carried in the reply packet; the request delay is a residency delay of all network domains that the request packet passes through on the first path, and the reply delay corresponding to each path includes a residency delay of all network domains that the reply packet passes through on the path;

determining a link delay corresponding to each path according to the first time point, the request delay, the second time point corresponding to each path, and the reply delay corresponding to each path;

calculating a difference between a reference delay corresponding to the target path group and the link delay corresponding to each path to obtain the compensation delay upper limit corresponding to each path.

2. The method according to claim 1, wherein determining the link delay corresponding to each path according to the first time point, the request delay, the second time point corresponding to each path, and the reply delay corresponding to each path, comprises:

determining a first link delay corresponding to the first path according to the first time point, the request delay, a second time point corresponding to the first path, and a reply delay corresponding to the first path;

determining a second link delay corresponding to a further path according to the first time point, the request delay, a second time point corresponding to the further path, a reply delay

corresponding to the further path, and the first link delay, wherein the further path is a path other than the first path in the target path group.

3. The method according to claim 1, wherein the reference delay is determined by:

determining a second path from the target path group;

calculating a sum value of a reply delay corresponding to the second path, a link delay corresponding to the second path and a preset adjustment delay, to obtain the reference delay corresponding to the target path group; the second path is a path in the target path group, via which the reply packet is received at the latest.

4. The method according to any one of claims 1-3, wherein the request packet carries a first field, which is to be filled with the request delay, and the reply packet carries a second field and a third field, the second field is to be filled with the request delay, and the third field is to be filled with the reply delay.

5. The method according to any one of claims 1-3, wherein the reply delay corresponding to each path is a sum value of a processing delay and the residency delay of all network domains that the reply packet passes through on the path; the processing delay is a delay from a third time point to a fourth time point; the third time point is a time point when the second node receives the request packet, and the fourth time point is a time point when the second node sends the reply packet.

6. The method according to claim 1, wherein the method further comprises:

generating an original packet according to a preset period;

determining one path from the target path group as the first path;

processing the original packet based on tunnel information of the first path to obtain the request packet;

wherein a first timer event is registered in the first node, and a duration for a first timer corresponding to the first timer event is the preset period;

the method further comprises:

after the first timer times out, generating the original packet based on the first timer event

and resetting the first timer.

7. The method according to claim 6, wherein the method further comprises:

after sending the request packet, determining whether a duration from a current time point to the first time point reaches a preset duration to obtain a determining result;

in response to determining that the determining result indicates that the preset duration has not been reached and a first number of reply packets have been received, executing an operation of determining the link delay corresponding to each path according to the first time point, the request delay, the second time point corresponding to each path, and the reply delay corresponding to each path, wherein the first number is the number of paths included in the target path group;

in response to determining that the determining result indicates that the preset duration has been reached and no reply packet has been received, re-executing an operation of determining one path from the target path group as the first path, until the number of times of re-executions reaches a preset number of times;

in response to determining that the determining result indicates that the preset duration has been reached and at least one reply packet has been received, determining a link delay corresponding to a path transmitting each received reply packet based on the first time point, the request delay, a second time point corresponding to the path transmitting each received reply packet, and a reply delay corresponding to the path transmitting each received reply packet.

8. The method according to claim 7, wherein before executing the operation of determining the link delay corresponding to the path transmitting each received reply packet based on the first time point, the request delay, the second time point corresponding to the path transmitting each received reply packet, and the reply delay corresponding to the path transmitting each received reply packet, the method further comprises:

determining whether the first node has configured the reference delay;

in response to determining that the first node has configured the reference delay, executing the operation of determining the link delay corresponding to the path transmitting each received reply packet based on the first time point, the request delay, the second time point corresponding

to the path transmitting each received reply packet, and the reply delay corresponding to the path transmitting each received reply packet.

9. The method according to claim 7 or 8, wherein the method further comprises:

after sending the request packet, registering a second timer event in the first node and starting a second timer corresponding to the second timer event; wherein a duration for the second timer is the preset duration;

determining whether the duration from the current time point to the first time point reaches the preset duration to obtain the determining result, comprises:

determining whether the second timer has timed out;

in response to determining that the second timer has not timed out, obtaining a first determining result, which indicates that the duration from the current time point to the first time point does not reach the preset duration;

in response to determining that the second timer has timed out, obtaining a second determining result, which indicates that the duration from the current time point to the first time point reaches the preset duration.

10. The method according to claim 1, wherein the metadata corresponding to each reply packet further includes a sequence number of the reply packet; the method further comprises:

executing the operation of determining the link delay corresponding to each path according to the first time point, the request delay, the second time point corresponding to each path and the reply delay corresponding to each path in response to determining that the sequence number of the reply packet is the same as a sequence number of the request packet, and a sum value of the request delay and a reply delay corresponding to a path transmitting the reply packet is less than the preset duration, and

discarding a reply packet in response to determining that the sequence number of the reply packet is different from a sequence number of the request packet, and/or a sum value of a reply delay corresponding to the path transmitting the reply packet and the request delay is greater than or equal to a preset duration.

11. The method according to claim 1, wherein the first node is configured with a first table

and a second table associated with the first table; the first table is to record first configuration information of the target path group issued by a controller, and the second table is to record second configuration information of each path included in the target path group issued by the controller;

wherein the first configuration information includes: an identifier of the target path group, the number of the paths included in the target path group, an address of the second node, a preset adjustment delay, the reference delay, a period of sending the request packet, a timeout duration of receiving the reply packet, and a first pointer, wherein the first pointer points to a first address of the second table; and/or

the second configuration information includes: identifiers of the paths included in the target path group, an identifier of a receiving interface for receiving the reply packet, tunnel identifier for sending the request packet, and the compensation delay upper limit;

the method further comprises:

after obtaining the compensation delay upper limit corresponding to each path, updating a compensation delay upper limit corresponding to each path in the second table with the obtained compensation delay upper limit;

wherein the method further comprises:

in response to determining that the reference delay is calculated, updating a reference delay in the first table with the calculated reference delay.

12. The method according to claim 1, wherein the first node is configured with a third table and a fourth table associated with the third table; the third table is to record third configuration information of the target path group, and the fourth table is to record fourth configuration information, for obtaining the compensation delay upper limit, corresponding to each path included in the target path group;

the method further comprises:

before sending the request packet to the second node, obtaining the third configuration information of the target path group and filling the third configuration information into the third table;

after obtaining the metadata, filling fourth configuration information corresponding to the metadata into the fourth table;

wherein the method further comprises:

after obtaining the compensation delay upper limit, recovering the third and fourth tables corresponding to the target path group;

wherein the third configuration information includes: an identifier of the target path group, the number of the paths included in the target path group, a timeout duration of receiving the reply packet, the number of paths trying to send the request packet, the number of paths receiving the reply packet, a preset adjustment delay, a sequence number of the request packet, the first time point, and a second pointer; the second pointer points to a first address of the fourth table; and/or

the fourth configuration information includes: identifiers of the paths included in the target path group, the request delay, the reply delay and the second time point.

13. The method according to claim 1, wherein the method further comprises;

identifying a received packet;

in response to determining that the received packet is identified as the reply packet corresponding to the request packet, executing an operation of constructing the metadata corresponding to each reply packet;

in response to determining that the received packet is identified as a data packet, performing delay compensation on the data packet according to a compensation delay upper limit corresponding to a third path, which is a path transmitting the data packet;

wherein the compensation delay upper limit corresponding to the third path is the compensation delay upper limit stored in the first node; or

the compensation delay upper limit corresponding to the third path is the compensation delay upper limit carried in the data packet.

14. The method according to claim 1, wherein the method further comprises:

sending the obtained reference delay and/or the compensation delay upper limit

corresponding to each path to the second node.

15. A method for obtaining a compensation delay upper limit, wherein the method is applied to a second node connected to a first node through a target path group including multiple paths, and the method comprises:

receiving a request packet sent by the first node through a first path in the target path group, and constructing metadata corresponding to the request packet; wherein the metadata includes a request delay carried in the request packet; the request delay is a residency delay of all network domains that the request packet passes through on the first path;

encapsulating the request delay in a reply packet;

sending the reply packet to the first node through each path in the target path group.

16. The method according to claim 15, wherein the reply packet carries a second field and a third field; the second field is to be filled with the request delay, and the third field is to be filled with a reply delay; the reply delay includes a residency delay of all network domains that the reply packet passes through on a path.

17. The method according to claim 15, wherein the metadata further includes a third time point, which is a time point when the second node receives the request packet;

wherein, encapsulating the request delay in the reply packet, comprises:

calculating a delay from the third time point to a fourth time point as a processing delay; wherein the fourth time point is a time point when the second node sends the reply packet; a sum value of the processing delay and a residency delay of all network domains that the reply packet passes through on a path is the reply delay;

encapsulating the request delay and the processing delay in the reply packet.

18. The method according to claim 15, wherein encapsulating the request delay in the reply packet, comprises:

generating an original packet corresponding to the request packet, wherein the original packet carries the request delay;

processing the original packet based on tunnel information of each path in the target path

group, to obtain the reply packet corresponding to each path.

19. The method according to claim 15, wherein the second node is configured with a first table and a second table associated with the first table; the first table is to record first configuration information of the target path group issued by a controller, and the second table is to record second configuration information of each path included in the target path group issued by the controller;

wherein the first configuration information includes: an identifier of the target path group, the number of the paths included in the target path group, an address of the first node, a preset adjustment delay, a reference delay, a period of sending the request packet, a timeout duration of receiving the reply packet, and a first pointer, wherein the first pointer points to a first address of the second table; and/or

the second configuration information includes: identifiers of the paths included in the target path group, an identifier of a receiving interface for receiving the reply packet, tunnel identifier for sending the request packet, and the compensation delay upper limit.

20. The method according to claim 19, wherein the method further comprises:

receiving the compensation delay upper limit corresponding to each path sent by the first node;

updating a compensation delay upper limit corresponding to each path in the second table with the obtained compensation delay upper limit;

receiving the reference delay corresponding to the target path group sent by the first node;

updating a reference delay in the first table with the calculated reference delay.

21. The method according to claim 15, wherein the method further comprises:

identifying a received packet;

in response to determining that the received packet is identified as the request packet, executing an operation of constructing the metadata corresponding to the request packet;

in response to determining that the received packet is identified as a data packet, determining a third path from the target path group, and sending the data packet to the first node

through the third path;

wherein the data packet carries a compensation delay upper limit corresponding to the third path.

22. A forwarding node, for executing the method according to any one of claims 1-14, or executing the method according to any one of claims 15-21.