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(54) Title: REDUCED PACKET HEADER IN WIRELESS COMMUNICATIONS NETWORK

7E	Alias Address (A)	Type (2 bytes)	Data (46-576 bytes)	7E

7E	00	Source (6 bytes)	Destination (6 bytes)	Alias Address (A)	7E

7E	01	Source (6 bytes)	Destination (6 bytes)	Alias Address (A)	7E

(57) Abstract

Methods, systems and computer program products are provided which reduce overhead in the communication of messages having a message header over a communication link. An alias address is selected from a predefined set of alias addresses and associated with a portion of the header of the message. If no unused alias addresses are available the least recently used alias address is associated with the portion of the message header. The portion of the message header is removed from the message and the alias address substituted. This reduced data message is then transmitted. The number of alias addresses may be increased to avoid churning of alias addresses. The message is reconstructed based on the alias address and the associated portion of the original message.

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REDUCED PACKET HEADER IN WIRELESS COMMUNICATIONS NETWORK

Field of the Invention

The present invention relates to communication networks and more particularly to communications networks which utilize packet communication protocols such as the Ethernet protocol.

Background of the Invention

In computing and communications it has become commonplace to network computers or other data processing devices. One problem with networking processing systems relates to the infrastructure necessary to communicate between processors. Typically, communication occurs over a hardwired interface utilizing a communication protocol such as the Ethernet protocol. However, this infrastructure is not always available or, it may be impractical in certain environments or for certain applications to create a fixed infrastructure. For example, in a residential building it may be impractical or prohibitively expensive to wire the structure for a computer network. Similarly, in a business environment, portable processing systems may need to be moved from

location to location while still maintaining a link to a network.

As a result of these and other such situations, wireless and other communication systems which reduced the amount of fixed infrastructure have been utilized as the mechanism for communication between processing systems. However, wireless systems have typically been either expensive to operate or had reduced bandwidth in comparison to hardwired systems. While a dedicated wireless system may be operated at increased speed, often, these wireless networks are integrated with existing hard-wired networks and, thus, it may be desirable to use the existing networking protocols such as Ethernet, token ring or the networking protocols. However, the Ethernet protocol and other conventional networking protocols were not developed for use in a wireless environment and may be inefficient when operated in a wireless network environment.

In light of the above discussion, a need exists for increased performance in wireless communications so as to more efficiently allow operation of existing communication protocols over wireless communication links.

Summary of the Invention

In view of the above discussion, it is an object of the present invention to provide improved efficiency in networking computers over wireless and other reduced bandwidth communication links.

A further object of the present invention is to provide an increase in throughput over reduced bandwidth communication links which is transparent to users of the communication links.

Still another object of the present invention is to provide increased throughput of a communication link while remaining compatible to existing networking protocols.

These and other objects of the present invention are provided by methods, systems and computer program products which reduce overhead in the communication of messages having a message header over a communication link. This reduction in overhead may be accomplished after receiving a message to be transmitted on the communication link by determining if an unused alias address from a first predefined set of alias addresses is available. If an unused alias address is available, the unused alias address is associated with at least a portion of the header of the received message. If an unused alias address is not available, a used alias address from the first predefined set of alias addresses is associated with at least a portion of the header of the received message. At least a portion of the message header from a subsequent message having a message header, a portion of which is substantially identical the message header of the received message, is then removed to provide a reduced data message. The reduced data message and the associated alias address are then transmitted on the

communication link. The communication link may be a wireless communication link.

By associating an alias address with header information of a message, the alias address may be substituted for the header information. This substitution may result in fewer bytes of data being transmitted over the communication link. Furthermore, by automatically selecting used links which have not been recently used the present invention eliminates the need to "take down" a link which has previously been established. Thus, no overhead is associated with removing an unused link.

In a particular embodiment of the present invention, the alias address and at least a portion of the message header associated with the message are transmitted on the communication link. A confirmation of the association of the portion of the message header and the associated alias address may also be received from the communication link. A transmitted reduced data message may then be received from the communication link and the subsequent message reconstructed from the portion of the message header associated with the received alias address and the reduced data message.

By associating the alias address with a portion of the header of the original message and then reconstructing the original message based on the alias address, the present invention provides for reduced overhead per communication. The reduction in overhead may be achieved for any protocol with a header which

identifies multiple packets in a message independent of the protocol of the original message because the original message is reconstructed to conform to the protocol but the format of the reduced data packet transmitted on the communication link may be independent of the format of the original message provided that the header information may be separated from the data portion of the message.

In another embodiment of the present invention, alias addresses associated with at least a portion of a message header are identified as used. However, used alias addresses may be associated with a portion of a message header by determining when each used alias address from the first predefined set of alias addresses was last utilized so as to provide a last time of use for each of the used alias addresses. A used alias address with the oldest last time of use is then associated with the portion of the header of the received message if an unused alias address is not available. Thus, the present invention may avoid the need to take down no longer used alias address associations.

In one particular embodiment of the present invention, the portion of the message header removed to create the reduced data message includes a source address and a destination address of the message.

In another embodiment of the present invention, the association of alias addresses with the message headers is monitored. The number of alias addresses in the first predefined set of alias

addresses is increased based upon the monitoring so as to provide a second predefined set of alias address.

By monitoring the association of alias addresses, the present invention may selectively increase the number of available addresses to reduce the amount of communication bandwidth utilized to establish alias address associations. Thus, the number of available addresses may be dynamically adjusted to reduce the likelihood of "churning" of alias addresses.

In a further embodiment of the present invention, alias addresses are removed from the second predefined set of alias addresses if the alias addresses are determined to be inactive. In particular, where the second predefined set of alias addresses comprises a combination of the first predefined set of alias addresses and a third predefined set of alias addresses, the number of alias addresses may be reduced to the first predefined set of alias addresses if all of the third predefined set of alias addresses have been removed from the second predefined set of alias addresses. Thus, the number of alias addresses may also be dynamically reduced if the number of alias addresses needed to avoid churning declines.

As will further be appreciated by those of skill in the art, the present invention may be embodied as a method, apparatus/system or computer program product.

Brief Description of the Drawings

Figure 1 is block diagram of a communication system utilizing one embodiment of the present invention;

Figures 2A through 2C are illustrations of data packets utilized by one embodiment of the present invention;

Figure 3 is a flowchart illustrating operations carried out upon receipt of a packet by a communications interface according to one embodiment of the present invention;

Figure 4 is a flow chart illustrating operations carried out upon receipt of data from a communication link by a communications interface according to one embodiment of the present invention;

Figures 5A through 5E are illustrations of data packets utilized by an alternative embodiment of the present invention;

Figure 6 is a flowchart illustrating operations carried out upon receipt of a packet by a communications interface according to an alternative embodiment of the present invention;

Figure 7 is a flow chart illustrating operations carried out upon receipt of data from a communication link by a communications interface according to an alternative embodiment of the present invention; and

Figure 8 is a flow chart illustrating operations carried out upon receipt of data from a communication link by a communications interface according to a second alternative embodiment of the present invention.

Detailed Description of the Invention

The present invention now will be described more fully hereinafter with reference to the accompanying drawings, in which preferred embodiments of the invention are shown. This invention may, however, be embodied in many different forms and should not be construed as limited to the embodiments set forth herein; rather, these embodiments are provided so that this disclosure will be thorough and complete, and will fully convey the scope of the invention to those skilled in the art. Like numbers refer to like elements throughout. As will be appreciated by one of skill in the art, the present invention may be embodied as methods or devices. Accordingly, the present invention may take the form of an entirely hardware embodiment, an entirely software embodiment or an embodiment combining software and hardware aspects.

Figure 1 illustrates one embodiment of the present invention. As seen in Figure 1, a source 10 for a communication message has access to a wireless communication interface 12. A destination of the communication message has access to a second wireless communication interface 14 which communicates with the first wireless communication interface 12 over wireless communication link 16.

In a particular embodiment of the present invention the source 10 and destination 18 are Ethernet sources and destinations. In such a case the communications interfaces 12 and 14 may be wireless Ethernet adapters or other adapters capable of

transmitting Ethernet packets over a wireless communication link. The source and destination devices may be network computers, workstations, personal computers, personal information managers or other devices capable of acting as the source or destination of a data packet in a packet communication protocol such as the Ethernet communication protocol.

While the present invention is described herein with reference to the Ethernet protocol, as will be appreciated by those of skill in the art, other packet based communication protocols may also benefit from the teachings of the present invention. For example, Transport Control Protocol/Internet Protocol (TCP/IP), Asynchronous Transfer Mode (ATM) protocol and other such packet communication based protocols may be utilized with the teachings of the present invention.

Furthermore, the present invention is described herein with reference to wireless communication links, however, the present invention should not be construed as limited to wireless communications. As used herein the term communication link refers to any type of link between two processors remote from each other which allows communications between the two processors. The teachings of the present invention may be beneficial to any communication link where the amount of data to be transmitted over the communication link is to be reduced. Examples of such communication links include low-speed modem communications, satellite communication links, cellular communication links, radio frequency

communication links, microwave communication links or any communication link with a rate schedule based on the amount of data transferred across the communication link.

Figure 1 illustrates a single source and a single destination which may communicate through communication link 16. However, as will be appreciated by those of skill in the art, multiple sources and destinations may be accessible through communication interfaces 12 and 14. Furthermore, the communication between a source and a destination may be in either direction across communication link 16. Communication interfaces 12 and 14 may each provide access to both sources and destinations which utilize communication interfaces 12 and 14 to communicate across communication link 16. Accordingly, Figure 1 is exemplary and should not be construed as limiting the present invention.

In overview, the operation of certain embodiments of the present invention provides for data reduction in the transmission of packets over a communication link, such as the wireless communication link 16, by reducing the header size of the communication packets. More specifically, data packets with routing information, such as destination and source addresses, are stripped of this header information prior to transmission on the communication link. An alias address is assigned to the header and the alias address is added to the data packet. As used herein the term "alias address" refers to a designation

associated the header information of the original message such that the original message may be recreated knowing the alias address. The data and alias address are then transmitted on the communication link. The receiving side of the communication link receives the modified data packet and reconstructs the original data packet based on the alias address received. Subsequent messages with the same source and destination addresses are then also stripped of the source and destination address information and the associated alias address used for communication over the communication link. Because the alias address can be smaller than the corresponding source and destination address of the original header, the amount of data transmitted over the communication link may be reduced.

In specific aspects of the present invention, alias addresses are assigned to unused alias addresses until all of the alias addresses have been utilized. After all of the alias addresses have been utilized, when a data packet with a new source and destination is received for transmission on the communication link, the least recently used alias address is reassigned to the new source and destination addresses. Thus, the present invention may alter the alias address associations without the overhead of explicitly terminating previous alias address associations. Furthermore, if it is determined that the assignment of alias addresses is occupying too large an amount of the bandwidth of the communication link, the size of the

alias address may be expanded to reduce the rate at which reassignment occurs.

The specific operation of various embodiments of the present invention will now be described with respect to an Ethernet example and the block diagram of **Figure 1**. Reference is also made to **Figures 3, 4 and 6** through 8 which are flowchart illustrations of embodiments of the present invention. It will be understood that each block of the flowchart illustrations, and combinations of blocks in the flowchart illustrations, can be implemented by computer program instructions. These program instructions may be provided to a processor to produce a machine, such that the instructions which execute on the processor create means for implementing the functions specified in the flowchart block or blocks. The computer program instructions may be executed by a processor to cause a series of operational steps to be performed by the processor to produce a computer implemented process such that the instructions which execute on the processor provide steps for implementing the functions specified in the flowchart block or blocks.

Accordingly, blocks of the flowchart illustrations support combinations of means for performing the specified functions, combinations of steps for performing the specified functions and program instruction means for performing the specified functions. It will also be understood that each block of the flowchart illustrations, and combinations of blocks in the flowchart illustrations, can be

implemented by special purpose hardware-based systems which perform the specified functions or steps, or combinations of special purpose hardware and computer instructions.

Figure 3 illustrates the operation of a communications interface, such as the wireless communications interface 12, when a data packet is received for transmission on a communication link, such as the wireless communication link 16. As is illustrated in Figure 3, when the wireless communication interface 12 receives the data packet from source 10, the wireless communication interface 12 extracts the header from the data packet and determines the source and destination addresses from that header (block 30). It is then determined if an existing link (*i.e.* an alias address) has been associated with the source and destination address across the communication link 16 has been established for that source and destination address (block 32). If a link has not been established the least recently used alias address is assigned to the source and destination address (block 34) and a request is sent on the communication link 16 to assign the alias address to the source and destination address (block 36). The least recently used alias address will be an unused alias address if all alias addresses have not been assigned. In the present example, the alias address is one byte (8 bits) in size with 2 addresses ("00" and "01") being reserved for control so as to define a predefined set of 254 alias addresses such that 254 alias addresses would

need to be assigned before a previously assigned alias address (used alias address) would be reused.

Figure 2B illustrates a data packet transmitted on the communication link 16 by a communication interface 12 or 14 to request that a link be established. The format of the data packet includes "00" as the first byte of the data packet after the frame header. The "00" indicates that the packet is requesting that a link be established. The next 12 bytes of the packet specify the source and destination address of the original data packet. The source and destination addresses are then followed by one byte which specifies the requested alias address to be associated with the source and destination addresses. Utilizing the format illustrated in Figure 2B a link request is a 16 byte packet.

Returning to Figure 3, after transmitting the request to establish a link, the communication interface 12 and 14 sets a reassignment flag (block 38) which is used as part of a handshake with the receiving communication interface 14 or 12 to verify that the link is established (*i.e.* both sides of the communication link 16 have the same association of source and destination address to alias address) and waits for an acknowledgment packet to be received from the communication link 16. After receiving the acknowledgment, the communication interface 12 or 14 checks to see if the reassignment flag remains set (block 40). If the reassignment flag remains set then the request for the link failed and a new alias address

is selected (block 34) and the process repeated (blocks 36 and 38). This process may be repeated until a link is established or may repeated for a finite number of attempts and, if still unsuccessful, the message may be discarded or an error notification provided to the source of the packet.

If the reassignment flag is not set (block 40), then a link has been established. The communication interface 12 or 14 then checks the CRC of the original packet (block 42) and discards the packet if a CRC error is indicated (block 44). Alternatively, the CRC check could be performed prior to establishing a link.

If no CRC error is detected, then the CRC and source and destination addresses are removed from the packet and replaced with the alias address (block 46). A format for the packet to be transmitted on the communication link 16 in the present Ethernet example is illustrated in Figure 2A. As seen in Figure 2A, the packet transmitted across the communication link 16 includes the frame header followed by the alias address (1 byte), followed by the message type (2 bytes) and then 46 to 576 bytes of data. After creation of the reduced data packet, the reduced data packet is transmitted on the communication link 16 (block 48).

The processing of subsequent data packets received by a communication interface 12 or 14 having the same alias address is also illustrated in Figure 3. As is seen in Figure 3, when the packet is received the header is extracted (block 30) and it is determined if

a link exists (block 32). Because the packet is a subsequent packet, a link exists and the reassignment flag will not be set (block 40). The CRC of the packet is checked (block 42) and if no error is indicated the header information is removed (block 46) and the reduced data packet transmitted on the communication link 16 (block 48).

Figure 4 illustrates the operations of a communication interface 12 or 14 according to one embodiment of the present invention when a packet is received from the communication link 16. When a packet is received, the first byte (C) after the frame header "7E" is extracted (block 50) and it is determined if the first byte after the frame header specifies a request to establish a link (C="00")(block 52). If the first byte after the frame header specifies a link request, the source, destination and alias address fields of the packet (see Figure 2B) are extracted (block 54) and the alias address is associated with the source and destination addresses (block 56). A confirmation packet is then constructed (block 58) and scheduled for transmission on the communication link 16 (block 60).

Figure 2C illustrates a data packet transmitted on the communication link 16 by a communication interface 12 or 14 to confirm that a link has been established. The format of the data packet includes "01" as the first byte of the data packet after the frame header (C="01"). The "01" indicates that the packet is confirming that a link has been

established. The next 12 bytes of the packet specify the source and destination address of the original data packet. The source and destination address are then followed by one byte which specifies the alias address which has been associated with the source and destination addresses. Utilizing the format illustrated in **Figure 2C** a link confirmation packet is a 16 byte packet.

Returning to **Figure 4** at block 52, if the first byte after the frame header of the packet is not a "00" it is determined if the byte is a "01" (block 62) indicating that the packet is a confirmation packet as illustrated in **Figure 2C**. If the first byte after the frame header specifies a link confirmation packet then the source, destination and alias address fields of the packet (*see* **Figure 2C**) are extracted (block 64) and the reassignment flag associated with the alias address is reset (block 66). Processing then continues as described above with respect to **Figure 3** to transmit the data of the original packet over the communication link 16.

If the first byte after the frame header is not "00" or "01" then the packet is a data packet of the format specified in **Figure 2A**. The first byte after the frame header then specifies the alias address of the packet which is matched with the source and destination address pair associated with the alias address (block 68). The original packet is then reconstructed and scheduled for transmission to the original destination 18 (block 72).

Figure 5A through 8 illustrate an alternative embodiment of the present invention where the size of the alias address may be expanded. Such an embodiment reduces the likelihood of "churning" of alias addresses. Because there is some overhead associated with establishing a link which associates the alias address with the source and destination addresses a condition may arise where a large percentage of the communication link 16 bandwidth is taken up by packets which establish links. The onset of this condition, referred to herein as "churning," may be delayed or prevented by expanding the alias address field to include two bytes of address data, thus substantially increasing the number of available alias addresses and reducing the frequency of alias address reassignments.

Figures 5A and 5B illustrate examples of the single byte and double byte addresses associated with the alternative embodiment of the present invention. As seen in Figure 5A, the first bit of the single byte address is set to "0" to indicate the single byte address. Figure 5B illustrates that the first bit of the extended address field is set to "1" to indicate an extended address.

Figure 6 illustrates the operation of the alternate embodiment of the present invention when receiving a packet for transmission on the communication link 16. As seen in Figure 6, the communication interface 12 or 14 first determines if an existing link is associated with the source and destination addresses of the received packet (block

80). If no link exists, then it is determined if an unused alias address is available (block 82). If extended alias addresses are not in use then this determination is made based on the availability of single byte alias addresses. If extended addresses are in use then this determination is made based upon the availability of an extended alias address. If no unused alias address is available then it is determined if alias addresses are churning (block 84).

The determination of whether churning is occurring may be made by tests based on the ratio of link-establishment requests to data packets transmitted over the communication link or the time since the full address space was reassigned (for example, the time lapsed during the most recent 254 reassignment of 8-bit aliases), or other methods known to those of skill in the art. In one embodiment, churning is declared when the probability (as estimated by relative frequency of occurrence) becomes too great that an active link will be interrupted by alias reassignment, where a link is considered active if it was used during last T milliseconds.

If churning is occurring, then the field length of the alias address field is extended to more than one byte and extended aliases are used (block 86). An alias address is then selected from the unused extended alias addresses (block 90). If churning is not occurring, then the least recently used alias is selected for association with the source and destination addresses (block 88). If extended alias

addresses are not in use then this selection is made based on the last use of single byte alias addresses. If extended addresses are in use then this selection is made based upon the last use of an extended alias address.

In either case, once an alias address is selected a link establishment request is sent on the communication link (block 92). The format of exemplary link establishment request packets are seen in Figure 5D for an extended alias address and Figure 2B for a single byte address. Figure 2B is described above. Figure 5D illustrates a data packet transmitted on the communication link 16 by a communication interface 12 or 14 to request that an extended alias address link be established. The format of the data packet includes "02" as the first byte of the data packet after the frame header. The "02" indicates that the packet is requesting that an extended alias address link be established. The next 12 bytes of the packet specify the source and destination address of the original data packet. The source and destination address are then followed by two bytes which specify the requested alias address to be associated with the source and destination addresses. Utilizing the format illustrated in Figure 5D a link request is a 17 byte packet.

After transmitting the link establishment request, the communication interface 12 or 14 waits to receive confirmation that the link has been established (block 94). The operations for establishing a link

(block 92 and 94) may be carried out as described above with reference to Figures 3 and 4 where a retry on error technique is used to establish the link.

Once the link is established the original data packet is altered as described above to remove the source and destination addresses and the CRC and to include the alias address so as to provide a reduced data packet (block 96). This reduced data packet is then sent on the link 16 (block 98). The format of exemplary reduced data packets are illustrated in Figure 2A and Figure 5C.

Figures 7 and 8 illustrate operations of alternative embodiments of the present invention which utilize extended alias addressing when a packet is received from the communication link 16. As seen in Figure 7, when a packet is received from communication link 16, the first byte after the frame header is extracted (block 100). If the first byte is a "00" or "02" then the packet is a link establishment request and the appropriate source, destination and alias addresses are extracted from the packet (block 102 and block 104) based on the format of the packet (*See* Figure 2B and Figure 5D). The extracted alias address is then associated with the source and destination addresses (block 106). A confirmation packet is then constructed (block 108) and scheduled for transmission on the communication link 16 (block 110).

The format of the confirmation packet corresponds to the format of the establishment request. Accordingly, if a "00" link establishment request is

received, then the "01" format confirmation packet illustrated in **Figure 2C** is constructed. The confirmation packet format of **Figure 2C** is described above. However, if the link establishment request received was a "02" extended alias address link establishment request then a confirmation packet having the format of **Figure 5E** is constructed.

Figure 5E illustrates a data packet transmitted on the communication link 16 by a communication interface 12 or 14 to confirm that an extended alias address link has been established. The format of the data packet includes "03" as the first byte of the data packet after the frame header. The "03" indicates that the packet is confirming that an extended alias address link has been established. The next 12 bytes of the packet specify the source and destination address of the original data packet. The source and destination address are then followed by two bytes which specify the requested alias address to be associated with the source and destination addresses. Utilizing the format illustrated in **Figure 5E** a link confirmation packet is a 17 byte packet.

Returning now to **Figure 7**, if the first byte after the frame header of the packet received from the communication link 16 is not a "00" or "02," then it is determined if the first byte after the frame header is "01" or "03" (block 112). If the first byte is a "01" or "03" then the packet is a confirmation packet and the appropriate source, destination and alias addresses are extracted from the packet (block 112 and block 114)

based on the format of the packet (*See* Figure 2C and Figure 5E). The reassignment flag associated with the extracted alias address is then reset to indicate that that the link was successfully established (block 116).

If the first byte after the frame header of the received packet is not a "00", "01", "02" or "03" then the packet is a data packet of one of the formats shown in Figure 2A or Figure 5C. The alias address may be determined from the data packet by examining the first bit of the first byte after the frame header. If that bit is a "0" then a single byte alias address is used (*see* Figure 5A), however, if that bit is "1" then an extended alias address is used (*see* Figure 5B). In either case the alias address is extracted from the packet and matched with the associated source and destination pair (block 118). The original packet is then reconstructed, including the CRC (block 120) and scheduled for transmission to the destination (block 122).

Figure 8 illustrates the operation of an alternative embodiment of the present invention which utilizes extended alias addressing when a packet is received from the communication link 16 but does not utilize separate request and confirmation packets for extended alias addresses. By utilizing the same methodology to determine if churning is occurring, both sides of the communication link 16 may determine if churning is occurring independently, thereby avoiding the need for explicit signaling that extended alias addresses are to be used.

As seen in Figure 8, when a packet is received from communication link 16, the first byte after the frame header is extracted (block 130). If the first byte is a "00" or "01" the packet is either a link establishment request or a confirmation packet and it is then determined if churning is occurring (blocks 132 and 142) which would indicate whether or not single byte or extended alias addressing is used. Alternatively, the receiving communication interface could examine the first bit of the alias address field to determine if it was a "0" indicating single byte or a "1" indicating extended alias addressing. The communication interface could also determine the total length of the packet and, if that length is 16 bytes the single byte alias addressing is used. If the packet is 17 bytes, then extended alias addressing is used. In either case, after it is determined if single byte or extended alias addressing is used, the appropriate source, destination and alias addresses are extracted from the packet (block 140 or block 144) based on the format of the packet (*See* Figures 2B and 2C or Figure 5D and 5E).

After extracting the alias address, it is then determined if the first byte after the frame header is "00" indicating a link request packet (block 146). If not, then the packet is a link confirmation and the reassignment flag associated with the alias address is reset (block 148). If the first byte after the frame header is a "00" then the packet is a link establishment request and the alias address is assigned

to the source and destination (block 150) and the appropriate confirmation packet constructed (block 152). The confirmation packet is then scheduled for transmission on the communication link 16 (block 154).

Returning to block 132, if the first byte after the frame header is not a "00" or a "01" then the packet is a data packet. The alias address is extracted as described above utilizing the first bit of the address to determine if the address is extended (block 134). The original packet is then reconstructed (block 136) and scheduled for transmission to the destination (block 138).

The association of alias addresses with source and destination addresses may be made using any number of techniques for association of items. For example, a look-up table or a linked list may be used to create the association between the alias address and the source and destination addresses. In a table implementation the alias address, source and destination addresses and time of last use of the alias address may be maintained at each side of the communication link 16 so as to facilitate selection of the previously used alias address which has been used the least recently.

In the extended alias address embodiment of the present invention, a "trash-collection" routine periodically examines the time of last use for each link that has an extended-length alias, and long-idle links with extended addresses are removed from the tables at both ends of the communication link 16. In

this way, alias length drifts back to its shortest option. Once no extended-field aliases are present in the tables, use of the "02" and "03" messages is held in abeyance until churning is once again detected, and the bridge tables are returned to their pre-expansion size.

Alternatively, the "trash-collection" routine could periodically remove from the tables at both ends links which have a time of last use older than a predefined threshold. When the total number of links falls below the number of links available in the set of non-extended alias addresses, the extended alias address links could be re-assigned to non-extended alias addresses for subsequent communications. As will be appreciated by those of skill in the art in light of the present disclosure, other methods of returning the system to operating with non-extended alias addresses could also be utilized.

While the present invention has been described with respect to the Ethernet communication protocol, as will be appreciated by those of skill in the art, the teachings of the present invention may be applied to other communication protocols. For example, if the communication interfaces 12 and 14 perform IP routing functions and the Ethernet packets contain IP datagrams, the communications interfaces 12 and 14 could also strip the IP routing information from within the datagrams. In such a case the routing information could either be saved or recalculated to provide the next hop in the datagrams path. Thus, the present

invention can be used with TCP/IP to further reduce overhead where the Ethernet and IP addressing are stripped and the gateway or router at each end re-bundles the IP datagram in an Ethernet packet which specifies the next hop in the IP path.

In the drawings and specification, there have been disclosed typical preferred embodiments of the invention and, although specific terms are employed, they are used in a generic and descriptive sense only and not for purposes of limitation, the scope of the invention being set forth in the following claims.

THAT WHICH IS CLAIMED IS:

1. A method of reducing overhead in communication of messages having a message header over a communication link, the method comprising the steps of:

receiving a message to be transmitted on the communication link;

determining if an unused alias address from a first predefined set of alias addresses is available;

associating an unused alias address from the first predefined set of alias addresses with at least a portion of the header of the received message if an unused alias address is available;

associating a used alias address from the first predefined set of alias addresses with at least a portion of the header of the received message if an unused alias address is not available;

removing at least a portion of the message header from a subsequent message having a message header, a portion of which is substantially identical the message header of the received message, to provide a reduced data message; and

transmitting the reduced data message and the associated alias address on the communication link.

2. A method according to Claim 1, wherein said removing step is preceded by the step of transmitting the alias address and at least a portion

of the message header associated with the message on the communication link.

3. A method according to Claim 2, further comprising the step of receiving from the communication link a confirmation of the association of the at least a portion of the message header and the associated alias.

4. A method according to Claim 1, further comprising the steps of:

receiving an alias address and a transmitted reduced data message from the communication link;

reconstructing the subsequent message from the at least a portion of the message header associated with the received alias address and the reduced data message.

5. A method according to Claim 1, further comprising the step of identifying as used an alias address associated with at least a portion of a message header.

6. A method according to Claim 1, wherein said step of associating a used alias address from the first predefined set of alias addresses comprises the steps of:

determining when each used alias address from the first predefined set of alias addresses was last utilized so as to provide a last time of use for each of the used alias addresses; and

associating a used alias address with the oldest last time of use from the first predefined set of alias addresses with at least a portion of the header of the received message if an unused alias address is not available.

7. A method according to Claim 1, wherein the at least a portion of the message header includes a source address and a destination address of the message.

8. A method according to Claim 1, wherein the communication link is a wireless communication link.

9. A method according to Claim 1, further comprising the steps of:

monitoring the association of alias addresses with the message headers; and

increasing the number of alias addresses in the first predefined set of alias addresses based upon said monitoring so as to provide a second predefined set of alias address.

10. A method according to Claim 9, wherein said increasing step comprises the step of transmitting an increased alias length notification on the communication link.

11. A method according to Claim 9, further comprising the step of removing alias addresses from

the second predefined set of alias addresses if the alias addresses are determined to be inactive.

12. A method according to Claim 11, wherein the second predefined set of alias addresses comprises a combination of the first predefined set of alias addresses and a third predefined set of alias addresses.

13. A method according to Claim 12, further comprising the step of reducing the number of alias addresses to the first predefined set of alias addresses if all of the third predefined set of alias addresses have been removed from the second predefined set of alias addresses.

14. A system for reducing overhead in communication of messages having a message header over a communication link, comprising:

means for receiving a message to be transmitted on the communication link;

means for determining if an unused alias address from a first predefined set of alias addresses is available;

means for associating an unused alias address from the first predefined set of alias addresses with at least a portion of the header of the received message if an unused alias address is available;

means for associating a used alias address from the first predefined set of alias addresses with

at least a portion of the header of the received message if an unused alias address is not available;

means for removing at least a portion of the message header from a subsequent message having a message header, a portion of which is substantially identical the message header of the received message, to provide a reduced data message; and

means for transmitting the reduced data message and the associated alias address on the communication link.

15. A system according to Claim 14, further comprising means for transmitting the alias address and at least a portion of the message header associated with the message on the communication link.

16. A system according to Claim 15, further comprising means for receiving from the communication link a confirmation of the association of the at least a portion of the message header and the associated alias.

17. A system according to Claim 14, further comprising:

means for receiving an alias address and a transmitted reduced data message from the communication link; and

means for reconstructing the subsequent message from the at least a portion of the message header associated with the received alias address and the reduced data message.

18. A system according to Claim 14, further comprising means for identifying as used an alias address associated with at least a portion of a message header.

19. A system according to Claim 14, wherein said means for associating a used alias address from the first predefined set of alias addresses comprises:

means for determining when each used alias address from the first predefined set of alias addresses was last utilized so as to provide a last time of use for each of the used alias addresses; and

means for associating a used alias address with the oldest last time of use from the first predefined set of alias addresses with at least a portion of the header of the received message if an unused alias address is not available.

20. A system according to Claim 14, wherein the at least a portion of the message header includes a source address and a destination address of the message.

21. A system according to Claim 14, wherein the communication link is a wireless communication link.

22. A system according to Claim 14, further comprising:

means for monitoring the association of alias addresses with the message headers; and

means for increasing the number of alias addresses in the first predefined set of alias addresses based upon said monitoring so as to provide a second predefined set of alias address.

23. A system according to Claim 22, wherein said means for increasing comprises means for transmitting an increased alias length notification on the communication link.

24. A system according to Claim 22, further comprising means for removing alias addresses from the second predefined set of alias addresses if the alias addresses are determined to be inactive.

25. A system according to Claim 24, wherein the second predefined set of alias addresses comprises a combination of the first predefined set of alias addresses and a third predefined set of alias addresses.

26. A system according to Claim 25, further comprising means for reducing the number of alias addresses to the first predefined set of alias addresses if all of the third predefined set of alias addresses have been removed from the second predefined set of alias addresses.

27. A computer program product for reducing overhead in communication of messages having a message

header over a communication link, the computer program product comprising:

a computer-readable storage medium having computer-readable program code means embodied in said medium, said computer-readable program code means comprising:

computer-readable program code means for receiving a message to be transmitted on the communication link;

computer-readable program code means for determining if an unused alias address from a first predefined set of alias addresses is available;

computer-readable program code means for associating an unused alias address from the first predefined set of alias addresses with at least a portion of the header of the received message if an unused alias address is available;

computer-readable program code means for associating a used alias address from the first predefined set of alias addresses with at least a portion of the header of the received message if an unused alias address is not available;

computer-readable program code means for removing at least a portion of the message header from a subsequent message having a message header, a portion of which is substantially identical the message header of the received message, to provide a reduced data message; and

computer-readable program code means for transmitting the reduced data message and the associated alias address on the communication link.

28. A computer program product according to Claim 27, further comprising computer-readable program code means for transmitting the alias address and at least a portion of the message header associated with the message on the communication link.

29. A computer program product according to Claim 28, further comprising computer-readable program code means for receiving from the communication link a confirmation of the association of the at least a portion of the message header and the associated alias.

30. A computer program product according to Claim 27, further comprising:

computer-readable program code means for receiving an alias address and a transmitted reduced data message from the communication link; and

computer-readable program code means for reconstructing the subsequent message from the at least a portion of the message header associated with the received alias address and the reduced data message.

31. A computer program product according to Claim 27, further comprising computer-readable program code means for identifying as used an alias address associated with at least a portion of a message header.

32. A computer program product according to Claim 27, wherein said computer-readable program code means for associating a used alias address from the first predefined set of alias addresses comprises:

computer-readable program code means for determining when each used alias address from the first predefined set of alias addresses was last utilized so as to provide a last time of use for each of the used alias addresses; and

computer-readable program code means for associating a used alias address with the oldest last time of use from the first predefined set of alias addresses with at least a portion of the header of the received message if an unused alias address is not available.

33. A computer program product according to Claim 27, wherein the at least a portion of the message header includes a source address and a destination address of the message.

34. A computer program product according to Claim 27, wherein the communication link is a wireless communication link.

35. A computer program product according to Claim 27, further comprising:

computer-readable program code means for monitoring the association of alias addresses with the message headers; and

computer-readable program code means for increasing the number of alias addresses in the first predefined set of alias addresses based upon said monitoring so as to provide a second predefined set of alias address.

36. A computer program product according to Claim 35, wherein said computer-readable program code means for increasing comprises computer-readable program code means for transmitting an increased alias length notification on the communication link.

37. A computer program product according to Claim 35, further comprising computer-readable program code means for removing alias addresses from the second predefined set of alias addresses if the alias addresses are determined to be inactive.

38. A computer program product according to Claim 37, wherein the second predefined set of alias addresses comprises a combination of the first predefined set of alias addresses and a third predefined set of alias addresses.

39. A computer program product according to Claim 38, further comprising computer-readable program code means for reducing the number of alias addresses to the first predefined set of alias addresses if all of the third predefined set of alias addresses have been removed from the second predefined set of alias addresses.

FIG. 1

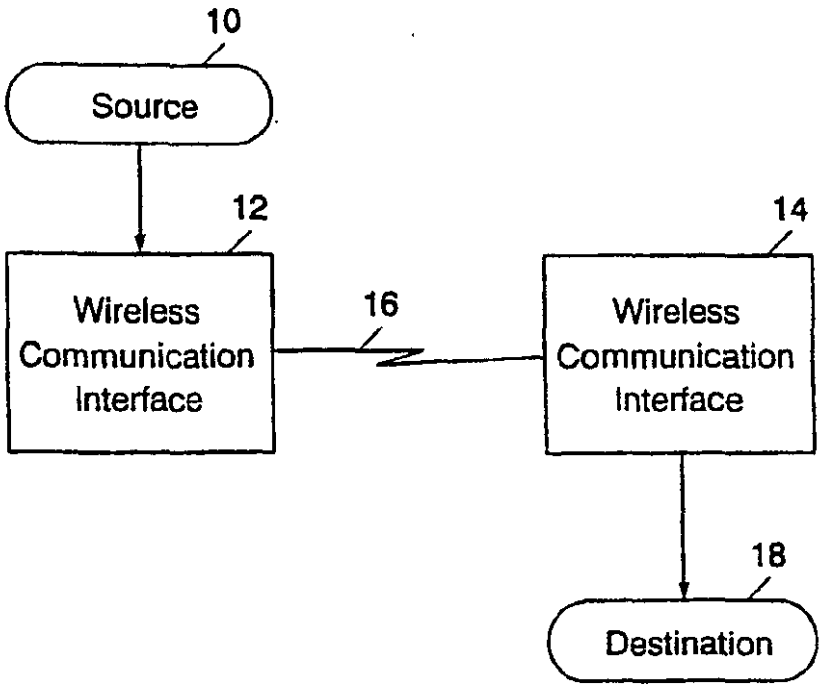

10
Source
12
Wireless Communication Interface
16
14
Wireless Communication Interface
18
Destination

FIG. 2A

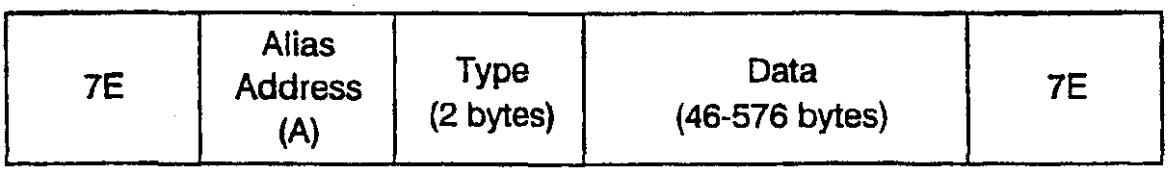


FIG. 2B

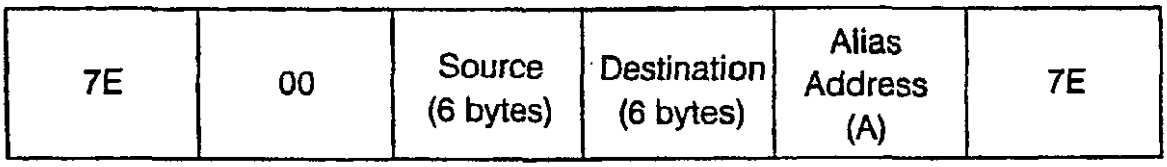


FIG. 2C

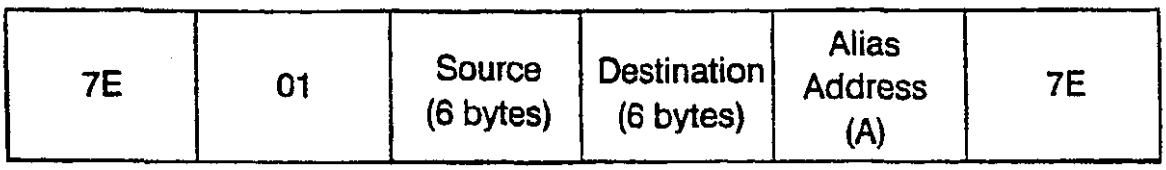


FIG. 3

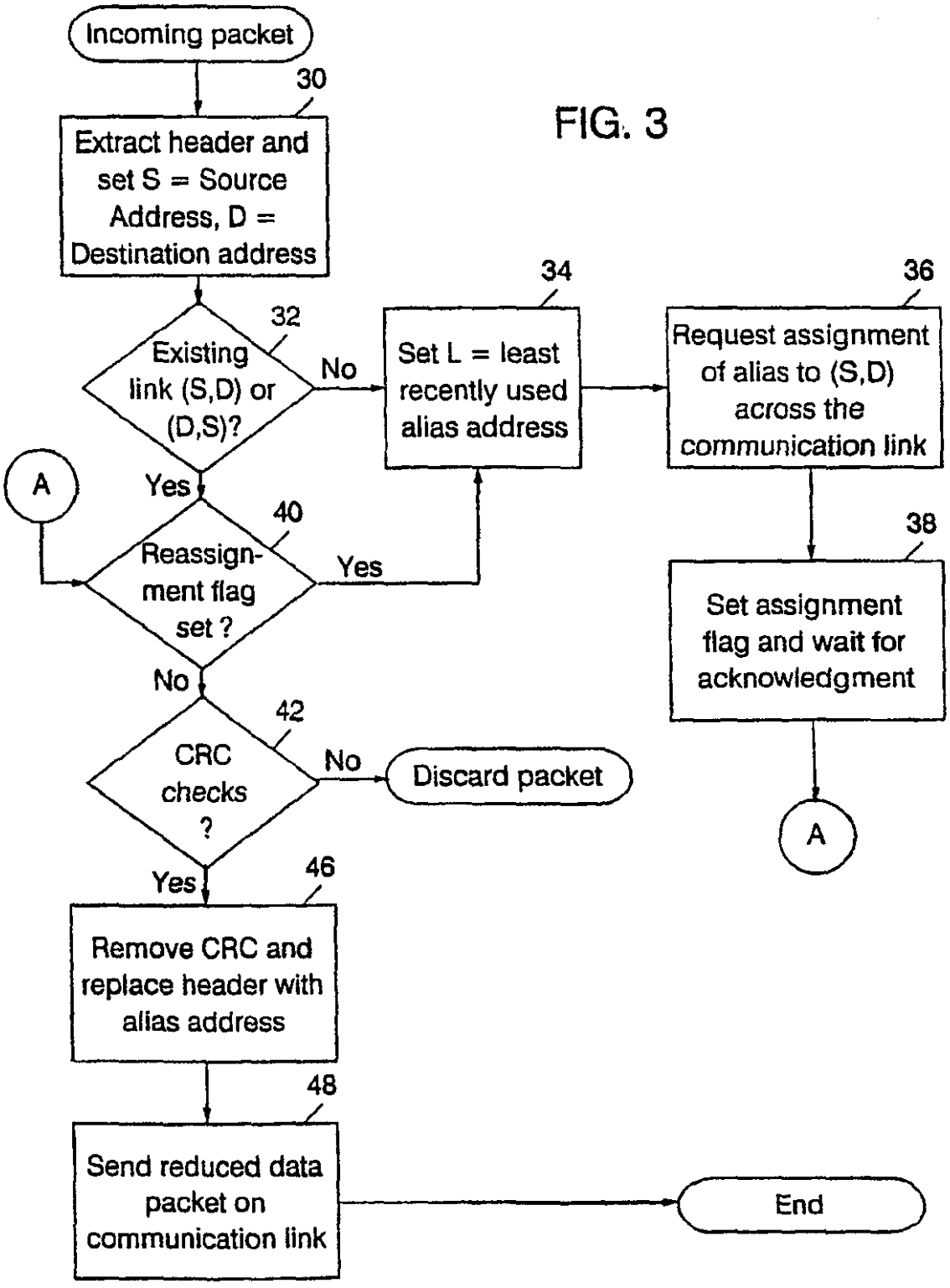

Incoming packet
30
Extract header and set S = Source Address, D = Destination address
32
Existing link (S,D) or (D,S)?
No
34
Set L = least recently used alias address
36
Request assignment of alias to (S,D) across the communication link
A
Yes
40
Reassign-ment flag set ?
Yes
38
Set assignment flag and wait for acknowledgment
No
42
CRC checks ?
No
Discard packet
A
Yes
46
Remove CRC and replace header with alias address
48
Send reduced data packet on communication link
End

FIG. 4

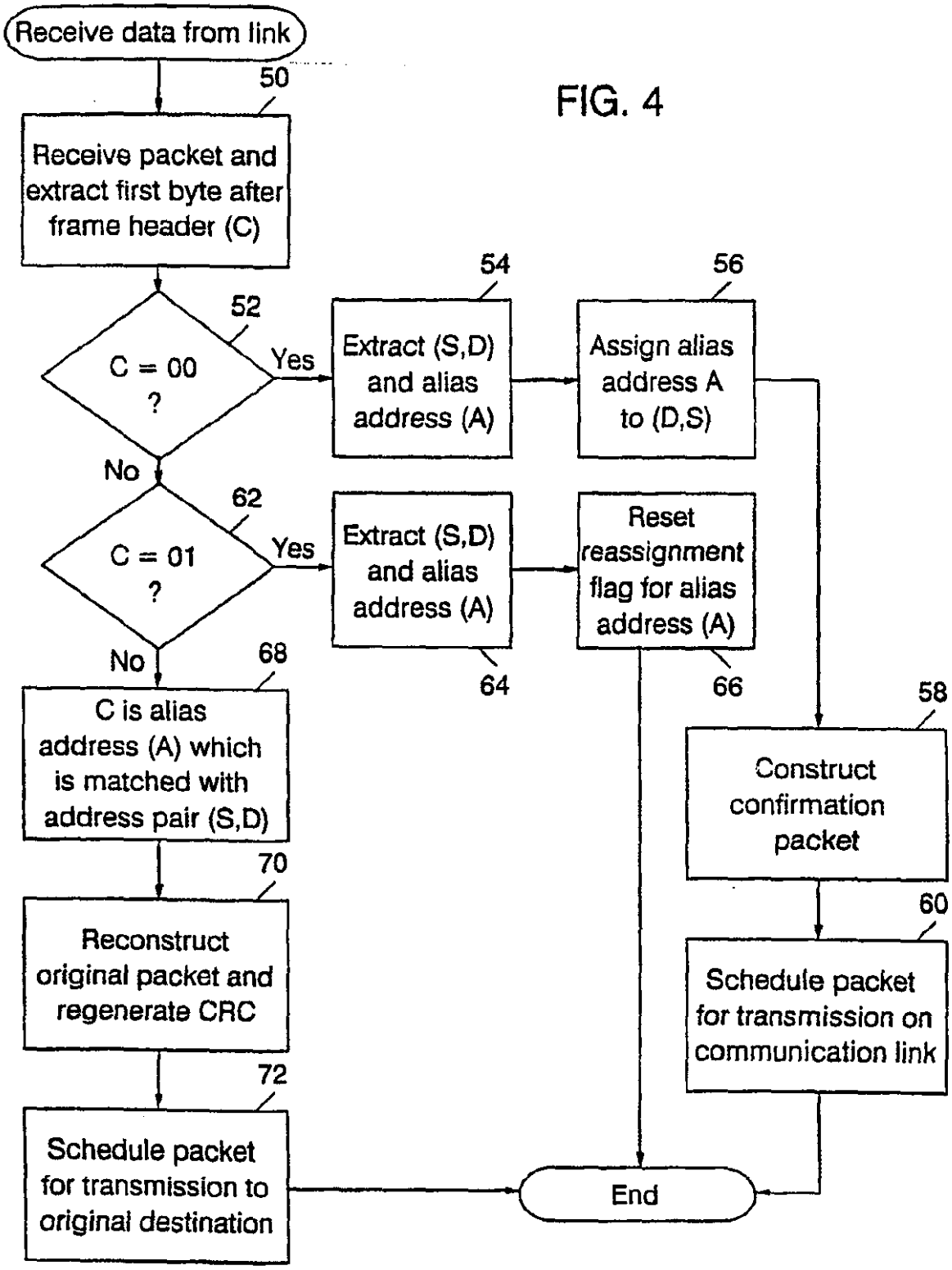

Receive data from link
50
Receive packet and extract first byte after frame header (C)
52
C = 00 ?
Yes
54
Extract (S,D) and alias address (A)
56
Assign alias address A to (D,S)
No
62
C = 01 ?
Yes
Extract (S,D) and alias address (A)
64
Reset reassignment flag for alias address (A)
66
No
68
C is alias address (A) which is matched with address pair (S,D)
70
Reconstruct original packet and regenerate CRC
72
Schedule packet for transmission to original destination
58
Construct confirmation packet
60
Schedule packet for transmission on communication link
End

FIG. 5A

Single byte address field 0xxxxxxx

FIG. 5B

Extended address field 1xxxxxxx|xxxxxxxx

FIG. 5C

7E	Alias Address (1 or 2 bytes)	Type (2 bytes)	Data (46-576 bytes)	7E

FIG. 5D

7E	02	Source (6 bytes)	Destination (6 bytes)	Alias Address (A) (2 bytes)	7E

FIG. 5E

7E	03	Source (6 bytes)	Destination (6 bytes)	Alias Address (A) (2 bytes)	7E

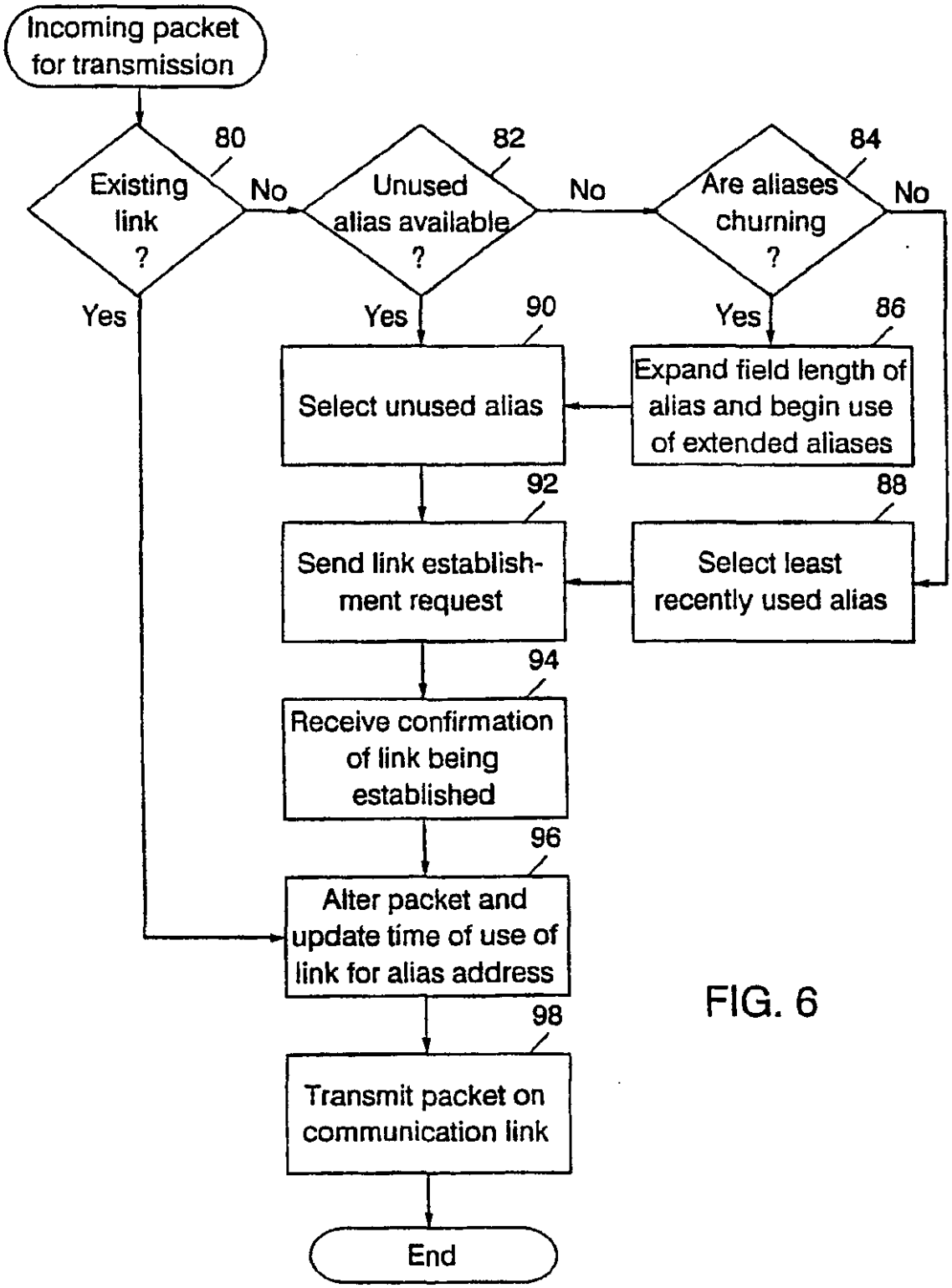

Incoming packet for transmission
80
Existing link ?
No
Yes
82
Unused alias available ?
No
Yes
84
Are aliases churning ?
No
Yes
90
Select unused alias
86
Expand field length of alias and begin use of extended aliases
92
Send link establish-ment request
88
Select least recently used alias
94
Receive confirmation of link being established
96
Alter packet and update time of use of link for alias address
98
Transmit packet on communication link
End

FIG. 6

FIG. 7

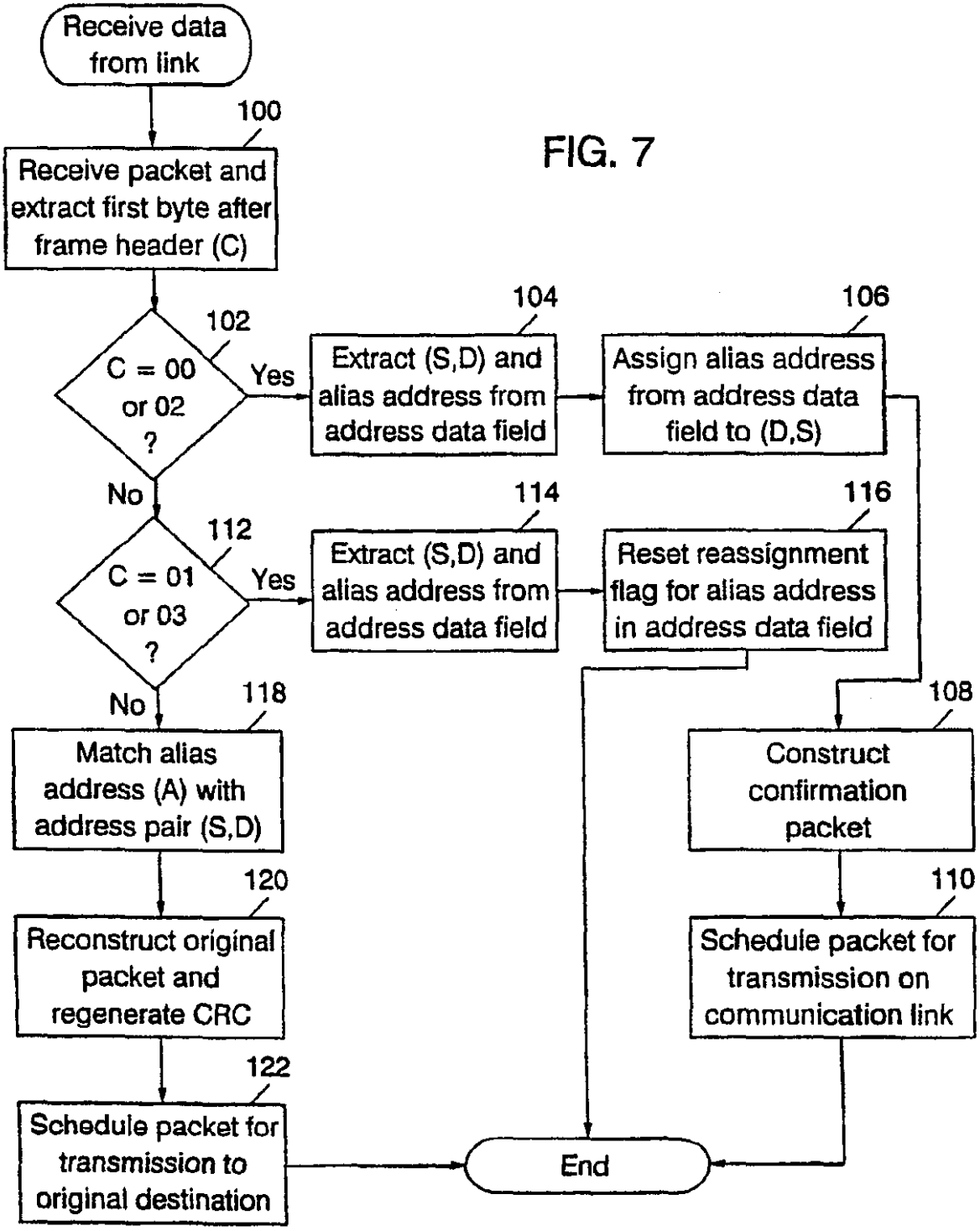
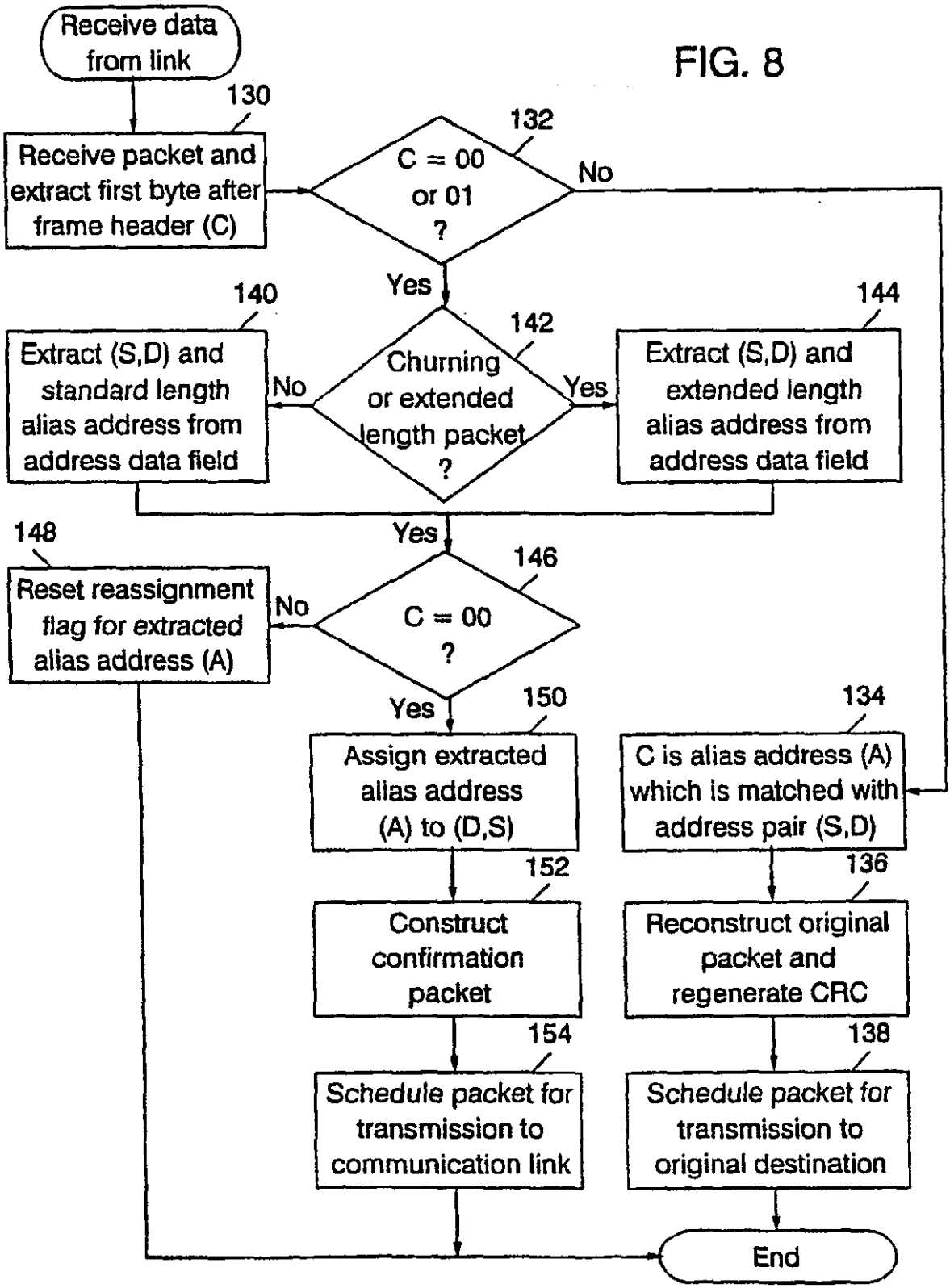

Receive data from link
100
Receive packet and extract first byte after frame header (C)
102
C = 00 or 02 ?
Yes
No
104
Extract (S,D) and alias address from address data field
106
Assign alias address from address data field to (D,S)
112
C = 01 or 03 ?
Yes
No
114
Extract (S,D) and alias address from address data field
116
Reset reassignment flag for alias address in address data field
118
Match alias address (A) with address pair (S,D)
120
Reconstruct original packet and regenerate CRC
122
Schedule packet for transmission to original destination
108
Construct confirmation packet
110
Schedule packet for transmission on communication link
End

FIG. 8


Receive data from link
130
Receive packet and extract first byte after frame header (C)
132
C = 00 or 01 ?
No
Yes
140
Extract (S,D) and standard length alias address from address data field
142
Churning or extended length packet ?
No
Yes
144
Extract (S,D) and extended length alias address from address data field
Yes
148
Reset reassignment flag for extracted alias address (A)
146
C = 00 ?
No
Yes
150
Assign extracted alias address (A) to (D,S)
134
C is alias address (A) which is matched with address pair (S,D)
152
Construct confirmation packet
136
Reconstruct original packet and regenerate CRC
154
Schedule packet for transmission to communication link
138
Schedule packet for transmission to original destination
End

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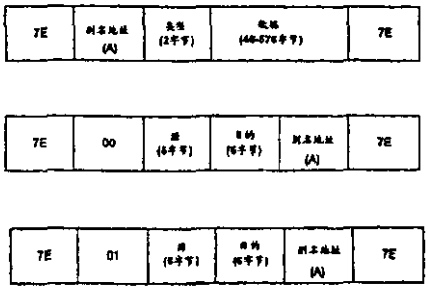
权利要求书5页 说明书12页 附图页数8页

[54]发明名称 无线通信网中的简化分组头标

[57]摘要

提供了对通信链路上传送的具有头标的消息减少开销的方法、系 统和计算机程序产品。从一组预定义的别名地址中选择一个别名地址，并且将其与一部分头标相关联。如果没有未用的别名地址，则将最近 最少使用的别名地址与该部分头标相关联。从消息中移去该部分头标 并用别名地址来取代。然后传输这个简化的数据消息。可以增加别名 地址的数量以免搅乱别名地址。消息的重建是根据别名地址和与其相 关的原始消息部分完成的。



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权　利　要　求　书

1. 在通信链路上减少具有头标的消息通信的开销的方法，该方法包括以下步骤:

接收将要在通信链路上发送的消息;

判断第一预定义别名地址集中是否有可用的未用别名地址;

如果有可用的未用别名地址，则将第一预定义别名地址集中的一个未用别名地址与接收消息的至少一部分头标相关联;

如果没有未用的别名地址可用，则将第一预定义别名地址集中的一个用过的别名地址与接收消息的至少一部分头标相关联;

从具有头标的后续消息中移除该至少一部分头标以提供简化的数据消息，该部分是接收消息的基本一致的头标; 和

在通信链路上发送该简化的数据消息和相关联的别名地址.

2. 根据权利要求 1 的方法，其特征在于所述的移除步骤之前有一个在通信链路上发送与该消息相关联的别名地址和至少一部分头标的步骤.

3. 根据权利要求 2 的方法，还包括从通信链路接收对至少一部分头标和相关的别名之间的关联的确认的步骤.

4. 根据权利要求 1 的方法，还包括以下步骤:

从通信链路接收别名地址和所传输的简化的数据消息;

根据与接收的别名地址相关联的一部分头标和简化的数据消息重建后续消息.

5. 根据权利要求 1 的方法，还包括识别与至少一部分头标相关的别名地址是用过的的步骤.

6. 根据权利要求 1 的方法，其特征在于所述关联第一预定义别名地址集中一个用过的别名地址的步骤包括以下步骤:

确定第一预定义别名地址集中的每一个用过的别名地址是何时最后使用的，以提供每一个用过的别名地址的最后使用时间; 和

如果没有未用的别名地址可用，就将第一预定义别名地址集中具有最老最后使用时间的用过的别名地址与接收消息的至少一部分头标相关联.

7. 根据权利要求 1 的方法，其特征在于该至少一部分头标包括消息的源地址和目的地址.

8. 根据权利要求 1 的方法，其特征在于该通信链路是无线通信链路.

9. 根据权利要求 1 的方法，还包括以下步骤:

监视别名地址和头标之间的关联；和

根据上述监视，增加第一预定义别名地址集中的别名地址数，以提供第二预定义别名地址集.

10. 根据权利要求 9 的方法，其特征在于所述的增加步骤包括在通信链路上发送增加的别名长度通知的步骤.

11. 根据权利要求 9 的方法，还包括如果确定别名地址是不活动的、则从第二预定义别名地址集中移除该别名地址的步骤.

12. 根据权利要求 11 的方法，其特征在于该第二预定义别名地址集包括第一预定义别名地址集和第三预定义别名地址集的组合.

13. 根据权利要求 12 的方法，还包括如果全部第三预定义别名地址集已经从第二预定义别名地址集中移除、就将别名地址数减少为第一预定义别名地址集的步骤.

14. 在通信链路上减少具有头标的消息通信的开销的系统，包括:

用于接收将要在通信链路上发送的消息的装置;

用于判断第一预定义别名地址集中是否有可用的未用别名地址的装置;

用于如果有可用的未用别名地址、则将第一预定义别名地址集中的一个未用别名地址与接收消息的至少一部分头标相关联的装置;

用于如果没有未用的别名地址、则将第一预定义别名地址集中的一个用过的别名地址与接收消息的至少一部分头标相关联的装置;

用于从具有头标的后续消息中移除该至少一部分头标以提供简化的数据消息的装置，该部分是接收消息的基本一致的头标；和

用于在通信链路上发送该简化的数据消息和相关联的别名地址的装置.

15. 根据权利要求 14 的系统，还包括用于在通信链路上发送与该消息相关联的别名地址和至少一部分头标的装置.

16. 根据权利要求 15 的系统，还包括用于从通信链路接收对有关至少一部分头标和相关的别名的确认的装置.

17. 根据权利要求 14 的系统，还包括:

用于从通信链路接收别名地址和所传输的简化数据消息的装置；

用于根据与接收的别名地址相关联的至少一部分头标和简化的数据消息重建后续消息的装置。

18. 根据权利要求 14 的系统，还包括用于识别与至少一部分头标相关的别名地址是用过的的装置。

19. 根据权利要求 14 的系统，其特征在于所述用于关联第一预定义别名地址集中一个用过的别名地址的装置包括：

用于确定第一预定义别名地址集中的每一个用过的别名地址是何时最后使用的、以提供每一个用过的别名地址的最后使用时间的装置；和

用于如果没有未用的别名地址、就将第一预定义别名地址集中具有最老最后使用时间的用过的别名地址与接收消息的至少一部分头标相关联的装置。

20. 根据权利要求 14 的系统，其特征在于该至少一部分头标包括消息的源地址和目的地址。

21. 根据权利要求 14 的系统，其特征在于该通信链路是无线通信链路。

22. 根据权利要求 14 的系统，还包括：

用于监视别名地址和头标之间的关联的装置；和

用于根据上述监视增加第一预定义别名地址集中的别名地址数、以提供第二预定义别名地址集的装置。

23. 根据权利要求 22 的系统，其特征在于所述的用于增加的装置包括用于在通信链路上发送增加的别名长度通知的装置。

24. 根据权利要求 22 的系统，还包括用于如果确定别名地址是不活动的、则从第二预定义别名地址集中移除该别名地址的装置。

25. 根据权利要求 24 的系统，其特征在于该第二预定义别名地址集包括第一预定义别名地址集和第三预定义别名地址集的组合。

26. 根据权利要求 25 的系统，还包括用于如果全部第三预定义别名地址集已经从第二预定义别名地址集中移除、就将别名地址数减少为第一预定义别名地址集的装置。

27. 在通信链路上减少具有头标的消息通信的开销的计算机程序产品，该计算机程序产品包括：

计算机可读存储介质，该介质中嵌入了计算机可读程序代码装置，该计算机可读程序代码装置包括：

用于接收将要在通信链路上发送的消息的计算机可读程序代码装置；

用于判断第一预定义别名地址集中是否有可用的未用别名地址的计算机可读程序代码装置；

用于如果有可用的未用别名地址、则将第一预定义别名地址集中的一个未用别名地址与接收消息的至少一部分头标相关联的计算机可读程序代码装置；

用于如果没有未用的别名地址、则将第一预定义别名地址集中的一个用过的别名地址与接收消息的至少一部分头标相关联的计算机可读程序代码装置；

用于从具有头标的后续消息中移除该至少一部分头标以提供简化的数据消息的计算机可读程序代码装置，该部分是与接收消息的完全一致的头标；和

用于在通信链路上发送该简化的数据消息和相关联的别名地址的计算机可读程序代码装置。

28. 根据权利要求 27 的计算机程序产品，还包括在通信链路上发送与该消息相关联的别名地址和至少一部分头标的计算机可读程序代码装置。

29. 根据权利要求 28 的计算机程序产品，还包括用于从通信链路接收有关至少一部分头标和相关的别名的确认的计算机可读程序代码装置。

30. 根据权利要求 27 的计算机程序产品，还包括：

用于从通信链路接收别名地址和所传输的简化数据消息的计算机可读程序代码装置；和

用于根据与接收的别名地址相关联的一部分头标和简化的数据消息重建后续消息的计算机可读程序代码装置。

31. 根据权利要求 27 的计算机程序产品，还包括用于识别与至少一部分头标相关的别名地址是用过的的计算机可读程序代码装置。

32. 根据权利要求 27 的计算机程序产品，其特征在于所述用于关联第一预定义别名地址集中一个用过的别名地址的计算机可读程序代

码装置包括:

用于确定第一预定义别名地址集中的每一个用过的别名地址是何时最后使用的、以提供每一个用过的别名地址的最后使用时间的计算机可读程序代码装置;和

用于如果没有未用的别名地址可用、就将第一预定义别名地址集中具有最老最后使用时间的用过的别名地址与接收消息的至少一部分头标相关联的计算机可读程序代码装置.

33. 根据权利要求 27 的计算机程序产品,其特征在于该至少一部分头标包括消息的源地址和目的地址.

34. 根据权利要求 27 的计算机程序产品,其特征在于该通信链路是无线通信链路.

35. 根据权利要求 27 的计算机程序产品,还包括:

用于监视别名地址和头标之间的关联的计算机可读程序代码装置;和

用于根据上述监视而增加第一预定义别名地址集中的别名地址数、以提供第二预定义别名地址集的计算机可读程序代码装置.

36. 根据权利要求 35 的计算机程序产品,其特征在于所述用于增加的计算机可读程序代码装置包括用于在通信链路上发送增加的别名长度通知的计算机可读程序代码装置.

37. 根据权利要求 35 的计算机程序产品,还包括用于如果确定别名地址是不活动的、则从第二预定义别名地址集中移除该别名地址的计算机可读程序代码装置.

38. 根据权利要求 37 的计算机程序产品,其特征在于该第二预定义别名地址集包括第一预定义别名地址集和第三预定义别名地址集的组合.

39. 根据权利要求 38 的计算机程序产品,还包括用于如果全部第三预定义别名地址集已经从第二预定义别名地址集中移除、就将别名地址数减少为第一预定义别名地址集的计算机可读程序代码装置.

说　明　书

无线通信网中的简化分组头标

发明的领域

本发明涉及通信网络并且更具体地涉及使用如以太网协议这样的分组通信协议的通信网络.

发明的背景

网络计算机或其他数据处理设备在计算和通信中已经很普通. 网络处理系统的一个问题是处理器之间的通信所需要的基础设施. 通常，通信在使用通信协议（如以太网协议）的硬连线接口上完成. 但是，并不是总有这样的基础设施，在特定的环境或特定的应用中建立固定的基础设施可能是不现实的. 例如，在居民楼为计算机网布线也许就无法实现或太昂贵. 类似地，在商用环境下，便携式处理系统可能需要到处移动而同时仍然维持网络链路.

由于这些和其它类似情况，无线以及其它减少固定基础设施量的通信系统已经用于处理系统间的通信. 然而，无线系统与硬连线系统相比通常运营费用比较昂贵或者带宽较小. 当专用无线系统以提高的速率工作时，通常这些无线网络与现存的硬连线网络综合在一起，因此可能希望使用现有的网络协议，如以太网、令牌环或其它网络协议. 然而，以太网协议以及其它常规网络协议并不是为无线环境开发的，并且当工作在无线网络环境时可能效率不高.

根据上述讨论，需要提高无线通信的性能以便现有通信协议更有效地在无线通信链路上工作.

发明概要

根据上述讨论，本发明的一个目的是为无线或其它低带宽通信链路上的网络计算机提供更高的效率.

本发明的另一个目的是提高低带宽通信链路的吞吐量，而这对于通信链路的用户是透明的.

本发明还有一个目的是在保持与现有网络协议兼容的同时提高通信链路的吞吐量.

本发明的这些和其它目的是通过减少通信链路上具有头标的消息通信中的开销的方法、系统和计算机程序产品实现的. 这种减少可以

在接收到将要在通信链路上传输的消息后通过确定在第一预定义别名地址集中是否有可用的未使用的别名地址来完成。如果有未使用的别名地址，就将未使用的别名地址与至少一部分接收消息的头标相关联。如果没有未使用的别名地址，就将第一预定义别名地址集中的一个使用过的别名地址与接收消息的至少一部分头标相关联。后续的具有头标的消息（它的一部分与接收消息的头标完全一致）中至少有一部分头标被移去以提供简化的数据消息。然后在通信链路上发送简化的数据消息以及相关的别名地址。该通信链路可以是无线通信链路。

通过将别名地址与消息的头标信息相关联，别名地址就可以取代头标信息。这种替换可以导致在通信链路上传输较少字节的数据。此外，通过自动选择最近未使用的使用过的链路，本发明不再需要“拆除”以前建立的链路。因此，没有与拆除不使用的链路相关的开销。

在本发明的具体实施例中，别名地址以及至少一部分与消息相关联的头标是在通信链路上传输的。从通信链路上也可以接收到对头标的所述那部分和相关联的别名地址的并联的确认。然后就可以从通信链路上接收所传输的简化数据消息，并且通过与接收的别名地址相关联的头标部分和简化数据消息重建随后的消息。

通过将别名地址与原始消息的头标的一部分相关联，并且然后根据别名地址重建原始消息，本发明降低了每次通信的开销。对于任何具有用于识别该消息中与原始消息协议无关的多个分组的头标的协议都可以降低开销，这是由于原始消息要被加以重建以便符合协议，而在通信链路上发送的简化数据分组的格式可以独立于所提供的原始消息格式，因为头标信息可以从消息的数据部分中分离出来。

在本发明的另一个实施例中，与至少一部分头标相关的别名地址被标识为用过的。然而通过确定第一预定义别名地址集中每一个用过的别名地址是何时最后使用的、以便为每个用过的别名地址提供最后使用时间，用过的别名地址也可以与头标的一部分相关联。如果没有可用的未使用的别名地址，就将具有最早的最后使用时间的用过的别名地址与接收消息的头标该部分相关联。这样，本发明就不需要拆除不再使用的别名地址关联。

在本发明的一个具体实施例中，为了建立简化数据消息而从头标中除去的这部分，包括消息的原地址和目的地址。

在本发明的另一个实施例中，别名地址和头标的关联是被进行监视的．根据监视来增加第一预定义别名地址集中的别名地址的数量以便提供第二预定义的别名地址集．

通过监视别名地址的关联，本发明可以选择性地增加可用地址数以便减少建立别名地址关联所占用的通信带宽量．因此，可以动态调整可用地址数以便降低“搅乱”别名地址的可能性．

在本发明的另一个实施例中，如果确定别名地址是不活动的，就从第二预定义别名地址集中除去该别名地址．更具体地，在第二预定义别名地址集包括第一预定义别名地址集和第三预定义别名地址集的组合的场合下，如果已经从第二预定义别名地址集中除去了全部第三预定义别名地址集，则其别名地址数就减少到第一预定义别名地址集．因此，如果需要避免搅乱的别名地址数下降，则别名地址数也可以动态地减少．

如那些本领域的技术人员所称道的，本发明可以表现为方法，装置/系统或计算机程序产品．

附图的简要描述

图 1 是使用本发明的一个实施例通信系统的框图；

图 2A 到图 2C 说明本发明的一个实施例所使用的数据分组；

图 3 是说明根据本发明的一个实施例的通信接口接收到分组后所进行的操作的流程图；

图 4 是说明根据本发明的一个实施例的通信接口从通信链路接收数据后所进行的操作的流程图；

图 5A 到图 5E 说明本发明的另一个实施例所使用的数据分组；

图 6 是说明根据本发明的另一个实施例的通信接口接收到分组后所进行的操作的流程图；

图 7 是说明根据本发明的另一个实施例的通信接口从通信链路接收数据后所进行的操作的流程图；而

图 8 是说明根据本发明的另一个实施例的通信接口从通信链路接收数据后所进行的操作的流程图．

发明的详细描述

现在将参考附图对本发明进行更全面的描述，其中说明了本发明的优选实施例．然而，本发明可以表现为很多不同的形式，并且不应

该解释为受到这里的实施例的限制；相反，所提供的实施例是为了使这个揭示全面、彻底，并且将向那些本领域的技术人员充分地传达本发明的范畴．自始至终，相同的号码表示相同的单元．正如本领域的技术人员所理解的，本发明可以表示为方法或装置．据此，本发明可以完全由硬件实现、完全由软件实现或由软件和硬件相结合而实现．

图 1 说明本发明的一个实施例．如图 1 所示，传送消息的源 10 可接入无线通信接口 12．通信消息的目的设备可接入通过无线通信链路 16 与第一无线通信接口 12 通信的第二无线通信接口 14．

在本发明的一个具体实施例中，源 10 和目的设备 18 是以太网源和各种目的设备．在这种情况下，通信接口 12 和 14 可以是无线以太网适配器或其它能够在无线通信链路上传送以太网分组的适配器．源和目的设备可以是网络计算机、工作站、个人计算机、个人信息管理器或能够在如以太网通信协议这样的分组通信协议中作为数据分组的源或目的设备的其它设备．

在这里参考以太网协议描述本发明的同时，正如那些本领域的技术人员所理解的，其它基于分组的通信协议也同样可以从本发明的教导中受益．例如，传输控制协议/网际协议（TCP/IP），异步传输模式（ATM）协议和其它基于分组通信的协议也可以使用本发明的教导．

此外，在这里是参考无线通信链路来描述本发明，然而，本发明不应该解释为只限于无线通信．这里所使用的通信链路是指两个彼此远离的处理器之间的让两个处理器进行通信的任何类型的链路．本发明的教导对要降低通过通信链路传送的数据量的任何通信链路都是有益的．这种通信链路的例子包括低速调制解调器通信、卫星通信链路、蜂窝通信链路、射频通信链路、微波通信链路或任何基于通过通信链路传输的数据量来确定速率的通信链路．

图 1 说明可以通过通信链路 16 通信的单个源和单个目的设备．然而，正如那些本领域的技术人员所意识到的，通过通信接口 12 和 14 可以很容易地接入多个源和多个目的设备．此外，源和目的设备之间的通信在通信链路 16 上可以是双向的．通信接口 12 和 14 中的每一个都可以提供对使用通信接口 12 和 14 通过通信链路 16 通信的源和目的设备的接入．据此，图 1 是一个示范，而不应解释为限制本发明．

总体上，本发明特定实施例的操作是通过减小通信分组中头标的

大小，从而来减小通过诸如通信链路 16 这样的通信链路传输的分组中的数据．更具体地，具有路由信息（如目的设备和源地址）的数据分组在通信链路上传输之前，这些头标信息被剥离．将一个别名地址分配给头标并将别名地址添加到数据分组中．这里使用的术语“别名地址”指与原始消息的头标信息相关的指示，这样，知道了别名地址就可以重建原始消息．随后在通信链路上发送数据和别名地址．通信链路的接收端接收修改过的数据分组并且根据接收的别名地址重建原始数据分组．此后，具有相同源和目的地址的后续消息也被剥离源和目的地址信息并使用相关的别名地址在通信链路上进行通信．由于别名地址会比相应的原始头标的源和目的地址短小，因此可以减小通信链路上传输的数据量．

具体到本发明，别名地址被分配给未使用的别名地址直到所有别名地址都已经利用．所有别名地址被使用之后，当接收到要在通信链路上传输的具有新的源和目的设备的数据分组时，就将最近最少使用的别名地址分配给新的源和目的地址．这样，本发明不必明显地终止以前的别名地址关联就可以改变别名地址关联．此外，如果判断分配别名地址占用了太大的通信链路带宽，则可以扩展别名地址空间以减小重分配的出现率．

现在将针对以太网例子和图 1 的框图描述本发明不同实施例的具体操作．同时还要参考说明本发明的实施例的流程图—图 3，4 和 6 到 8．应该理解，流程图中的每一个单元和流程图中的单元组合可以通过计算机程序指令来实现．可以将这些程序指令提供给处理器以得出这样一种机器，使得处理器中执行的指令可以建立实现流程单元中指定功能的装置．计算机程序指令可以由一个处理器来执行以产生一系列由处理器完成的操作步骤，从而完成一个计算机实现的过程，这样，处理器上执行的指令可提供实现流程单元指定功能所需的步骤．

据此，流程图中的各单元支持完成指定功能的装置组合、完成指定功能的步骤组合、和完成指定功能的程序指令装置．还应该理解流程图中的每一个单元和流程图中的单元组合都可以由完成指定功能或步骤或专用硬件和计算机指令组合的专用硬件系统来实现．

图 3 说明当接收到要在通信链路（如无线通信链路 16）上传输的数据分组时通信接口的操作（如无线通信接口 12）．如图 3 所示，当

无线通信接口 12 从源 10 接收到数据分组时，无线通信接口 12 从数据分组中提取头标并且从头标中确定源和目的地址（单元 30）. 然后判断是否存在与通过通信链路 16 的源和目的地址相关联的链路（即别名地址）（单元 32）. 如果链路尚未建立，就将最近最少使用的别名地址分配给源和目的地址（单元 34）并且在通信链路 16 上发送请求将别名地址分配给源和目的地址（单元 36）. 如果所有别名地址尚未完全分配，该最近最少使用的别名地址将是一个未使用的别名地址. 在本例子中，别名地址是一字节（8 比特）大小，并且有两个地址（“00”和“01”）为控制而保留，从而定义了一组预定义的 254 个别名地址，这样，在以前分配的别名地址（用过的别名地址）被复用前，有 254 个别名地址需要分配.

图 2B 说明通过通信接口 12 或 14 在通信链路 16 上传输的、用于请求建立链路的数据分组. 数据分组的格式中包括帧头之后的数据分组的为“00”的第一字节. “00”表明该分组是请求建立链路. 分组的下 12 个字节指定原始数据分组的源和目的地址. 源和目的地址的后面跟随的一个字节指示与源和目的地址相关联的、所请求的别名地址. 使用图 2B 说明的格式，链路请求是一个 16 字节的分组.

回到图 3，在传输了链路建立请求后，通信接口 12 和 14 设置一个重新赋值标志（单元 38），该标志用来作为与该接收通信接口 14 或 12 进行信息交换的一部分，从而验证链路已经建立（即，通信链路 16 的两端都具有相同的源和目的地址与别名地址的关联）并且等待从通信链路 16 接收应答分组. 接收到应答后，通信接口 12 或 14 检查重新赋值标志是否仍处于被设置状态（单元 40）. 如果重新赋值标志仍处于被设置状态，那么链路请求失败并且选择一个新的别名地址（单元 34），然后重复该过程（单元 36 和 38）. 这个过程可以一直重复到链路建立，或者只进行有限次尝试，如果仍不成功，就将该消息丢弃或向分组的源提供一个错误通知.

如果重新赋值标志未设置（单元 40），则链路已经建立. 随后通信接口 12 或 14 校验原始分组的 CRC（单元 42）并在 CRC 错误时将该分组丢弃（单元 44）. 另外，CRC 校验可以在建立链路之前进行.

如果未检测到 CRC 错误，那么就从分组中移去 CRC 和源和目的地址并用别名地址取代（单元 46）. 在本以太网例子中的通信链路 16 上

传输的分组的格式如图 2A 所示．在图 2A 中，通信链路 16 上传输的分组包括帧头、其后的别名地址（1 字节）、再其后的消息类型（2 字节）、以及随后的 46 到 576 字节数据．在建立简化的数据分组后，在通信链路 16 上传输该简化的数据分组（单元 48）．

图 3 中还说明了对通信接口 12 或 14 接收的具有相同别名地址的后续数据分组的处理．如图 3 所示，接收到分组时，提取头标（单元 30）并判断是否存在链路（单元 32）．由于该分组是一个后续分组，所以链路将存在，并且重新赋值标志将成为未设置（单元 40）．需要校验分组的 CRC（单元 42），并在没有 CRC 错误的情况下移去头标信息（单元 46），然后在通信链路 16 上发送简化的数据分组（单元 48）．

图 4 根据本发明的一个实施例说明从通信链路 16 接收到分组时，通信接口 12 或 14 的操作．当接收到分组时，帧头“7E”后的第一字节（C）被提取出来，并判断该帧头后的第一字节是否表示链路建立请求（C=“00”）（单元 52）．如果帧头后的第一字节表示链路请求，则提取分组的源、目的和别名地址（见图 2B），并将别名地址与源和目的地址相关联（单元 56）．然后构造一个确认分组（单元 58）并将其安排在通信链路 16 上进行传输（单元 60）．

图 2C 说明通信接口 12 或 14 为了确认链路建立而在通信链路 16 上发送的数据分组．数据分组的格式包括帧头之后的数据分组的第一字节为“01”（C=“01”）．“01”表明该分组是链路已经建立的确认．分组的下 12 个字节指定原始数据分组的源和目的地址．源和目的地址的后面跟随的一个字节指示与源和目的地址相关联的别名地址．使用图 2C 说明的格式，一个链路确认分组是一个 16 字节的分组．

返回到图 4 的单元 52，如果分组的帧头后的第一字节不是“00”，则判断该字节是否是一个如图 2C 所示的指示该分组是确认分组的“01”．如果帧头后的第一字节表示一个链路确认分组，那么就将分组的源、目的和别名地址（见图 2C）提取出来（单元 64），并且复位与该别名地址相关的重新赋值标志（单元 66）．然后流程进行到上面针对图 3 所进行的描述，在通信链路 16 上发送原始分组的数据．

如果帧头后的第一字节不是“00”或“01”，那么该分组就是图 2A 所表示格式的数据分组．于是帧头后的第一字节表示分组的别名地址，该别名地址与其相关联的源和目的地址对匹配（单元 68）．于是，原

始分组被重新构造并被安排传输到原始目的 18（单元 72）.

图 5A 到 8 说明本发明的另一个实施例，在这个实施例中别名地址的大小可以扩展. 这种实施例减小了“搅乱”别名地址的可能性. 由于建立将别名地址与源和目的地址相关联的链路也有一定的开销，因此可能出现建立链路的分组占据通信链路 16 很大一部分带宽的情况. 可以通过将别名地址域扩展为包括两字节地址数据，以便极大地增加可用别名地址数并减少别名地址复用的频率，从而延缓或避免这种情况（这里称为“搅乱”）的发生.

图 5A 和 5B 说明与本发明的另一个实施例相关的单字节和双字节地址的例子. 如图 5A 所示，单字节地址的第一比特被设为“0”表示单字节地址. 图 5B 说明：扩展地址域的第一比特被设为“1”表示扩展地址.

图 6 说明接收到要在通信链路 16 上传输的分组时，本发明的另一个实施例的操作. 如图 6 所示，通信接口 12 或 14 首先判断是否存在与所接收分组的源和目的地址相关联的链路（单元 80）. 如果没有链路，就判断是否有未使用的别名地址（单元 82）. 如果未使用扩展别名地址，那么这个判断就是根据单字节别名地址的可用性作出的. 如果使用了扩展别名地址，那么这个判断就是根据扩展别名地址的可用性作出的. 如果没有未使用的别名地址，那么就判断别名地址是否已经搅乱（单元 84）.

对别名地址是否已经搅乱的判断可以根据链路建立请求与通信链路上传输的数据分组的比率或在全部地址空间被分配以后的时间（例如，最近 254 次 8 比特别名分配后经历的时间），或本领域技术人员周知的其它方法作出. 在一个实施例中，对搅乱的判断是在活动链路被别名地址重分配中断的概率（以发生的相对频率来进行估计）将变得很大时作出的，这里如果链路在过去 T 毫秒中使用过就认为它是活动的.

如果发生搅乱，那么就将别名地址域的域长度扩展为大于一字节并使用扩展别名（单元 86）. 然后从未使用的扩展别名地址中选择别名地址（单元 90）. 如果未发生搅乱，那么就选择最近最少使用的别名，将其与源和目的地址相关联（单元 88）. 如果未使用扩展别名地址，那么这个选择是根据最后使用的单字节别名地址作出的. 如果使

用了扩展地址，那么这个选择是根据最后使用的扩展别名地址作出的。

在任何一种情况下，一旦选择了别名地址，就在通信链路上发送链路建立请求（单元 92）。图 5D 是针对扩展别名地址的示范链路建立请求分组的格式，而图 2B 针对单字节地址的示范链路建立请求分组的格式。图 2B 已经在上面进行了描述。图 5D 说明通信接口 12 或 14 在通信链路 16 上传输的请求建立扩展别名地址链路的数据分组。在数据分组格式中，帧头后的第一数据分组字节为“02”。“02”表示这是请求建立扩展别名地址链路的分组。分组的下 12 个字节指明原始数据分组的源和目的地址。源和目的地址的后面跟随着两个字节，它们指明所请求的与源和目的地址相关联的别名地址。在使用图 5D 所示的格式的情况下，链路请求是一个 17 字节的分组。

发送链路建立请求后，通信接口 12 或 14 等待接收链路已经建立的确认（单元 94）。建立链路的操作（单元 92 和 94）可以根据上面参考图 3 和 4 所做的描述完成，其中在建立链路时使用了出错重试技术。

一旦建立了链路，就按照上面的描述改变原始数据分组，以便移去源和目的地址以及 CRC 并添加别名地址以提供简化的数据分组（单元 96）。然后在链路 16 上发送这个简化的数据分组（单元 98）。图 2A 和图 5C 说明了简化数据分组的示范格式。

图 7 和 8 说明本发明的另一个实施例的操作，该实施例在从通信链路 16 接收到分组时使用扩展别名寻址。如图 7 所示，当从通信链路 16 接收到分组时，将帧头后的第一字节提取出来（单元 100）。如果该第一字节是“00”或“02”，那么该分组是链路建立请求，并根据分组的格式（见图 2B 和图 5D）从分组中提取正确的源、目的和别名地址（单元 102 和 104）。然后将所提取的扩展别名地址与源和目的地址相关联（单元 106）。随后构造确认分组（单元 108）并安排在通信链路 16 上传输（单元 110）。

确认分组的格式与建立请求的格式相对应。因此，如果接收到“00”链路建立请求，那么就构造图 2C 中所说明的“01”格式的确认分组。图 2C 的确认分组格式已经在上面做了描述。然而，如果所接收的链路建立请求是“02”扩展别名地址链路建立请求，那么就构造具有图 5E 格式的确认分组。

图 5E 说明通信接口 12 或 14 在通信链路 16 上传输的一个用于确

认扩展别名地址链路已经建立的数据分组。该数据分组的格式是以“03”作为帧头后数据分组的第一字节。“03”表示该分组确认：扩展别名地址链路已经建立。分组的下 12 个字节指明原始数据分组的源和目的地址。源和目的地址后面跟随的两个字节指明所请求的与源和目的地址相关联的别名地址。在使用图 5E 所示的格式时，链路确认分组是一个 17 字节的分组。

现在回到图 7，如果从通信链路 16 上接收的分组帧头后的第一字节不是“00”也不是“02”，那么就判断帧头后的第一字节是否为“01”或“03”（单元 112）。如果该第一字节是“01”或“03”，那么该分组就是确认分组，并根据分组的格式（见图 2C 和 5E）从分组中提取正确的源、目的和别名地址（单元 112 和单元 114）。然后复位与所提取的别名地址相关联的重新赋值标志以指示链路已经成功建立（单元 116）。

如果接收分组的帧头后的第一字节不是“00”，“01”，“02”，也不是“03”，那么该分组就是图 2A 或图 5C 所示多种格式中的一种数据分组。可以通过检查帧头后的第一字节的第一比特来判断数据分组的别名地址。如果该比特为“0”，那么使用的是单字节别名地址（见图 5A），而如果该比特是“1”，那么使用的就是扩展别名地址（见图 5B）。无论哪种情况都从分组中提取别名地址，并与该源和目的对相匹配（单元 118）。然后重建包括 CRC（单元 120）的原始分组，并安排将其发送到目的（单元 122）。

图 8 说明本发明的另一个实施例，该实施例在从通信链路 16 接收到分组时使用扩展别名寻址，但是对扩展别名地址不使用单独的请求和确认分组。通过使用相同的方法可判断是否发生了搅乱，通信链路 16 的两端都可以独立地判断是否发生了搅乱，藉此避免了对使用扩展别名地址时的显式信令的需要。

如图 8 所示，从通信链路 16 接收到分组时，提取帧头后的第一字节（单元 130）。如果第一字节是“00”或“01”，那么该分组是一个链路建立请求或确认分组，然后判断是否发生了搅乱（单元 132 和 142），这可以指示是使用单字节还是扩展别名寻址。另外，接收通信接口可以检查别名地址域的第一比特，判断它是一个指示单字节的“0”还是一个指示扩展别名寻址的“1”。通信接口还可以判断分组的总长

度，如果长度是16那么使用的就是单字节别名寻址．如果分组的长度是17，那么使用的是扩展别名寻址．在两种情况下，当判断是使用单字节还是扩展别名寻址后，就根据分组的格式（见图2B和2C或图5D和图5E）从分组中提取正确的源、目的和别名地址．

提取别名地址后，判断帧头后的第一字节是否是指示链路请求分组的“00”（单元146）．如果不是，那么该分组是链路确认分组，于是就复位与该别名地址相关联的重新赋值标志（单元148）．如果帧头后的第一字节是“00”，那么该分组是链路建立请求，于是为源和目的设备分配别名地址（单元150）并且构造适当的确认分组（单元152）．然后安排在通信链路16上传输该确认分组（单元154）．

返回单元132，如果帧头后的第一字节不是“00”或“01”，那么该分组就数据分组．根据上面的描述，用地址的第一比特判断地址是否是扩展的，从而可以提取别名地址（单元134）．然后重建原始数据分组（单元136）并且安排将其传输到目的设备（单元138）．

可以使用很多用于关联项目的技术来实现别名地址与源和目的地址的关联．例如，可以使用查找表或链表来建立别名地址与源和目的地址之间的关联．通信链路16的每一端都可以维护一个关联着别名地址、源和目的地址、以及该别名地址的最后使用时间的表，以便帮助选择最近最少使用的以前使用过的别名地址．

在本发明的扩展别名地址实施例中，一个“垃圾收集”例程可以周期性地检查每个具有扩展长度别名的链路的最后使用时间，并从通信链路16两端的表中移去带有扩展地址的长期空闲的链路．这样，别名长度就有回到最短的可能选择．一旦表中没有了扩展域别名，就暂时不再使用“02”和“03”消息，直到再次检测到发生搅乱，桥接表回到预扩展大小．

另外，“垃圾收集”例程还可以周期性地从两端的表中移去那些最后使用时间早于预定门限的链路．当链路总数小于在非扩展别名地址集中可得到的链路数时，在随后的通信中将扩展别名地址链路重分配给非扩展别名地址．那些本领域的技术人员将会意识到，根据本发明的揭示，还可以使用其它令系统返回到使用非扩展别名地址的方法．

在本发明参考以太网通信协议进行讨论时，本领域的技术人员将会意识到，本发明的教导也可以应用与其它通信协议．例如，如果通

信接口 12 和 14 完成 IP 路由功能并且以太网分组包含 IP 数据报，通信接口 12 和 14 也可以从数据报中剥离 IP 路由信息．这种情况下，可以将路由信息保存起来，或者重新计算以提供数据报路径中的下一跳．这样，本发明可以与 TCP/IP 一起使用以进一步减少开销，在此场合下，以太网和 IP 寻址信息被剥离，而每一端的网关或路由器将把 IP 数据报重新绑定到指定 IP 路径中下一跳的一个以太网分组中．

在附图和说明书中，已经揭示了本发明的优选实施例，虽然使用了特定的术语，但它们仅是用于一般性的描述功能，而不是出于限制的目的，本发明的范畴是由下面的权利要求限定的．

说 明 书 附 图

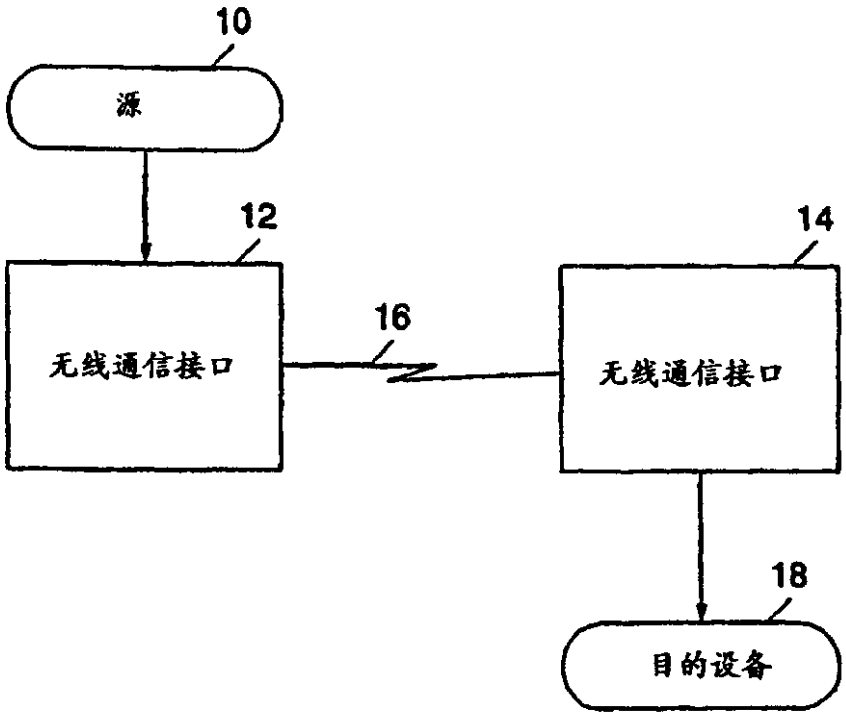

图 1

7E	别名地址 (A)	类型 (2字节)	数据 (46-576字节)	7E

图 2A

7E	00	源 (6字节)	目的 (6字节)	别名地址 (A)	7E

图 2B

7E	01	源 (6字节)	目的 (6字节)	别名地址 (A)	7E

图 2C

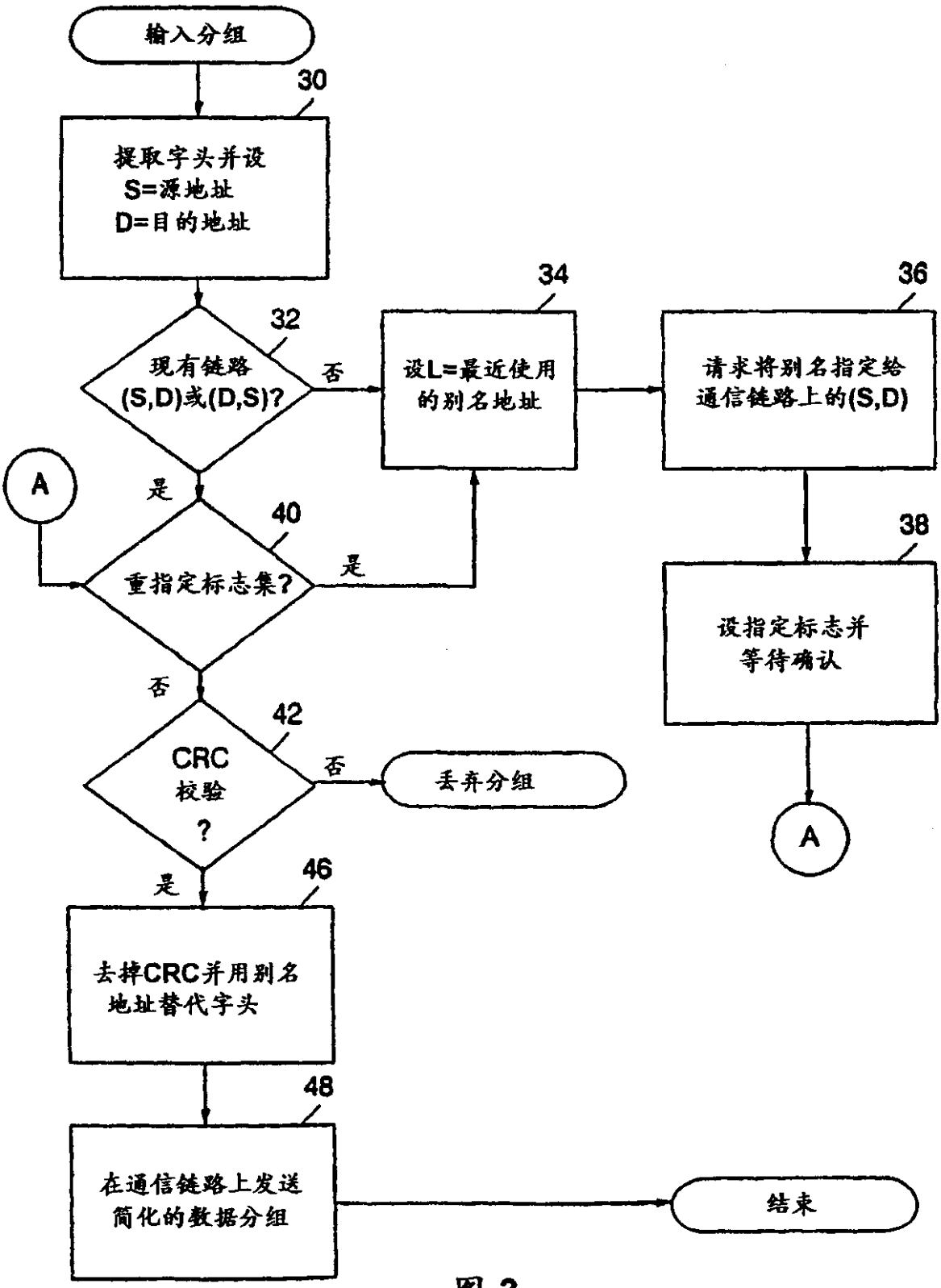
输入分组
30
提取字头并设
S=源地址
D=目的地址
32
现有链路
(S,D)或(D,S)?
否
34
设L=最近使用
的别名地址
36
请求将别名指定给
通信链路上的(S,D)
A
是
40
重指定标志集?
是
38
设指定标志并
等待确认
否
42
CRC
校验
?
否
丢弃分组
A
是
46
去掉CRC并用别名
地址替代字头
48
在通信链路上发送
简化的数据分组
结束

图 3

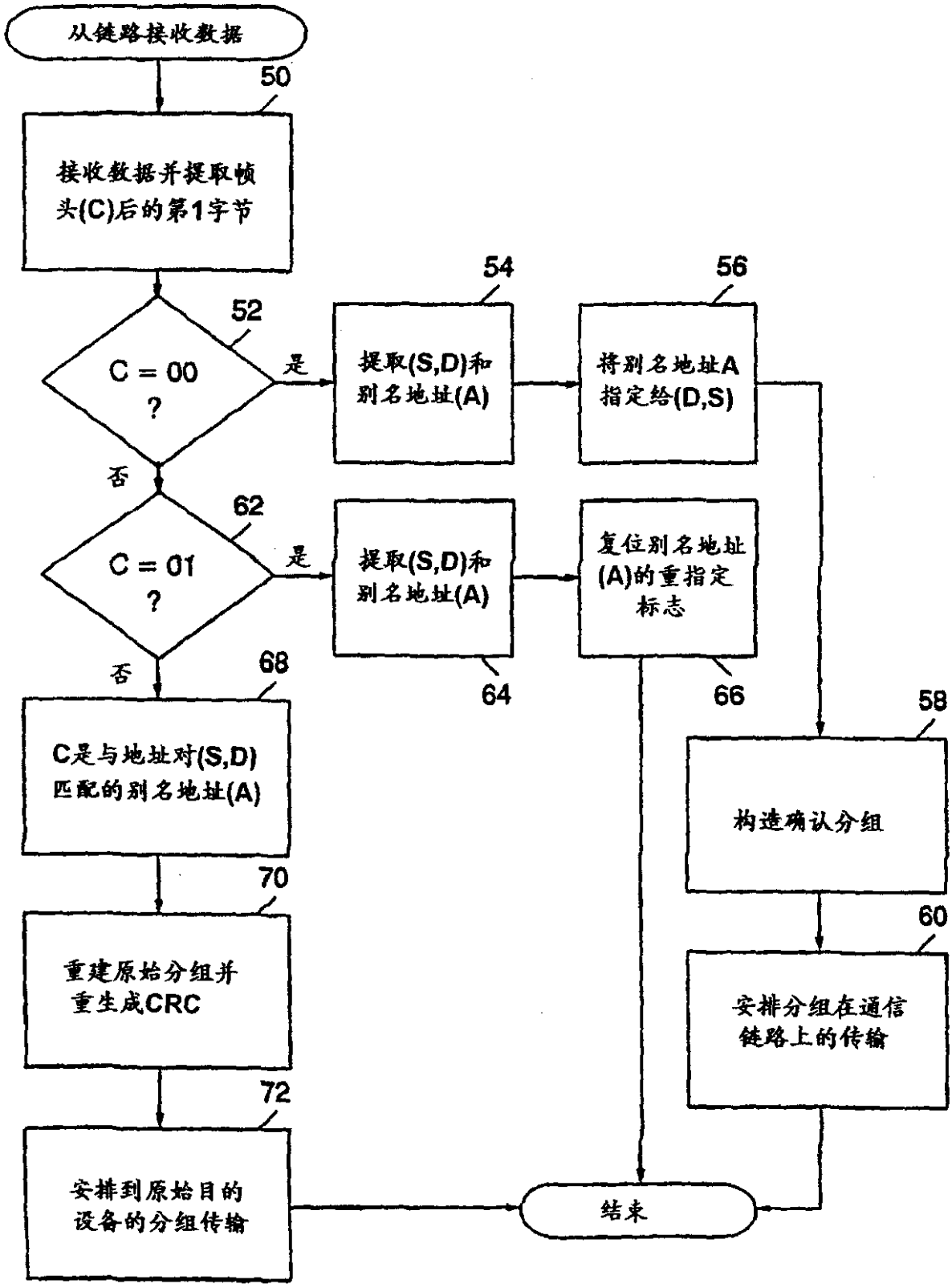
从链路接收数据
50
接收数据并提取帧头(C)后的第1字节
52
C = 00 ?
是
54
提取(S,D)和别名地址(A)
56
将别名地址A指定给(D,S)
否
62
C = 01 ?
是
提取(S,D)和别名地址(A)
复位别名地址(A)的重指定标志
64
66
否
68
C是与地址对(S,D)匹配的别名地址(A)
58
构造确认分组
70
重建原始分组并重生成CRC
60
安排分组在通信链路上的传输
72
安排到原始目的设备的分组传输
结束

图 4

单字节地址域 0xxxxxxx

图 5A

扩展地址域 1xxxxxxx|xxxxxxxx

图 5B

7E	别名地址 (1或2字节)	类型 (2字节)	数据 (46-576字节)	7E

图 5C

7E	02	源 (6字节)	目的 (6字节)	别名地址(A) (2字节)	7E

图 5D

7E	03	源 (6字节)	目的 (6字节)	别名地址(A) (2字节)	7E

图 5E

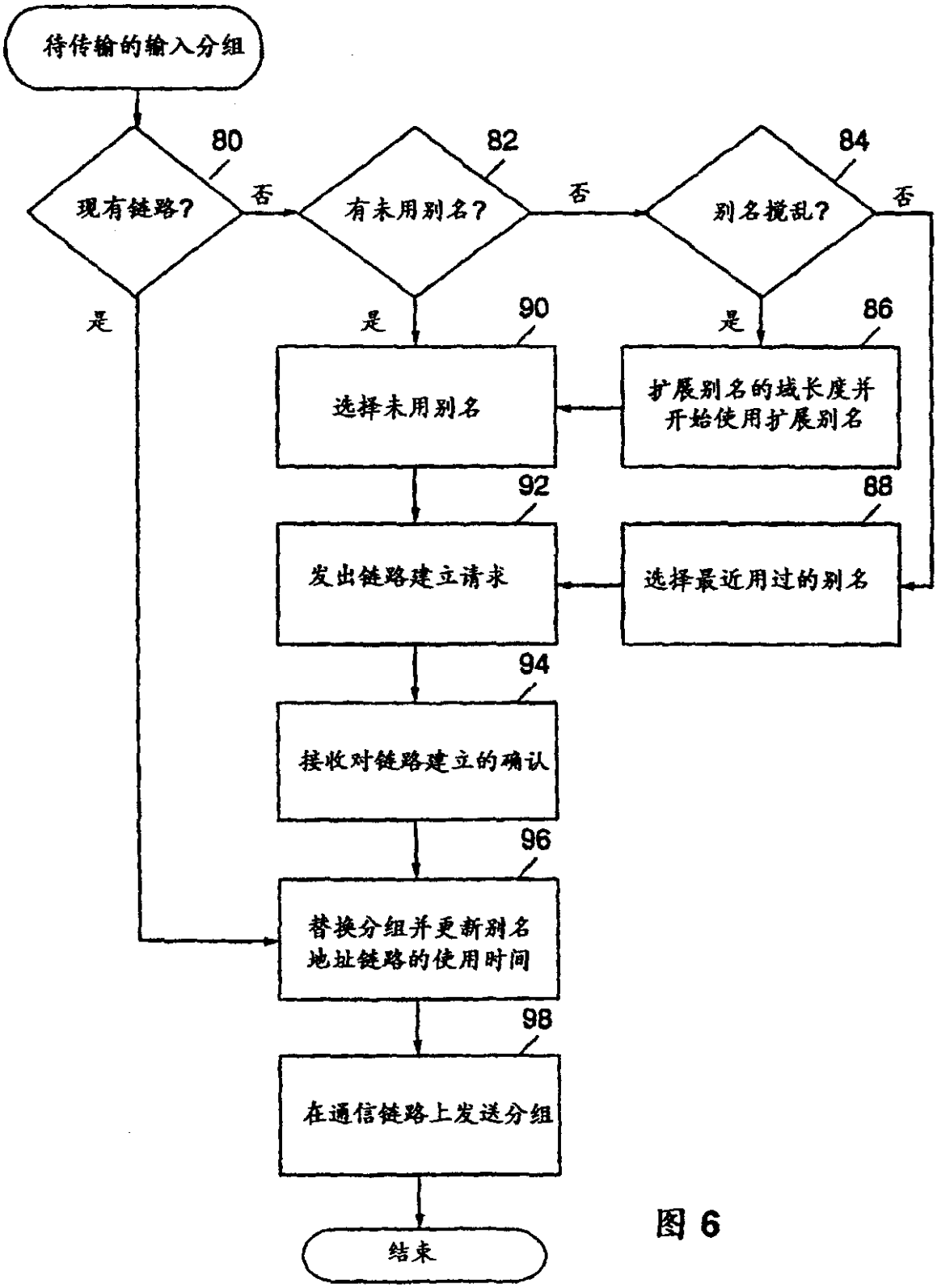
待传输的输入分组
80
现有链路?
否
82
有未用别名?
否
84
别名搅乱?
否
是
是
是
90
选择未用别名
86
扩展别名的域长度并
开始使用扩展别名
92
发出链路建立请求
88
选择最近用过的别名
94
接收对链路建立的确认
96
替换分组并更新别名
地址链路的使用时间
98
在通信链路上发送分组
结束

图 6

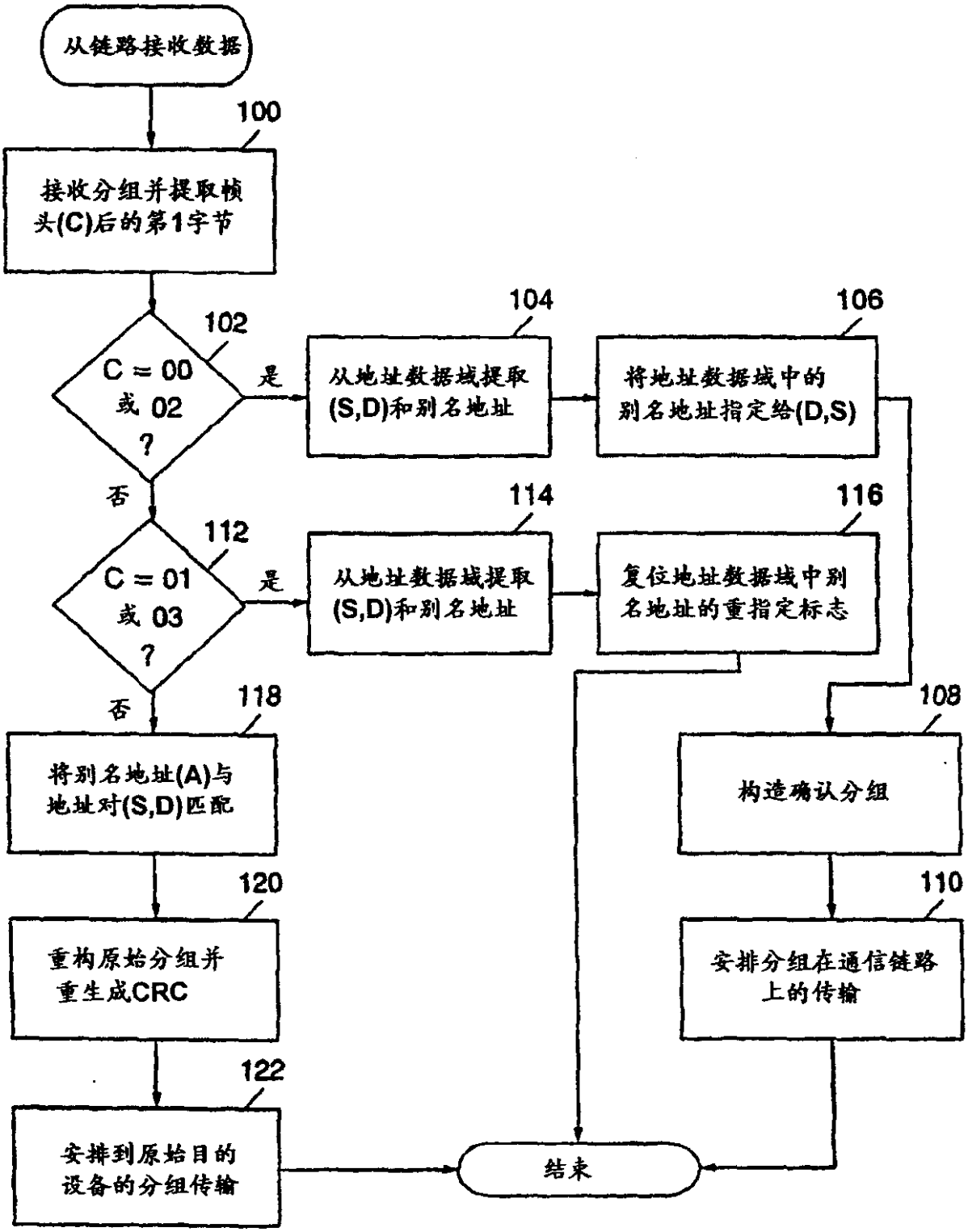
从链路接收数据
100
接收分组并提取帧头(C)后的第1字节
102
C = 00 或 02 ?
是
104
从地址数据域提取(S,D)和别名地址
106
将地址数据域中的别名地址指定给(D,S)
否
112
C = 01 或 03 ?
是
114
从地址数据域提取(S,D)和别名地址
116
复位地址数据域中别名地址的重指定标志
否
118
将别名地址(A)与地址对(S,D)匹配
120
重构原始分组并重生成CRC
122
安排到原始目的设备的分组传输
108
构造确认分组
110
安排分组在通信链路上的传输
结束

图 7

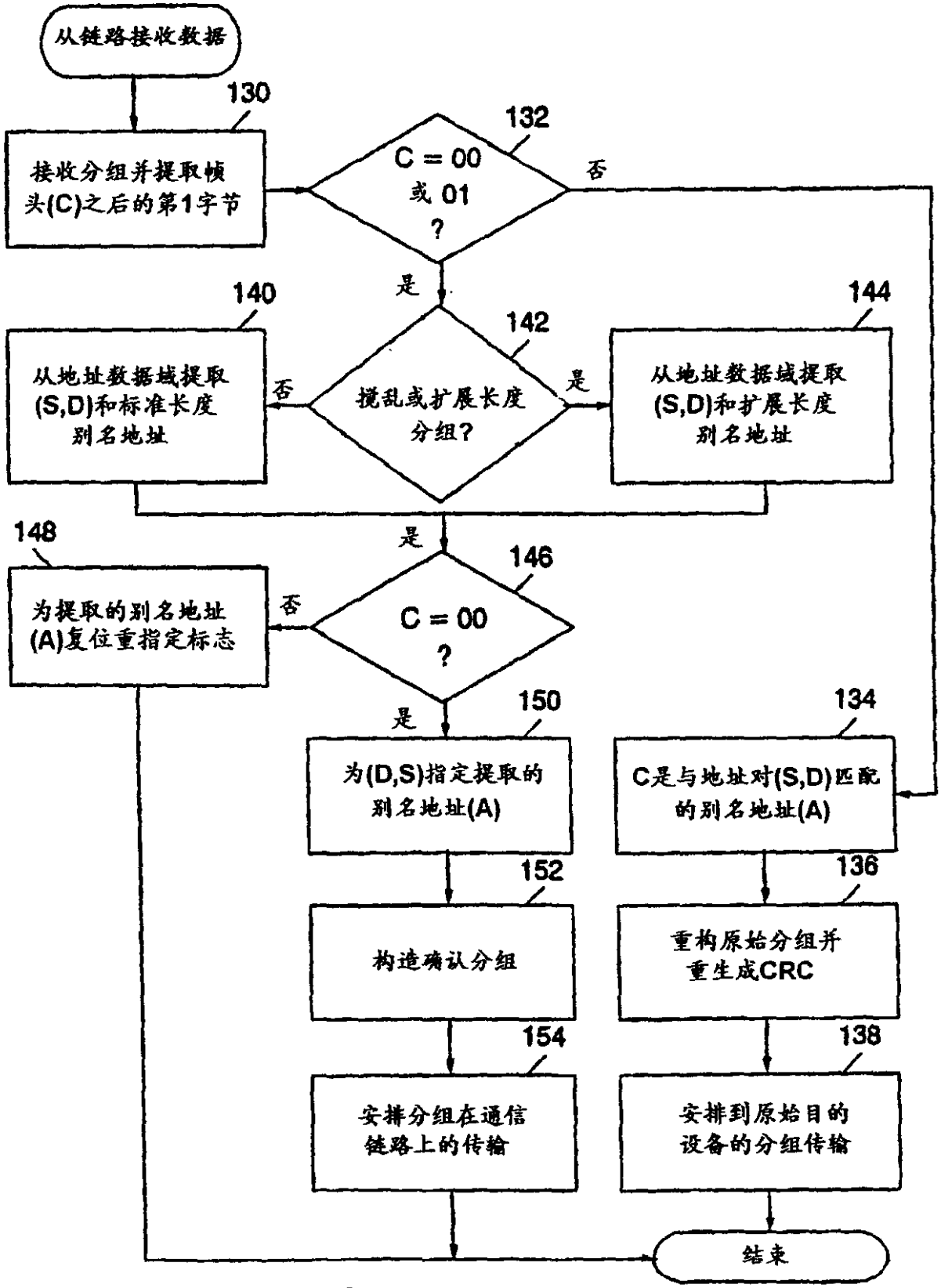
从链路接收数据
130
接收分组并提取帧头(C)之后的第1字节
132
C = 00 或 01 ?
否
是
140
从地址数据域提取(S,D)和标准长度别名地址
142
搅乱或扩展长度分组?
否
是
144
从地址数据域提取(S,D)和扩展长度别名地址
148
为提取的别名地址(A)复位重指定标志
否
146
C = 00 ?
是
150
为(D,S)指定提取的别名地址(A)
134
C是与地址对(S,D)匹配的别名地址(A)
152
构造确认分组
136
重构原始分组并重生成CRC
154
安排分组在通信链路上的传输
138
安排到原始目的设备的分组传输
结束

图 8