

METHOD, APPARATUS AND SYSTEM FOR SENDING AND RECEIVING DATA MESSAGES BY MULTIPLE SENDING AND SELECTIVELY RECEIVING

TECHNICAL FIELD

[0001] This disclosure relates to the technical field of communication, in particular to a method, an apparatus and a system for sending and receiving data message by multiple sending and selectively receiving.

BACKGROUND

[0002] In the field of data transmission, some key data have requirements for real-time performance and high-speed transmission. Key data with such requirements are not sensitive to bandwidth usage during transmission, but are sensitive to packet loss and delay. Therefore, in a case of sufficient network bandwidth, relevant enterprise users would rather spend several times the bandwidth to ensure link quality.

[0003] For such requirements, an optional solution is a multi-path sending and de-duplication receiving scheme, referred to as a multiple sending and selectively receiving scheme. A basic idea thereof is that a plurality of links (which can be virtual links, i.e., tunnels) are bound together, each of the plurality of links sends an identical message, and a receiving end receives a message arrived first and discards a message arrived later. A most important technology in the multiple sending and selectively receiving scheme is a packet-reception de-duplication algorithm. A general method is to identify a same data packet at a sending end and compare an identifier of the data packet at the receiving end, and how the receiving end compares the identifier of the data packet affects the consumption of the receiving device host, such as the consumption of CPU and memory.

[0004] How to solve the existing problem of occupying a large amount of system resources in the de-duplication of the multiple sending and selectively receiving scheme is an urgent problem to be solved.

SUMMARY

[0005] To address the problem in the prior art, the embodiments of this disclosure provide a method, an apparatus and a system for sending and receiving data message by multiple sending and selectively receiving, thereby solving an existing problem of consuming a device storage

space in a multiple sending and selectively receiving scheme.

[0006] An embodiment of this disclosure provides a method for sending data message by multiple sending and selectively receiving, including: acquiring a data message to be sent; adding an identification field to each of the data messages, and the identification field includes a feature code of the data messages and a sequence number in a de-duplication array; replicating the data messages at least once to obtain at least one copy of the data messages; and sending the data messages and the copies of the data messages sent respectively via different links.

[0007] An embodiment of this disclosure also provides a method for receiving data message by multiple sending and selectively receiving, including: receiving a data message and at least one copy of data message corresponding thereto via different links, respectively; and parsing an identification field in the data message and the copies of the data message corresponding thereto, extracting a feature code in the identification field and a sequence number in a de-duplication array; and performing a de-duplication judgment in the de-duplication array based on the feature code and the sequence number in the de-duplication array, and discarding the data message or the copies of the data message if a same element is present in the de-duplication array.

[0008] An embodiment of this disclosure also provides an apparatus for multiple sending and selectively receiving of sending end, including: an acquisition unit configured to acquire a data message to be sent; an identification field adding unit configured to add an identification field to each of the data messages, and the identification field includes a feature code of the data message and a sequence number in a de-duplication array; a replication unit configured to replicate the data message at least once to obtain at least one copy of the data message; and a sending unit configured to send the data message and the copies of the data message sent respectively via different links.

[0009] An embodiment of this disclosure also provides an apparatus for multiple sending and selectively receiving of receiving end, including: a receiving unit configured to receive a data message and at least one copy of data message corresponding thereto via different links, respectively; a parsing unit configured to parse an identification field in the data message and the copies of the data message corresponding thereto, and extract a feature code in the identification field and a sequence number in a de-duplication array; and a processing unit configured to perform a de-duplication judgment in the de-duplication array based on the feature code and the

sequence number in the de-duplication array, and discard the data message or the copies of the data message if a same element is present in the de-duplication array.

[0010] An embodiment of this disclosure also provides a system for data message multiple sending and selectively receiving, including: a sending end further including: a communication entity of sending end, a multiple sending and selectively receiving module of sending end, and a network communication module of sending end; and a receiving end further including: a communication entity of receiving end, a multiple sending and selectively receiving module of receiving end, and a network communication module of receiving end, and the communication entity of sending end sends a data message to the multiple sending and selectively receiving module of sending end, the multiple sending and selectively receiving module of sending end acquires the data message and adds an identification field to each of the data messages, and the identification field includes a feature code of the data messages and a sequence number in a de-duplication array, replicates the data messages at least once to obtain at least one copy of the data messages; and sends the data messages and the copies of the data messages to the network communication module of sending end; the network communication module of sending end sends the data message and the copies of the data messages via different links, respectively. The network communication module of receiving end receives data messages and at least one copy of data messages corresponding thereto via different links, respectively; the multiple sending and selectively receiving module of receiving end parses the identification field in the data messages and the copies of the data messages corresponding thereto, and extracts the feature code in the identification field and the sequence number in a de-duplication array; and performs a de-duplication judgment in the de-duplication array based on the feature code and the sequence number in the de-duplication array, and discards the data messages or the copies of the data messages if a same element is present in the de-duplication array; and the communication entity of receiving end performs a subsequent processing on the de-duplicated data messages.

[0011] An embodiment of this disclosure also provides a computer device, including: a memory, a processor and a computer program stored in the memory and runnable on the processor, and the method is implemented when the computer program is executed by the processor.

[0012] An embodiment of this disclosure also provides a computer-readable storage medium, and a computer program is stored on the computer-readable storage medium, and the

method is implemented when the computer program is executed by a processor.

[0013] In the embodiments of this disclosure, the memory consumed by caching the data messages at the receiver in the de-duplication step is saved in the multiple sending and selectively receiving scheme.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014] In order to more clearly illustration the embodiments of the disclosure or the technical solution in the prior art, a brief description of the drawings for the embodiments will be given below. Obviously, the drawings in the following description merely illustrate some embodiments of the disclosure, for persons ordinarily skilled in the art, and those skilled in the art can derive other drawings from them without paying any creative effort.

[0015] FIG. 1 is a structural diagram of a network transmission architecture according to an embodiment of this disclosure;

[0016] FIG. 2 is a flowchart of a method for sending data message according to an embodiment of this disclosure;

[0017] FIG. 3 is a flowchart of a method for receiving data message according to an embodiment of this disclosure;

[0018] FIG. 4 is a structural diagram of an apparatus for multiple sending and selectively receiving of sending end according to an embodiment of this disclosure;

[0019] FIG. 5 is a structural diagram of an apparatus for multiple sending and selectively receiving of receiving end according to an embodiment of this disclosure;

[0020] FIG. 6 is a structural diagram of a system for multiple sending and selectively receiving according to an embodiment of this disclosure;

[0021] FIG. 7 is a schematic diagram of processing data messages by a system for multiple sending and selectively receiving according to an embodiment of this disclosure;

[0022] FIG. 8 is a schematic diagram of de-duplication judgment by a multiple sending and selectively receiving module of receiving end according to an embodiment of this disclosure;

[0023] FIG. 9 is a flowchart of generating a length of a de-duplication array according to an embodiment of this disclosure;

[0024] FIG. 10 is a schematic diagram of transmission of data messages with delay between two links according to an embodiment of this disclosure;

[0025] FIG. 11 is a schematic diagram of multiple sending and selectively receiving of a star topology network structure according to an embodiment of this disclosure;

[0026] FIG. 12 is a schematic diagram of a sending network control message with a de-duplication array length and a feature code length according to an embodiment of this disclosure;

[0027] FIG. 13 is a schematic diagram of encapsulation of data messages by a network communication module of sending end according to an embodiment of this disclosure; and

[0028] FIG. 14 is a computer device according to an embodiment of this disclosure.

Reference signs:

401. acquiring unit; 402. identification field adding unit; 403. replication unit; 404. sending unit; 405. testing unit; 406. setting unit; 501. receiving unit; 502. parsing unit; 503. processing unit; 504. de-duplication array generating unit; 601. sending end; 6011. communication entity of sending end; 6012. multiple sending and selectively receiving module of sending end; 6013, network communication module of sending end; 602, receiving end; 6021, communication entity of receiving end; 6022, multiple sending and selectively receiving module of receiving end; 6023, network communication module of receiving end; 701. communication entity of sending end; 702. multiple sending and selectively receiving module of sending end; 703. network communication module of sending end; 704. communication entity of receiving end; 705. multiple sending and selectively receiving module of receiving end; 706. network communication module of receiving end; 707. data message; 1402, computer device; 1404, processor; 1406, memory; 1408, drive mechanism; 1410, input/output module; 1412, input device; 1414, output device; 1416, presentation device; 1418, graphical user interface; 1420, network interface; 1422, communication link; 1424, communication bus.

DETAILED DESCRIPTION

[0029] The technical solution in the embodiments of the present invention will be described clearly and integrally below with reference to drawings in the embodiments of the present disclosure. Obviously, those described are only a part, rather than all, of the embodiments of the present disclosure. Based on the embodiments of the present disclosure, any other embodiments that are obtained by those of ordinary skilled in the art without paying any

creative effort should fall within the protection scope of the present disclosure.

[0030] FIG. 1 is a structural diagram of a network transmission architecture according to an embodiment of this disclosure, which illustrates a schematic diagram in which a sending end sends a data message to be sent to a receiving end via a plurality of links, such as a link 1 and a link 2. The link 1 or the link 2 may include one or more network relay devices such as routers, respectively. Wired network or wireless network, such as Ethernet, xDSL, a fiber-optic network, a mobile network, or the like, may be used as a link to transmit data. In order to improve the real-time performance of data messages, the sending end simultaneously sends a same data message via a plurality of links (in this case, two links, however, more links can be included in other embodiments). No matter which link experiences delay or jitter, the data messages can be guaranteed to quickly reach a receiving end via other links. The receiving end receives the data messages via a plurality of links, and there may be duplication in one or more received data messages. According to a feature code of the data messages and a sequence number in a de-duplication array, whether the received data messages are duplicated can be analyzed; and in a case where the duplication occurs, corresponding data messages can be discarded; and in a case where there is no duplication, the data messages can be transmitted to a subsequent processing flow, for example, transmitted to a communication entity for subsequent processing, and the communication entity may be a network protocol stack, or an application program or a third-party communication component. That is, after discarding duplicate data messages in an embodiment of this disclosure, the receiving end processes the plurality of data messages received according to the processing method in the prior art, or using other technical solutions. Other technical solutions refer to, but are not limited to, those in the prior art.

[0031] FIG. 2 is a flowchart of sending data message according to an embodiment of this disclosure, which illustrates a process in which the sending end sends a same data message via the plurality of links after adding the feature code and the sequence number in the de-duplication array to the data message to be sent in the multiple sending and selectively receiving scheme, thus the receiving end can quickly de-duplicate the received data messages to save system resources. The method specifically includes the steps of: 201, acquiring a data message to be sent; 202, adding an identification field to each of the data messages, and the identification field includes a feature code of the data messages and a sequence number in a de-duplication array; 203, replicating the data messages at least once to obtain at least one copy of the data messages;

and 204, sending the data messages and the copies of the data messages sent respectively via different links.

[0032] As an embodiment of this disclosure, the step of acquiring a data message to be sent further includes: acquiring the data message to be sent from a communication entity.

[0033] In this embodiment, the communication entity further includes, but is not limited to, a network protocol stack, an application program or a third-party communication component. The communication entities exchange communication payloads via links, and the communication entities can terminate the communication payloads locally or continue to forward the communication payloads via the links. The links include, but are not limited to, Ethernet, xDSL, a fibre-optic network, a wireless network, or the like.

[0034] As an embodiment of this disclosure, the data message to be sent is communication payloads.

[0035] In this embodiment, the communication payloads include, but are not limited to, an IP message, a TCP message, a UDP message, pure payloads, or the like.

[0036] As an embodiment of this disclosure, the step of adding an identification field to each of the data messages further includes that a high bit of the identification field is the feature code and a low bit of the identification field is the sequence number in the de-duplication array.

[0037] In this embodiment, positions of the feature code and the sequence number in the de-duplication array may be interchanged, and no restriction is made here.

[0038] As an embodiment of this disclosure, the sequence number in the de-duplication array includes a sequence number distinguish the data messages to be sent in this round. The sequence number may be, for example, a numerical number with a sequence. The feature code includes an identifier for determining a round of the data messages.

[0039] In the embodiment of this disclosure, the sequence number distinguish the data messages to be sent in this round may be consecutive numerical numbers, which is configured to locate the data messages in the de-duplication array. For example, integers starting from 1 are used to number the data messages in the de-duplication array, and each number represents a data message. The sequence number may also be consecutive numbers starting from any number.

[0040] The feature code may be a character or a string to distinguish the data messages sent in different rounds. For example, 1 bit, i.e., 0 or 1 is used to mark data messages in this round or in a next round, 0 is used to mark the data messages in this round and 1 is used to mark

the data messages in the next round. The feature code may also be configured as more bits (i.e., a length of the feature code) to mark a round of the data messages. One round of the data messages has a same feature code.

[0041] In this embodiment, the length of the de-duplication array, that is, a number (2^N) of elements in the de-duplication array, which can be any data to verify the feature code, for example, may be the same data as the feature code, is determined based on the status of the plurality of links sending the data messages and the copies of the data messages. The length of the feature code, i.e., a number of bits (M), is determined by the round of the data messages, or by a preset value (for example, 1 bit).

[0042] A product of the length of the de-duplication array and the length of the feature code is equal to a memory capacity consumed by communication devices at both ends, that is, $C=M \times 2^N$, C is memory consumption of the receiving end, M is the length of the feature code, 2^N is the length of the de-duplication array, and both M and N are positive integers ≥ 1 . The method of the embodiments of this disclosure can complete the communication process of multiple sending and selectively receiving based on small memory consumption, and higher de-duplication efficiency is achieved, and more communication time of both ends is saved.

[0043] As an embodiment of this disclosure, before the step of adding an identification field to each of the data messages, the method further includes: testing a network status of different links via which the data messages and the copies of the data messages are sent; and setting a length of the de-duplication array based on the network status.

[0044] In this embodiment, the network status may include, but is not limited to, part or all of a link delay, a packet loss rate, a packet sending rate, a network jitter, or the like.

[0045] After the length of the de-duplication array is set based on the network status, the feature code and the sequence number in the de-duplication array corresponding to the data messages can be obtained. For example, assuming that the length of the de-duplication array is 2^3 , the feature code may be 1234 (i.e., the length of the feature code is 4 bits), or the feature code can be 1 (i.e., the length of the feature code is 1 bit), one of numbers 1 to 8 can be assigned to each of the data messages as the sequence number in the de-duplication array based on an order in which the data messages are sent. In this embodiment, the length of the feature code can be set based on the length of the de-duplication array, for example, the length of the de-duplication array is obtained by a subsequent calculation method (the length of the de-duplication array is set

based on the network status), then the length of the corresponding feature code can be a minimum value 1. When the length of the de-duplication array is slightly smaller than the length obtained by the subsequent calculation method, the length of the feature code may increase accordingly. M and N can be inversely proportional to each other, i.e., the smaller the N value is, the larger the M value may be, so as to ensure that the feature code between different rounds of de-duplication array is not duplicated.

[0046] In other embodiment, the identification field can be preset, that is, the content and length of feature code and the sequence number in the de-duplication array can be set, and the preset identification field can be added to the data messages.

[0047] As an embodiment of this disclosure, the step of testing a network status of different links via which the data messages and the copies of the data messages are sent further includes, but is not limited to, testing based on a PING command or other existing or customized detection protocols.

[0048] As an embodiment of this disclosure, the step of setting a length of the de-duplication array based on the network status further includes: calculating a delay difference between a link with a best network status and a link with a worst network status; and setting the length of the de-duplication array based on a product of the delay difference and a packet sending rate.

[0049] In this embodiment, in the network status corresponding to each of the links, a time when a test data message is transmitted to the receiving end via the link corresponding to the worst network status is a T3 moment, and a time when a same test data message is simultaneously transmitted to the receiving end via the link corresponding to the best network status is a T2 moment. A delay difference ΔT is obtained by $T3 - T2$. The delay difference ΔT is multiplied by the packet sending rate of the network communication module, and the length of the de-duplication array is greater than the product. For example, the delay difference between the link with the best network status and the link with the worst network status is 20ms, the packet sending rate of the network communication module is 1.488Mpps, then the length of the de-duplication array is greater than 29.76K, i.e., $2^N > 29.76K$, the length parameter $N=15$ of the de-duplication array can be obtained. That is, in a case where $N=15$, the de-duplication array can have more than 29.76K sequence numbers to ensure that each of the data messages is marked. According to the sequence number, the data messages can be located in the de-duplication array

of the receiving end. In this embodiment, the value of N may be, for example, a minimum integer corresponding to N obtained when the length 2^N of the de-duplication array is greater than the product, thereby reducing the memory consumption.

[0050] As an embodiment of this disclosure, the step of setting a length of the de-duplication array based on the network status further includes: calculating a time difference between a moment when a last data message is sent via the link with the worst network status and a moment when a first data message is sent via the link with the best network status in a previous round; and setting a length of the de-duplication array in this round based on a product of the time difference and the packet sending rate.

[0051] In this embodiment, the round refers to a process of sending data messages and copies of data messages via a plurality of different links, and different rounds refer to a process of sending different data messages (and copies of data messages thereof) via different links. In a case of sending data messages (and copies of data messages thereof) in the previous round, a moment when a last data message is transmitted to the receiving end via the link with the worst network status is a $T1$ moment, and a moment when a first data message is transmitted to the receiving end via the link with the best network status is a $T0$ moment, a time difference is obtained by $T1-T0$, the time difference is multiplied by the packet sending rate of the network communication module, and the length of the de-duplication array is greater than the product. For example, the time difference is 30ms, the packet sending rate of the network communication module is 1.488Mpps, then the length of the de-duplication array is greater than 44.64K, that is, $2^N > 44.64K$, the length parameter $N=16$ of the de-duplication array can be obtained. That is, in a case where $N=16$, the de-duplication array can have more than 44.64K sequence numbers to ensure that each of the data messages is marked. According to the sequence number in the de-duplication array, the corresponding data messages can be located in the de-duplication array of the receiving end. In this embodiment, the value of N may be, for example, a minimum integer corresponding to N obtained when the length 2^N of the de-duplication array is greater than the product, thereby reducing the memory consumption.

[0052] The time difference is greater than the delay difference, so as to ensure that when data messages in this round have not been transmitted in all links, the data message transmission in the next round will not proceed, that is, the multiple sending and selectively receiving in the next round is not performed before the multiple sending and selectively receiving in this round

does not come to an end.

[0053] As an embodiment of this disclosure, before the step of adding an identification field to each of the data messages, the method further includes: setting a length of the de-duplication array in this round based on a number of data messages sent in the previous round.

[0054] In this embodiment, the length of the de-duplication array in the identification field is preset before the data messages are sent, that is, the parameters of the length of the de-duplication array are preset. For example, in a case of 3 bits, the sequence numbers in the de-duplication array are numbered in order of 1-8; and in a case of 5 bits, the sequence numbers in the de-duplication array are numbered in order of 1-32. For example, the length of the de-duplication array in this round can be equal to twice the number of data messages sent in the previous round. There may be only 4 data messages in a case where the data messages are sent in the previous round, then there are also only 4 data messages to be sent in this round, the preset de-duplication array length parameter N can be set to 3, that is, the sequence numbers in the de-duplication array are numbered in order of 1-8. The feature code can be set to the desired value.

[0055] As an embodiment of this disclosure, before the step of sending the data messages and the copies of the data messages sent respectively via different links, the method further includes:

[0056] sending a length M of the feature code and a parameter N of the length of the de-duplication array, and the length M of the feature code is set based on the parameter N of the length of the de-duplication array, and a lower limit of the length M of the feature code is 1.

[0057] In this embodiment, the information may be sent through an existing network control message, or may also be sent through a customized data message. After receiving the information, the receiving end can open up a memory space ($M \times 2^N$) based on the information to generate a de-duplication array. Of course, the receiving end can also proactively set the length of the de-duplication array and the length of the feature code by testing the network status of different links, or dynamically set the length of the de-duplication array and the length of the feature code based on the number of data messages in the previous round of multiple sending and selectively receiving.

[0058] As an embodiment of this disclosure, after the step of sending the data messages

and the copies of the data messages sent respectively via different links, the method further includes:

encapsulating the data messages and the copies of the data messages based on a protocol of the data messages; and

sending the data messages and the copies of the data messages encapsulated via different links, respectively.

[0059] In this embodiment, the network communication module encapsulates the data messages based on the protocol of the data messages, and the protocol may include, but is not limited to, an IP tunnel protocol, a VxLan tunnel protocol, a TCP protocol, or the like. The network communication module is configured to manage the actual network hardware and externally encapsulate the communication payloads. The network communication module may be a network drive or a lower-level protocol stack. The network communication module encapsulates the data messages and the copies of the data messages to which the identification field is added, and then sends the data messages and the copies thereof through Ethernet, xDSL, a fibre-optic network, a mobile network, or the like.

[0060] FIG. 3 is a flowchart of a method for receiving data message according to an embodiment of this disclosure, which illustrates a process in which the receiving end receives the data messages sent by the sending end as shown in FIG. 2 above, parses and de-duplicates the data messages after generating the de-duplication array in the multiple sending and selectively receiving scheme, thus the receiving end can quickly de-duplicate the received data messages to save system resources. The method specifically includes the steps of:

301, receiving data messages and at least one copy of data messages corresponding thereto via different links, respectively;

302, parsing an identification field in the data messages and the copies of the data messages corresponding thereto, extracting a feature code in the identification field and a sequence number in a de-duplication array; and

303, performing a de-duplication judgment in the de-duplication array based on the feature code and the sequence number in the de-duplication array, and discarding the data messages or the copies of the data messages if a same element is present in the de-duplication array.

[0061] As an embodiment of this disclosure, the step of receiving the data message and at least one copy of data messages corresponding thereto via different links, respectively, further

includes: receiving, by the network communication module, the encapsulated data messages and the encapsulated copies of the data messages sent by the sending end from different links.

[0062] As an embodiment of this disclosure, the step of parsing an identification field in the data messages and the copies of the data messages corresponding thereto further includes: de-capsulating the received data messages and at least one copy of the data messages corresponding thereto.

[0063] In this embodiment, de-capsulating refers to a step of the sending end corresponding to a step of encapsulating, by the network communication module, the data messages. According to the protocol of the received data messages, a corresponding message header such as an IP tunnel protocol, a VxLan tunnel protocol and a TCP protocol is removed.

[0064] As an embodiment of this disclosure, the step of extracting a feature code in the identification field and a sequence number in a de-duplication array further includes: extracting a high bit of the identification field as the feature code and extracting a low bit of the identification field as the sequence number in the de-duplication array.

[0065] As an embodiment of this disclosure, the sequence number in the de-duplication array includes a sequence number distinguish the data messages to be sent in this round, and the feature code includes an identifier determining a round of the data messages.

[0066] As an embodiment of this disclosure, the step of performing a de-duplication judgment in the de-duplication array based on the feature code and the sequence number in the de-duplication array further includes: locating a corresponding element in the de-duplication array by the sequence number in the de-duplication array; and comparing whether the feature code is the same as the element.

[0067] As an embodiment of this disclosure, the step of performing a de-duplication judgment in the de-duplication array based on the feature code and the sequence number in the de-duplication array, and discarding the data messages or the copies of the data messages if a same element is present in a same position of the de-duplication array further includes: locating a corresponding element in the de-duplication array by the sequence number in the de-duplication array; and comparing whether the feature code is the same as the element, and discarding the data messages or the copies of the data messages if the feature code is the same as the element.

[0068] In this embodiment, an element in the de-duplication array can be directly located based on the sequence number in the de-duplication array, and a large number of computing time

and computing resources for reading and comparing the received data messages one by one can be saved.

[0069] As an embodiment of this disclosure, the step of performing a de-duplication judgment in the de-duplication array based on the feature code and the sequence number in the de-duplication array, further includes:

covering, by the feature code, the element in the de-duplication array located using the sequence number in the de-duplication array if the same element is not matched in the de-duplication array.

[0070] In this embodiment, in a case where same data messages and copies of data messages are transmitted via a plurality of links, a packet loss may occur on some links, the data messages or copies of the data messages received via another link can supplement the lost data messages without the link where the packet loss occurs to initiate a retransmission request, thereby saving the negotiation communication time between the sending end and the receiving end.

[0071] As an embodiment of this disclosure, before the step of receiving the data message and at least one copy of data messages corresponding thereto via different links, respectively, the method further includes: receiving a length M of the feature code and a parameter N of the length of the de-duplication array, generating the de-duplication array based on the length M of the feature code and the parameter N of the length of the de-duplication array, and a storage space of the de-duplication array is $M \times 2^N$.

[0072] In this embodiment, the length M of the feature code and the parameter N of the length of the de-duplication array received can be obtained by the sending end after network test calculation, and then the information is transmitted through a network control message. When transmitting data messages to each other as needed, the sending end and the receiving end need to open up a memory space to generate a de-duplication array based on the length M of the feature code and the parameter N of the length of the de-duplication array, so as to perform a de-duplication judgment. Therefore, when the technical solution of this disclosure is applied to a complex network environment, savings in a cache space and computing resources are enormous.

[0073] As an embodiment of this disclosure, before the step of receiving data messages and at least one copy of data messages corresponding thereto via different links, respectively, the method further includes: setting a length of the de-duplication array in this round based on the

number of data messages received in a previous round.

[0074] In this embodiment, the receiving end can set the length of the feature code according to a preset rule, which is the same as the length of the feature code set by the sending end.

[0075] As an embodiment of this disclosure, before the step of receiving data messages and at least one copy of data messages corresponding thereto via different links, respectively, the method further includes: testing a network status of the different links; and setting a length of the de-duplication array based on the network status.

[0076] In this embodiment, reference can be made to the method of setting the length of the de-duplication array at the sending end according to the network status of the different links, which shall not be described herein any further.

[0077] As an embodiment of this disclosure, before the step of receiving the data message and at least one copy of data messages corresponding thereto via different links, respectively, the method further includes: sending a length M of the feature code and a parameter N of the length of the de-duplication array, and the length M of the feature code is set based on the parameter N of the length of the de-duplication array, and a lower limit of the length M of the feature code is 1. Therefore, the calculation resources of the sending end to determine the length M of the feature code and the parameter N of the length of the de-duplication array can be saved.

[0078] As an embodiment of this disclosure, after the de-duplication judgment of data messages in this round is completed, the data messages are sent to subsequent communication entities for subsequent processing of the data messages.

[0079] FIG. 4 is a structural diagram of an apparatus for multiple sending and selectively receiving of sending end according to an embodiment of this disclosure, which illustrates a basic structure of multiple sending and selectively receiving of sending end, and functional modules may be implemented through software or specific chips, connected between the communication entities of the sending end and the network communication module of the sending end, and corresponding processing is performed on the data messages to implement the de-duplication processing of the multiple sending and selectively receiving scheme in the embodiments of this disclosure. The apparatus specifically includes: an acquiring unit 401, an identification field adding unit 402, a replication unit 403, a sending unit 404; a testing unit 405 and a setting unit 406. The acquiring unit 401 is configured to acquire a data message to be sent; the identification field

adding unit 402 is configured to add an identification field to each of the data messages, and the identification field includes a feature code of the data messages and a sequence number in a de-duplication array; the replication unit 403 is configured to replicate the data messages at least once to obtain at least one copy of the data messages; and the sending unit 404 is configured to send the data messages and the copies of the data messages sent respectively via different links.

[0080] In this embodiment, the sequence number in the de-duplication array includes a sequence number to distinguish the data messages to be sent in this round, and the feature code includes an identifier for determining a round of the data messages.

[0081] As an embodiment of this disclosure, the apparatus also includes: the testing unit 405 and the setting unit 406. The testing unit 405 is configured to test a network status of different links via which the data messages and the copies of the data messages are sent; and the setting unit 406 is configured to set a length of the de-duplication array based on the network status.

[0082] As an embodiment of this disclosure, the setting unit 406 is further configured to calculate a delay difference between a link with a best network status and a link with a worst network status; and set the length of the de-duplication array based on a product of the delay difference and a packet transmission rate.

[0083] As an embodiment of this disclosure, the setting unit 406 is further configured to calculate a time difference between a moment when a last data message is sent via the link with the worst network status and a moment when a first data message is sent via the link with the best network status in a previous round; and set a length of the de-duplication array in this round based on a product of the time difference and the packet sending rate.

[0084] As an embodiment of this disclosure, the setting unit 406 is further configured to set a length of the de-duplication array in this round based on a number of data messages sent in the previous round.

[0085] As an embodiment of this disclosure, the sending unit 404 is further configured to send a length M of the feature code and a parameter N of the length of the de-duplication array, and the length M of the feature code is set based on the parameter N of the length of the de-duplication array, and a lower limit of the length M of the feature code is 1, and the length M can be taken to be 1, 2, 3...etc.

[0086] FIG. 5 is a structural diagram of an apparatus for multiple sending and selectively

receiving of receiving end according to an embodiment of this disclosure, which illustrates a basic structure of the multiple sending and selectively receiving of receiving end, and functional modules may be implemented through software or specific chips, connected between the communication entities of the sending end and the network communication module, and corresponding processing is performed on the received data messages to implement the de-duplication processing of the multiple sending and selectively receiving scheme in the embodiments of this disclosure. The device specifically includes: a receiving unit 501, a parsing unit 502, a processing unit 503, and a de-duplication array generating unit 504. The receiving unit 501 is configured to receive data messages and at least one copy of data messages corresponding thereto via different links, respectively; the parsing unit 502 is configured to parse an identification field in the data messages and the copies of the data messages corresponding thereto, extract a feature code in the identification field and a sequence number in a de-duplication array; and the processing unit 503 is configured to perform a de-duplication judgment in the de-duplication array based on the feature code and the sequence number in the de-duplication array, and discard the data messages or the copies of the data messages if a same element is present in the de-duplication array.

[0087] As an embodiment of this disclosure, the apparatus also includes: the de-duplication array generating unit 504 configured to receive a length M of the feature code and a parameter N of the length of the de-duplication array, generate the de-duplication array based on the length M of the feature code and the parameter N of the length of the de-duplication array, and a storage space of the de-duplication array is $M \times 2^N$.

[0088] As an embodiment of this disclosure, the de-duplication array generating unit 504 is further configured to set a length of the de-duplication array in this round based on a number of data messages sent in the previous round.

[0089] FIG. 6 is a structural diagram of a system for multiple sending and selectively receiving according to an embodiment of this disclosure, which illustrates a structure of the system performing de-duplication in the multiple sending and selectively receiving scheme according to an embodiment of this disclosure, and describes that nodes in the system only include both a sending end and a receiving end. However, in other embodiments, there may be more sending ends and receiving ends, each of the nodes may include one sending end and one receiving end, or each of the nodes may include a plurality of sending ends and a plurality of

receiving ends. Each of the nodes including a sending end 601 and another node including a receiving end 602 in the system is currently taken as an example for illustration. The sending end 601 further includes: a communication entity of sending end 6011, a multiple sending and selectively receiving module of sending end 6012, and a network communication module of sending end 6013. The receiving end 602 further includes: a communication entity of receiving end 6021, a multiple sending and selectively receiving module of receiving end 6022, and a network communication module of receiving end 6023. The communication entity of sending end 6011 sends data messages to the multiple sending and selectively receiving module of sending end 6012. The multiple sending and selectively receiving module of sending end 6012 acquires data messages, adds an identification field to each of the data messages, and the identification field includes a feature code of the data messages and a sequence number in a de-duplication array, replicates the data messages at least once to obtain at least one copy of the data messages; and sends the data messages and the copies of the data messages to the network communication module of sending end 6013. The network communication module of sending end 6013 sends the data messages and the copies of the data messages via different links, respectively. The network communication module of receiving end 6023 receives data messages and at least one copy of data messages corresponding thereto via different links, respectively. The multiple sending and selectively receiving module of receiving end 6022 parses the identification field in the data messages and the copies of the data messages corresponding thereto, extracts the feature code in the identification field and the sequence number in a de-duplication array, performs a de-duplication judgment in the de-duplication array based on the feature code and the sequence number in the de-duplication array, and discards the data messages or the copies of the data messages if a same element is present in the de-duplication array. The communication entity of receiving end 6021 performs a subsequent processing on the de-duplicated data messages.

[0090] FIG. 7 is a schematic diagram of processing data messages by a system for multiple sending and selectively receiving according to an embodiment of this disclosure, which illustrates that the sending end sends the data messages to the receiving end via a plurality of links after processing and encapsulating the data messages to be sent, and sends the data messages to subsequent communication entities for further processing after de-capsulating and de-duplicating the received data messages at the receiving end. Only one link is illustrated in this

figure. However, as can be seen based on the idea of the technical solution of this disclosure, there should be at least two links between the sending end and the receiving end to transmit the data messages. And the receiving end and the sending end are not absolute, in the process of interactive communication between the receiving end and the sending end, either party may be the sending end or the receiving end.

[0091] In this figure, both the sending end and the receiving end consist of three parts, which are a communication entity of sending end 701, a multiple sending and selectively receiving module of sending end 702, and a network communication module of sending end 703; a communication entity of receiving end 704, a multiple sending and selectively receiving module of receiving end 705, a network communication module of receiving end 706 and a data message 707 transmitted between the sending end and the receiving end. The receiving end and the sending end may be implemented by electronic devices such as computers, notebook computers, mobile phones, tablet computers, or the like.

[0092] Both the communication entity of sending end 701 and the communication entity of receiving end 704 may be network protocol stacks, application programs, or third-party communication components. The communication entities exchange the communication payloads, which can be transferred locally or forwarded continuously. The communication payloads can be an IP message, a TCP message, a UDP message, pure payloads, or the like.

[0093] Both the network communication module of sending end 703 and the network communication module of receiving end 706 may be responsible for managing the actual network hardware and externally encapsulating the communication payloads, may be a network drive or a lower-level protocol stack. The connected network includes, but is not limited to, Ethernet, xDSL, a fibre-optic network, a wireless network, or the like.

[0094] Both the multiple sending and selectively receiving module of sending end 702 and the multiple sending and selectively receiving module of receiving end 705 may be located at a lower layer of the communication entities, which represents interactions between the respective communication entities and the network communication module. The multiple sending and selectively receiving module of sending end 702 adds an identification field (PktId) to each of the data messages, then replicates the data messages, adds outer encapsulation through the network communication module of sending end 703, and then transmits the data messages to different links. After receiving the data messages, the multiple sending and selectively receiving

module of receiving end 705 performs de-duplication based on the PktId, and then hands the communication payloads over to the communication entity of receiving end 704.

[0095] In this embodiment, for example, the multiple sending and selectively receiving module of sending end 702 can also group the data messages with a plurality of data messages in each group. Each group of the data messages corresponds to the aforementioned de-duplication array, and different groups of the data messages correspond to the aforementioned rounds. Each group is assigned a feature code, and the data messages in the groups use a same feature code, a Packet Id (i.e., PktId) is generated by the feature code and the sequence number in the de-duplication array. The identification field PktId includes the feature code of M bits and the sequence number in the de-duplication array of N bits, where N is the parameter of the length of the de-duplication array, and the length of the de-duplication array is 2^N . The PktId is added to an outer layer of the data messages. To be specific, the multiple sending and selectively receiving module of sending end 702 generates and encapsulates a PktId using the feature code and the sequence number in the de-duplication array, with the high M bits of the PktId as a feature code field and the low N bits as an index field (the corresponding sequence number of the data messages in the de-duplication array), and then replicates the data messages added the PktId and sends them from different links, respectively.

[0096] FIG. 8 is a schematic diagram of de-duplication judgment by a multiple sending and selectively receiving module of receiving end according to an embodiment of this disclosure. The multiple sending and selectively receiving module of receiving end 705 (in FIG. 7) maintains a de-duplication array of which a size is equal to the product of the number of data messages in a group of data messages (that is, the length of the de-duplication array) and the length of the elements in the group. The multiple sending and selectively receiving module of receiving end 705 extracts the feature code from the high bit (M bits) of the PktId, and extracts the sequence number in the de-duplication array from the low bit (N bits), which is compared in the de-duplication array, and whether the received data messages are duplicate data messages may be judged. To be specific, the multiple sending and selectively receiving module of receiving end 705 extracts the feature code and the sequence number in the de-duplication array from the PktId, and locates the element in the de-duplication array by using the sequence number in the de-duplication array as an index code, compares the extracted elements with the feature code of the data messages, considers them as duplicate messages if they are the same, and

considers them as data messages first received in this round if they are different, and submits the data messages to the communication entity of receiving end 704 for subsequent processing after covering the feature code of the data messages to the corresponding position of the de-duplication array.

[0097] In this embodiment, the sequence number in the de-duplication array may be used as the index code to directly locate the corresponding elements by offsetting a subscript of the de-duplication array, and the elements in the de-duplication array are the feature code, after the feature code corresponding to the sequence number in the de-duplication array taken out from the de-duplication array is compared with the feature code in the identification field of the received data messages, whether the received data messages are duplicate data messages can be known. That is, only one memory read and one comparison are required to perform de-duplication on the received data messages.

[0098] The feature codes of different rounds are different, and the feature codes of adjacent rounds may also be different, that is, the length M of the feature code may be 1 bit or other values set as needed. The length of the de-duplication array may be set, or the length of the de-duplication array in this round may also be set based on the send amount of data to be sent in the previous round. The length of the de-duplication array can also be obtained by the method below.

[0099] FIG. 9 is a flowchart of generating a length of a de-duplication array according to an embodiment of this disclosure, which illustrates a method in which the multiple sending and selectively receiving module of send end or receiving end dynamically sets the length of the de-duplication array according to the network status between the multiple sending and selectively receiving module of send end or receiving end, and the parameter N of the length of the de-duplication array determines the number of elements in the de-duplication array (i.e., the length of the de-duplication array), that is, 2^N elements, the M value determines a size of each element (feature code), and $M \times 2^N$ is a size of memory in bits consumed by the receiving end to generate a de-duplication array.

[00100] S901, testing a network status of different links via which the data messages and copies of data messages are sent.

[00101] In this step, the multiple sending and selectively receiving module of send end or receiving end may be used to detect an underlying link, including but not limited to detection

based on a PING command and a customized detection protocol. The network statuses such as the packet sending rate and delay jitter of the underlying link are acquired, the M and N values are determined by calculating from these network statuses, and the calculated M and N values are synchronized with the opposite end to ensure that the de-duplication algorithm works properly when the data messages are sent.

[00102] S902, setting a length of the de-duplication array based on the network status.

[00103] The value of the parameter N of the length of the de-duplication array is related to the packet sending rate V of the plurality of links and the delay difference ΔT between the links. FIG. 10 is a schematic diagram of transmission of data messages with delay between two links according to an embodiment of this disclosure. The data messages are numbered $1 \dots 2^N + 1$, and X and Y are two links. Assuming that X is the link 1 with a low delay, and Y is the link 2 with a high delay. The data messages sent from the two links are represented by X-1, Y-1, X-2, Y-2...X-($2^N + 1$), Y-($2^N + 1$), and correspond to the data messages with sequence numbers from 1 to $2^N + 1$ in the identification field (PktId). By uniquely judgment whether the data messages are duplicate by the sequence number in the de-duplication array, the data message Y-1 needs to be ensured to arrive at the receiving end before the data message X-($2^N + 1$). That is, when the data messages transmitted by the sending end in this round are not completely transmitted to the receiving end on both the links, the link 1 with a low delay does not start a next round of data message transmission, that is, the delay difference between X-1 and X-($2^N + 1$) arriving at the receiving end should be greater than the delay difference between the two links. Each round of data message transmission refers to different groups of data messages, and the different groups of data messages have different feature codes.

[00104] As shown in FIG. 10, at the T0 moment, the sending end simultaneously sends the X-1 and Y-1 data messages via the link 1 and the link 2; at the T1 moment, the sending end sends a last data message X-($2^N + 1$) or Y-($2^N + 1$) via the link 1 or the link 2; at the T2 moment, the data message X-1 on the link 1 with a low delay arrives at the receiving end; and at the T3 moment, the Y-1 data message on the link 2 with a high delay arrives at the receiving end.

[00105] In this embodiment, $\Delta T = T3 - T2$, ΔT represents the delay difference between the link 1 and the link 2, $T1 - T0$ represents the total time used to transmit the data messages in this round, and V indicates the packet sending rate of the sending end, Equation is set forth below:

$$\Delta T \times V < (T1 - T0) \times V < 2^N.$$

[00106] The value of the parameter N of the length of the de-duplication array can be calculated according to the Equation, that is, $2^N > \Delta T \times V$, and the length of the de-duplication array can be obtained based on the N value.

[00107] If a delay jitter occurs in the network, ΔT should take a largest difference between a link with a lowest delay and a link with a highest delay. For example, the delay of the link 1 is jittered between 30ms-50ms, and the delay of the link 2 is jittered between 60ms-80ms, then a maximum delay difference is 80ms-30ms=50ms. For instance, a certain margin may also be given, i.e., $\Delta T > 50\text{ms}$, ΔT can be 60ms or 70ms.

[00108] The time difference can also be determined based on the moment when the link with the worst network state sends the last data message and the moment when the link with the best network state sends the first data message in the previous round. The length of the de-duplication array in this round is set based on the product of the time difference and the packet sending rate.

[00109] The length of the de-duplication array in this round may also be estimated based on the number of data messages sent in the previous round. That is, a change in the number of data messages sent in the previous round may affect the length of the de-duplication array of the receiving end when the data messages are sent in the next round, and the length of the de-duplication array of the receiving end is dynamically changed. The length of the de-duplication array is determined based on the number of data messages in the previous round or the number of data messages in the reception history.

[00110] A very small value of M may be taken, and in an extreme case, 1 bit can be taken, so that the de-duplication array degenerates into a bitmap structure, and the total memory consumption is $2^{(N-3)}$ bytes.

[00111] As an embodiment of this disclosure, if the delay difference ΔT is 200ms, the packet sending rate is 1.488Mpps (wire-speed packet sending on gigabit networks), 300K data messages are estimated within the delay difference of 200ms. A minimum value of the N value calculated by the above formula is 19. To provide a certain level of fault tolerance, a value of 20 can be taken here. Assuming that a value of M is taken to be 1, that is, the length of the feature code is 1 bit, and 1 byte can represent 8 feature codes (2^3). The memory consumption required for the de-duplication array is only $1 \times 2^{20}/8 = 128\text{K}$. On central nodes of some star topologies, for example, the schematic diagram of multiple sending and selectively receiving of a star topology

network structure according to the embodiment shown in FIG. 11, each pair of branch nodes and the central nodes is configured with the multiple sending and selectively receiving function, and the memory saving effect of all nodes may be more impressive.

[00112] In this embodiment, after the length parameter N of the de-duplication array and the length M value of the set feature code are calculated, these parameters are sent to the opposite end by a network control message. The network control message may be illustrated in FIG. 12. This figure is a schematic diagram of a sending network control message with a de-duplication array length and a feature code length according to an embodiment of this disclosure. Therefore, the sending end and receiving end configured with the multiple sending and selectively receiving scheme in this disclosure can work together, and can complete the deduplication of data messages in the multiple sending and selectively receiving scheme with less memory consumption.

[00113] Referring to the FIG. 7 again, the network communication module of sending end 703 and the multiple sending and selectively receiving module of receiving end 705 may be configured in a system kernel of the sending end or the receiving end, the network communication module of sending end 703 and the multiple sending and selectively receiving module of receiving end 705 may also be loaded into the system kernel through, for example, insmod in Linux, three-layer data messages (IP message) are hooked through a kernel netfilter mechanism. The data messages obtained by adding PktId to the IP message are encapsulated, and the underlying network is an IP network. However, the links may use an IP tunnel and a VxLan tunnel for encapsulation due to different connection methods. The network communication module of sending end 703 may encapsulate the data message 707 transmitted between the sending end and the receiving end. The format may be shown in FIG. 13. FIG. 13 is a schematic diagram of encapsulation of data messages by a network communication module of sending end according to an embodiment of this disclosure. The network communication module of receiving end 706 can de-capsulate the received data messages according to the corresponding link protocol, and obtain the data messages containing the PktId, and match in the de-duplication array the sequence number in the de-duplication array in the PktId to locate the element in the de-duplication array by the method in the embodiment of this disclosure, and compare whether the element in the de-duplication array is consistent with the feature code in the PktId, thereby judgment whether a duplicate data message is available. If the elements in the de-duplication

array are inconsistent with the feature code in the PktId, this means that the data message has not been received, and the elements in the de-duplication array are covered with the feature code. If the elements in the de-duplication array are consistent with the feature code in the PktId, this means that the data message has been received, and the received data message is discarded. Thus, the received data message can be de-duplicated by reading the elements in the de-duplication array once, so as to save the memory consumed by the cached data messages of the receiving end in the de-duplication step in the multiple sending and selectively receiving scheme.

[00114] The communication entity of receiving end 704 performs a subsequent processing on the de-duplicated data messages.

[00115] FIG. 14 is a computer device according to an embodiment of this disclosure. The device at the receiving end or the sending end in an embodiment of this disclosure may be a computer device in this embodiment, and implement the method herein. A computer device 1402 may include one or more processors 1404, such as one or more central processing units (CPUs), and each of the CPUs can implement one or more hardware threads. The computer device 1402 may also include any memory 1406 for storing any type of information such as codes, settings, data, or the like. Without limitation, for example, the memory 1406 may include any one or a combination of: any type of RAM, any type of ROM, a flash memory device, a hard disk, a CD-ROM, or the like. More generally, any memory can employ any technology to store information. Further, any memory may provide volatile or non-volatile retention of information. Furthermore, any memory may represent a fixed or removable component of the computer device 1402. In one case, when the processor 1404 executes associated instructions stored in any memory or a combination of memories, the computer device 1402 may perform any operation of associated instructions. The computer device 1402 also includes one or more drive mechanisms 1408 interacted with any memory, such as a hard disk drive, a CD-ROM drive, or the like.

[00116] The computer device 1402 may also include an input/output module 1410 (I/O) configured to receive various inputs (via an input device 1412) and provide various outputs (via an output device 1414). A particular output mechanism may include a presentation device 1416 and an associated graphical user interface (GUI) 1418. In other embodiments, the input/output module 1410 (I/O), the input device 1412, and the output device 1414 may not be included. The computer device 1402 only serves as a computer device in the network. The computer device 1402 may also include one or more network interfaces 1420 for exchanging data with other

devices via one or more communication links 1422. One or more communication buses 1424 couple together the components described above.

[00117]The communication link 1422 can be implemented in any manner, for example, through a local area network, a wide area network (such as Internet), a point-to-point connection, or any combination thereof. The communication link 1422 may include any combination of hardwired links, wireless links, routers, gateway functions, name servers, governed by any protocol or protocol combination.

[00118]An embodiment of this disclosure also provides a computer-readable instruction, and when the processor executes the instruction, a program therein causes the processor to implement the method.

[00119]It should be understood that in the embodiments of this disclosure, a size of the sequence numbers of the above processes does not imply an order of execution. The order of execution of the processes should be determined based on function and internal logic thereof, and should not constitute any restrictions on the implementation of the embodiments of this disclosure.

[00120]It should also be understood that in the embodiments of this disclosure, the term "and/or" only describes an association relationship of associated objects, and represents that there are three types of relationships. For example, A and/or B can represent that A is present alone, both A and B are present, and B is present alone. In addition, a character '/' herein generally represents that the associated objects have an 'or' relationship.

[00121]Those skilled in the art can realize that the units and algorithm steps of each example described in conjunction with the embodiments contained in this disclosure can be implemented in electronic hardware, computer software, or a combination thereof. In order to clearly illustrate the interchangeability of hardware and software, the composition and steps of each example have been generally described in terms of functionality in the above description. Whether these functions are executed in hardware or software depends on the specific application and design constraints of the technical solution. Those skilled in the art can adopt different methods to implement the functions for each specific application, however, such implementation should not be considered beyond the scope of this disclosure.

[00122]Those skilled in the art can clearly understand that for the convenience and conciseness of the description, reference can be made to the corresponding processes in the

aforementioned method embodiments for the specific working processes of the system, apparatus and units described above, which shall not be described herein any further.

[00123]In the embodiments provided in this disclosure, it should be understood that the disclosed system, apparatus and methods can be implemented in other ways. For example, the device embodiments described above are only schematic, e.g., a division of units is only a logical functional division. In actual implementation, there can be other division methods, for example, a plurality of units or components can be combined or integrated into another system, or some features can be ignored or not executed. In addition, the mutual coupling or direct coupling or communication connection displayed or discussed can be indirect coupling or communication connection through some interfaces, devices or units, or connections in electrical, mechanical or other forms may also be involved.

[00124]The units described as separate components may be or may not be physically separated, and the components displayed as units may be or may not be physical units, can be located in one place or distributed across a plurality of network units. Part or all of the units can be selected according to actual needs, in order to achieve the objective of the solution of the embodiments in this disclosure.

[00125]In addition, in the embodiments of this disclosure, functional units can be integrated into a processing unit, units can physically exist separately, or two or more units can be integrated into one unit. The integrated units can be implemented in both hardware and software functional units.

[00126]If implemented as a software functional unit and sold or used as an independent product, the integrated units can be stored on a computer-readable storage medium. Based on this understanding, the technical solution presented in this disclosure is essentially a part that contributes to the prior art, or all or part of the technical solution can be embodied in the form of software products. The computer software product is stored in a storage medium, including a plurality of instructions to enable a computer device (a personal computer, a server, or a network device) to perform all or part of the steps of the methods in the embodiments of this disclosure. The storage media include: a USB flash disk, a mobile hard disk, a Read-Only Memory (ROM), a Random Access Memory (RAM), a magnetic disk or a CD-ROM that can store a program code.

[00127]This disclosure applies specific embodiments to illustrate the principles and

implementation of this disclosure. The explanations of the embodiments are only used to help understanding of the methods and core ideas of this disclosure. Meanwhile, for those skilled in the art, there may be changes in the specific embodiments and application range based on the ideas of this disclosure. In summary, the disclosure contained in the description should not be understood as limitations on this disclosure.

CLAIMS

1. A method for sending data message by multiple sending and selectively receiving, comprising:

acquiring a data message to be sent;

adding an identification field to each of the data messages, wherein the identification field comprises a feature code of the data messages and a sequence number in a de-duplication array;

replicating the data messages at least once to obtain at least one copy of the data messages; and

sending the data messages and the copies of the data messages sent respectively via different links.

2. The method for sending data message by multiple sending and selectively receiving according to claim 1, wherein the data messages to be sent are acquired from a communication entity.

3. The method for sending data message by multiple sending and selectively receiving according to claim 1, wherein the step of adding an identification field to each of the data messages further comprises that a high bit of the identification field is the feature code and a low bit of the identification field is the sequence number in the de-duplication array.

4. The method for sending data message by multiple sending and selectively receiving according to claim 1, wherein the sequence number in the de-duplication array comprises a sequence number distinguishing the data messages to be sent in this round, and the feature code comprises an identifier determining a round of the data messages.

5. The method for sending data message by multiple sending and selectively receiving according to claim 1, wherein before the step of adding an identification field to each of the data messages, the method further comprises:

testing a network status of different links via which the data messages and the copies of the data messages are sent; and

setting a length of the de-duplication array based on the network status.

6. The method for sending data message by multiple sending and selectively receiving according to claim 5, wherein the step of setting a length of the de-duplication array based on the network status further comprises:

calculating a delay difference between a link with a best network status and a link with a

worst network status; and

setting the length of the de-duplication array based on a product of a packet sending rate and the delay difference.

7. The method for sending data message by multiple sending and selectively receiving according to claim 5, wherein the step of setting a length of the de-duplication array based on the network status further comprises:

calculating a time difference between a moment when a last data message is sent via the link with the worst network status and a moment when a first data message is sent via the link with the best network status in a previous round; and

setting a length of the de-duplication array in this round based on a product of the time difference and the packet sending rate.

8. The method for sending data message by multiple sending and selectively receiving according to claim 1, wherein before the step of adding an identification field to each of the data messages, the method further comprises:

setting a length of the de-duplication array in this round based on a number of data messages sent in a previous round.

9. The method for sending data message by multiple sending and selectively receiving according to any one of claims 5-8, wherein before the step of sending the data messages and the copies of the data messages sent respectively via different links, the method further comprises:

sending a length M of the feature code and a parameter N of the length of the de-duplication array, wherein the length M of the feature code is set based on the parameter N of the length of the de-duplication array, and a lower limit of the length M of the feature code is 1.

10. The method for sending data message by multiple sending and selectively receiving according to claim 1, wherein after the step of sending the data messages and the copies of the data messages sent respectively via different links, the method further comprises:

encapsulating the data messages and the copies of the data messages based on a protocol of the data messages; and

sending the data messages and the copies of the data messages encapsulated via different links, respectively.

11. A method for receiving data message by multiple sending and selectively receiving, comprising:

receiving a data message and at least one copy of data message corresponding thereto via different links, respectively; and

parsing an identification field in the data message and the copies of the data message corresponding thereto, extracting a feature code in the identification field and a sequence number in a de-duplication array; and

performing a de-duplication judgment in the de-duplication array based on the feature code and the sequence number in the de-duplication array, and discarding the data message or the copies of the data message if a same element is present in the de-duplication array.

12. The method for receiving data message by multiple sending and selectively receiving according to claim 11, the step of receiving the data message and at least one copy of data message corresponding thereto via different links, respectively, further comprises: receiving, by a network communication module, an encapsulated data message and an encapsulated copies of the data message sent by a sending end from different links.

13. The method for receiving data message by multiple sending and selectively receiving according to claim 11, wherein the step of extracting the feature code in the identification field and the sequence number in the de-duplication array further comprises:

extracting a high bit of the identification field as the feature code, and extracting a low bit of the identification field as the sequence number in the de-duplication array.

14. The method for receiving data message by multiple sending and selectively receiving according to claim 11, wherein the sequence number in the de-duplication array includes a sequence number distinguishing the data messages to be sent in this round, and the feature code comprises an identifier determining a round of the data messages.

15. The method for receiving data message by multiple sending and selectively receiving according to claim 11, wherein the step of performing a de-duplication judgment in the de-duplication array based on the feature code and the sequence number in the de-duplication array, and discarding the data messages or the copies of the data messages if the same element is present in a same position of the de-duplication array, further comprises:

locating a corresponding element in the de-duplication array by the sequence number in the de-duplication array; and

comparing whether the feature code is the same as the element, and discarding the data messages or the copies of the data messages if the feature code is the same as the element.

16. The method for receiving data message by multiple sending and selectively receiving according to claim 11, wherein the step of performing a de-duplication judgment in the de-duplication array based on the feature code and the sequence number in the de-duplication array, further comprises:

covering, by the feature code, the element in the de-duplication array located using the sequence number in the de-duplication array if the same element is not matched in the de-duplication array.

17. The method for receiving data message by multiple sending and selectively receiving according to claim 11, wherein before the step of receiving the data message and at least one copy of data message corresponding thereto via different links, respectively, the method further comprises:

receiving a length M of the feature code and a parameter N of the length of the de-duplication array,

generating the de-duplication array based on the length M of the feature code and the parameter N of the length of the de-duplication array, wherein a storage space of the de-duplication array is $M \times 2^N$.

18. The method for receiving data message by multiple sending and selectively receiving according to claim 11, wherein before the step of receiving the data message and at least one copy of data message corresponding thereto via different links, respectively, the method further comprises:

setting a length of the de-duplication array in this round based on a number of data messages received in a previous round.

19. The method for receiving data message by multiple sending and selectively receiving according to claim 11, wherein before the step of receiving the data message and at least one copy of data message corresponding thereto via different links, respectively, the method further comprises:

testing a network status of the different links; and

setting a length of the de-duplication array based on the network status.

20. The method for receiving data message by multiple sending and selectively receiving according to claim 19, wherein before the step of receiving the data message and at least one copy of data message corresponding thereto via different links, respectively, the method further

comprises:

sending a length M of the feature code and a parameter N of the length of the de-duplication array, wherein the length M of the feature code is set based on the parameter N of the length of the de-duplication array, and a lower limit of the length M of the feature code is 1.

21. An apparatus for multiple sending and selectively receiving of sending end, comprising:
 an acquisition unit configured to acquire a data message to be sent;
 an identification field adding unit configured to add an identification field to each of the data messages, wherein the identification field comprises a feature code of the data messages and a sequence number in a de-duplication array;
 a replication unit configured to replicate the data messages at least once to obtain at least one copy of the data messages; and
 a sending unit configured to send the data messages and the copies of the data messages sent respectively via different links.

22. An apparatus for multiple sending and selectively receiving of receiving end, comprising:

a receiving unit configured to receive a data message and at least one copy of data message corresponding thereto via different links, respectively;

a parsing unit configured to parse an identification field in the data message and the copies of the data message corresponding thereto, and extract a feature code in the identification field and a sequence number in a de-duplication array; and

a processing unit configured to perform a de-duplication judgment in the de-duplication array based on the feature code and the sequence number in the de-duplication array, and discard the data message or the copies of the data message if a same element is present in the de-duplication array.

23. A system for data message multiple sending and selectively receiving, comprising:

a sending end further comprising: a communication entity of sending end, a multiple sending and selectively receiving module of sending end, and a network communication module of sending end; and

a receiving end further comprising: a communication entity of receiving end, a multiple sending and selectively receiving module of receiving end, and a network communication module of receiving end, wherein

the communication entity of sending end sends a data message to the multiple sending and selectively receiving module of sending end, the multiple sending and selectively receiving module of sending end acquires the data message and adds an identification field to each of the data messages, wherein the identification field comprises a feature code of the data messages and a sequence number in a de-duplication array, replicates the data messages at least once to obtain at least one copy of the data messages; and sends the data messages and the copies of the data messages to the network communication module of sending end; the network communication module of sending end sends the data messages and the copies of the data messages via different links, respectively; and

the network communication module of receiving end receives data messages and at least one copy of data messages corresponding thereto via different links, respectively; the multiple sending and selectively receiving module of receiving end parses the identification field in the data messages and the copies of the data messages corresponding thereto, and extracts the feature code in the identification field and the sequence number in a de-duplication array; and performs a de-duplication judgment in the de-duplication array based on the feature code and the sequence number in the de-duplication array, and discards the data messages or the copies of the data messages if a same element is present in the de-duplication array; and the communication entity of receiving end performs a subsequent processing on the de-duplicated data messages.

24. A computer device, comprising: a memory, a processor and a computer program stored in the memory and runnable in the processor, wherein the method of any one of the claims 1-20 is implemented when the computer program is executed by the processor.

25. A computer-readable storage medium, wherein a computer program is stored on the computer-readable storage medium, and the method according to any one of the claims 1-20 is implemented when the computer program is executed by a processor.