

## BACKGROUND OF THE INVENTION

## FIELD OF THE INVENTION

5       The present invention relates to a data conversion apparatus, a signal, a data conversion method, a DCE (Data Circuit-terminating Equipment), a gateway and a communication apparatus. More specifically, the present invention relates to a data conversion apparatus etc. for  
10   inhibiting octet/bit insertion in a section which does not require octet insertion or bit insertion (hereinafter referred to "octet/bit insertion") during communication on the basis of PPP (Point-to-Point Protocol). The present invention further relates to a communication  
15   apparatus which reduces control packet on the communication line.

## DESCRIPTION OF THE RELATED ART

20       PPP is present as a data link layer protocol of OSI reference model. PPP is a bit/byte synchronous and an asynchronous link control protocol by a serial circuit. PPP is specified in RFC (Request For Comments) 1661 and RFC 1662 of IETF (Internet Engineering Task Force).

25       Fig. 1 is a diagram showing a PPP frame configuration (frame format). The PPP frame has a flag field, address field, control field, protocol field, information field and FCS field. The number of bytes of respective fields are 1 byte for the flag field, 1 byte for the address field,  
30   1 byte for the control field, 1 or 2 bytes for the protocol

field, and 2 or 4 bytes for the FCS field. The address field and the control field may sometimes be compressed by negotiation of LCP (Link Control Protocol) ACFC (Address and Control Field Compression). Further, the protocol  
5 field may sometimes be compressed by LCPPFC (Protocol Field Compression) negotiation. Still further, the FCS (Frame Check Sequence) field may sometimes be compressed by LCPFCS negotiation.

Fig. 2 is a diagram showing an example of communication  
10 between DTE (Data Terminal Equipment) through a communication network and PSTN (Public Switched Telephone Network). In Fig. 2, an exchange 8 and a gateway 10 forms a communication network 5. DTE 2 and DTE 14 perform communication through DCE 4, exchange 8, gateway 10 and  
15 PSTN12. The communication network 5 can be, for example, a mobile communication network, and DCE 4 be, for example, a mobile station.

In this case, it is considered that data communication between DTE 2 and DTE 14 is performed on the basis of PPP.  
20 Heretofore, when a data signal is transmitted from DTE 2 to DTE 14, the data signal has been transmitted after making octet/bit insertion in DTE 2. Further, in DTE 14, octet deletion or bit deletion (hereinafter referred to "octet/bit deletion") has been performed to the received  
25 data signal. On the other hand, when a data signal is transmitted from DTE 14 to DTE 2, octet/bit insertion has been performed in DTE 14, and octet/bit deletion in DTE 2.

Further, it is also considered that only data  
30 communication between DTE 2 and a given point (point for

terminating PPP) in the network is performed on the basis of PPP. As the given point in the network, for example, the exchange 8, the gateway 10 or the like is considered. Here, description is made for a case where the gateway 10  
5 is the terminating point. In the past, when a data signal is transmitted from DTE 2 to DTE 14, octet/bit insertion has been made in DTE 2, octet/bit deletion made on the received data signal in gateway 10, and then the data signal has been transmitted to DTE 14. On the other hand, when  
10 transmitting a data signal from DTE 14 to DTE 2, octet/bit insertion has been made in gateway 10, and octet/bit deletion has been made in DTE 2.

However, in data communication based on the prior art PPP, even in a section not requiring octet/bit insertion,  
15 a data signal is transmitted and received in the octet/bit inserted state. For example, it is considered that octet/bit insertion is unnecessary in the section between DCE 4 and gateway 10 in Fig. 2, however, in the prior art, octet/bit insertion has been made even in this section.  
20 When octet/bit insertion is made, data transmission amount is increased, and throughput is deteriorated. Octet insertion means, for example, a specific 1-byte data is escape processed with a 1-byte escape character (1 byte) to form a 2-byte data (will be described later in detail  
25 with reference to Fig. 9). Further, bit insertion is described using an example, when a flag ("01111110" in binary notation) is to be distinguished from other data portion, bit insertion is made, to data other than the flag, when five "1s" continue, "0" is inserted after the data.

30 Incidentally, as a DTE data link layer protocol used

for the purpose of connecting to internet/intranet through public communication network or private communication network, PPP (Point-to-Point Protocol) is frequently used.

PPP enables transfer of various network protocols such as IP (Internet Protocol), Appletalk, and the like. The PPP specifications are specified as RFC (Request For Comment) of IETF (Internet Engineering Task Force).

Fig. 17 is a diagram showing a communication example. In the example of Fig. 17, a DTE (Data Terminal Equipment) 52 and a DTE 60 perform communication through a DCE (Data Circuit-terminating Equipment) 54, a network 56 and a DCE 58. Here, the DCE 54 and the DCE 58 can be, for example, mobile stations (portable telephones).

Fig. 18 shows a PPP frame format. Flag represents start or end of PPP, and is used for identifying a frame partition. Address field is information representing address of this PPP frame, for which a fixed value is generally used. Control field is information used for identifying frame type, for which a fixed value is generally used. Protocol field is used for identifying the protocol of packet included in the information field, and protocol packet shown in the protocol field is included in the information field. FCS (Frame Check Sequence) is used for making error detection from the address field to the information field.

Fig. 19 shows a PPP procedure. PPP transfers to a link establish phase when a physical layer starts in a link stop phase. In the link establish phase, link setting procedure of LCP (Link Control Protocol) is carried out, after LCP link establishment, transfers to a verification

phase, where a verification procedure is carried out as necessary. When verification is successful, PPP transfers to a network layer protocol phase, where NCP link setting procedure corresponding to each network protocol is performed. When each NCP link is established, packet of network protocol corresponding to each NCP becomes transferable. Further, PPP transfers to a link end phase by a communication end request or the like. LCP instructs to transmit an end request packet, when its identification packet is received, so that PPP link is closed and the physical layer is cut off. Further, close of the PPP link is notified to the network layer. When the physical layer is cut off, PPP returns to the link stop phase.

A LCP or NCP link establish sequence example is shown in Fig. 20. Here, link establish condition is that node A and node B transmit and receive respective setting identification packets. In respective packets, ID is used for correspondence of setting request packet with response packet (setting identification packet, setting negation packet, or setting rejection packet), and ID value received in the request packet is included in the ID value of the response packet. When transmitting a setting request packet, an option (Opt\_A~G) can be designated.

Reception side of the setting request packet, when all options included in the setting request packet can be recognized, and those values are all tolerable, accepts all options included in the setting request packet in the setting identification packet and performs a response.

The setting request packet reception side, when an unrecognizable option is present in options included in

the setting request packet, in the setting rejection packet makes a response including the unrecognizable option.

The setting request packet reception side, when all options included in the setting request packet are  
5 recognizable, however, intolerable option values exist, in the setting negation packet includes only intolerable value option, however, changes these options to tolerable values and performs a response. Further, when options other than those included in the setting request packet  
10 are to be requested to the setting request packet transmission side, those options can also be added to the packet.

The setting request packet transmission side, when receiving a setting rejection packet, such rejected  
15 options are removed, and then transmits the setting request packet again.

The setting request packet transmission side, when receiving a setting negation packet, a setting request packet with option values changed to those included in the  
20 setting negation packet. However, when a plurality of values exist in the options of the setting negation packet, one of them is selected.

A negotiation procedure example up to LCP or NCP link establishment will be described with reference to Fig. 20.

25 (a) Setting request (configure request) packet was transmitted from node A to node B, however, lost halfway in the transmission.

(b) Node A, because a response packet to setting request packet of (a) is not received for a certain period  
30 of time, transmitted the setting request packet again. At

this moment, only ID value was set to a value different from the setting request packet of (a).

(c) Setting request packet was transmitted from node B to node A, however, lost halfway in the transmission.

5 (d) Node B, because options Opt\_C, Opt\_D, and Opt\_E in the setting request packet of (b) cannot be recognized, made a response including these options in the setting rejection (configure reject) packet.

(e) Node A, removed options Opt\_C, Opt\_D, and Opt\_E  
10 in the received setting rejection packet of (d), changed the ID value, and then transmitted setting request packet.

(f) Node B, because all options in the received setting request packet of (e) were recognizable and these values are all tolerable, in the setting identification  
15 (configure ack (acknowledge)) packet made a response including all options in the setting request packet.

(g) Node B, because a response packet to setting request packet of (c) is not received for a certain period of time, transmitted again the setting request packet of  
20 the same format as the setting request packet of (c).

(h) Node A, because option Opt\_G in the setting request packet of (g) cannot be recognized, made a response including this option in the setting rejection packet.

(i) Node B, removed the option Opt\_G in the received  
25 setting rejection packet of (h), changed the ID value and transmitted the setting request packet.

(j) Node A, because value w2 of the option Opt\_A in the setting request packet of (i) is tolerable, however, value z1 of the option Opt\_F is intolerable, and it is  
30 tolerable if the value is z2, in the setting negation

(configure nak (negative acknowledge)) packet changed the value of option Opt\_F to z2 and transmitted it.

(k) Node B, changed option Opt\_F in the received setting negation packet of (j) and transmitted the setting request packet.

(l) Node A, because all options in the received setting request packet of (k) can be recognized and these values are all tolerable, in the setting identification packet made a response including all options in the setting request packet.

An example of LCP link cut sequence is shown in Fig. 21.

(a) Node A transmitted end request (terminate request) packet to require link release.

(b) On receiving the end request packet, node B transmitted the end identification (terminate ack) packet. Node A receiving the end identification packet became a link close state.

(c) Node B, after waiting for a certain time from the end identification packet transmission, transmitted an end request packet.

(d) Node A, on receiving the end request packet, transmitted the end identification packet, cut off the physical layer, and transferred to the link stop phase. The node B receiving the end identification packet became a link close state, cut off the physical layer, and transferred to the link stop phase.

Fig. 22 shows a keep alive sequence example using LCP echo request/response packet.

The LCP echo request/response packet is used during

LCP link establishment and can be used for determining whether or not the link is held.

(a) Node A transmitted LCP echo request packet to confirm whether or not LCP link is maintained.

5       (b) Node B on receiving the LCP echo request packet, transmitted LCP echo response (echo reply) packet to respond that the link is maintained.

(c) Node B transmitted LCP echo request packet to confirm whether or not LCP link is maintained.

10       (d) Node A on receiving the LCP echo request packet transmitted LCP echo response packet to respond that the link is maintained.

As one of characteristics of packet communication, since the communication line is used only when data is generated, a communication node exists in which adoption of a communication fee system based on the data amount is possible. As a requirement in such a communication node, it is desirable that communication fee is not required when user data to be communicated does not exist, that is, actually the communication line is not used.

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In the past, when PPP is used as DTE data link layer protocol in a communication node adopting a communication tariff system based on the data amount, by transferring PPP control packets at the communication start time and communication end time, LCP echo request/response packet for making continuity confirmation of PPP link periodically, and the like, there are problems that an extra communication tariff is required from the user point of view, and communication cost and communication traffic amount tend to increase from the communication enterprise

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point of view.

## SUMMARY OF THE INVENTION

5       It is therefore an object of the present invention to inhibit octet/bit insertion in a section not requiring octet/bit insertion during data communication based on PPP so that data transmission amount is reduced, thereby improving the throughput.

10       Another object of the present invention is to reduce the control packet on the communication line. With this configuration, reduction of communication tariff/communication cost and an increase in subscriber capacity associated with communication traffic amount  
15       reduction can be achieved.

      In order to accomplish the above mentioned objects, in a first aspect of the present invention, there is provided a data conversion apparatus performing octet deletion or bit deletion to data having a PPP configuration  
20       and being octet-inserted or bit-inserted.

      In a second aspect of the present invention, there is provided a data conversion apparatus comprising:

      deletion means for performing octet deletion or bit deletion to data having a PPP frame configuration and being  
25       octet-inserted or bit-inserted; and

      additional information addition means for adding additional information including information for identifying a frame partition to the data octet-deleted or bit-deleted by the deletion means.

30       In a third aspect of the present invention, there is

provided a data conversion apparatus comprising:

flag deletion means for deleting a flag from data having a PPP frame configuration and being octet-inserted or bit-inserted; and

5 deletion means for performing octet deletion or bit deletion to the data flag-deleted by the flag deletion means.

In a fourth aspect of the present invention, there is provided a data conversion apparatus comprising:

10 flag deletion means for deleting a flag from data having a PPP frame configuration and being octet-inserted or bit-inserted;

deletion means for performing octet deletion or bit deletion to the data flag-deleted by the flag deletion  
15 means; and

additional information addition means for adding additional information including information for identifying a frame partition to the data octet-deleted or bit-deleted by the deletion means.

20 In a fifth aspect of the present invention, there is provided a data conversion apparatus performing octet deletion or bit deletion to data having a PPP frame configuration and being not octet-inserted or not bit-inserted.

25 In a sixth aspect of the present invention, there is provided a data conversion apparatus comprising:

additional information deletion means for deleting additional information from data having a frame configuration in which the additional information  
30 including information for identifying a frame partition

is added to a PPP frame configuration and being not  
octet-inserted or not bit-inserted; and

insertion means for performing octet insertion or bit  
insertion to the data deleted of additional information  
5 by the additional information deletion means.

In a seventh aspect of the present invention, there  
is provided a data conversion apparatus comprising:

insertion means for performing octet insertion or bit  
insertion to data having a frame configuration flag-  
10 deleted from a PPP frame configuration and being not  
octet-inserted or not bit-inserted; and

flag addition means for adding a flag to the data  
octet-inserted or bit-inserted by the insertion means.

In an eighth aspect of the present invention, there  
15 is provided a data conversion apparatus comprising:

additional information deletion means for deleting  
additional information from data having a frame  
configuration in which the additional information  
including information for identifying frame partition is  
20 added to a frame configuration flag-deleted from a PPP  
frame configuration and being not octet-inserted or not  
bit-inserted;

insertion means for performing octet insertion or bit  
insertion to the data additional information-deleted by  
25 the additional information deletion means; and

flag addition means for adding a flag to the data  
octet-inserted or bit-inserted by the insertion means.

In a ninth aspect of the present invention, there is  
provided a data conversion apparatus converting data  
30 having a PPP frame configuration and being not octet-

inserted or not bit-inserted into data having a frame configuration of data link layer protocol other than PPP.

In a tenth aspect of the present invention, there is provided a data conversion apparatus converting data  
5 having a frame configuration in which additional information including information for identifying a frame partition is added to a PPP frame configuration and being not octet-inserted or not bit-inserted into data having a frame configuration of data link layer protocol other  
10 than PPP.

In an eleventh aspect of the present invention, there is provided a data conversion apparatus converting data having a frame configuration flag-deleted from a PPP frame configuration and being not octet-inserted or not bit-  
15 inserted into data having a frame configuration of data link layer protocol other than PPP.

In a twelfth aspect of the present invention, there is provided a data conversion apparatus converting data having a frame configuration in which additional  
20 information including information for identifying frame partition is added to a frame configuration flag-deleted from a PPP frame configuration and being not octet-inserted or not bit-inserted into data having a frame configuration of data link layer protocol other than PPP.

25 In a thirteenth aspect of the present invention, there is provided a data conversion apparatus converting data having a frame configuration of data link layer protocol other than a PPP into data having a PPP frame configuration and being not octet-inserted or not bit-inserted.

30 In a fourteenth aspect of the present invention, there

is provided a data conversion apparatus converting data having a frame configuration of data link layer protocol other than a PPP into data having a frame configuration in which additional information including information for  
5 identifying frame partition is added to a PPP frame configuration and being not octet-inserted or not bit-inserted.

In a fifteenth aspect of the present invention, there is provided a data conversion apparatus converting data  
10 having a frame configuration of data link layer protocol other than a PPP into data having a frame configuration flag-deleted from a PPP frame configuration and being not octet-inserted or not bit-inserted.

In a sixteenth aspect of the present invention, there  
15 is provided a data conversion apparatus converting data having a frame configuration of data link layer protocol other than a PPP into data having a frame configuration flag-deleted from a PPP frame configuration to which additional information including information for  
20 identifying frame partition is added and being not octet-inserted or not bit-inserted.

In a seventeenth aspect of the present invention, there is provided a signal having a PPP frame configuration and including data not octet-inserted or not bit-inserted.

25 In an eighteenth aspect of the present invention, there is provided a signal having a PPP frame configuration to which additional information including information for identifying frame partition is added and including data not octet-inserted or not bit-inserted.

30 In a nineteenth aspect of the present invention, there

is provided a signal having a frame configuration of flag-deleted from a PPP frame configuration and including data not octet-inserted or not bit-inserted.

In a twentieth aspect of the present invention, there  
5 is provided a signal having a frame configuration of flag-deleted from a PPP frame configuration to which additional information including information for identifying frame partition is added and including data not octet-inserted or not bit-inserted.

10 In a twenty-first aspect of the present invention, there is provided a data conversion method performing octet deletion or bit deletion to data having a PPP frame configuration and being octet-inserted or bit-inserted.

In a twenty-second aspect of the present invention,  
15 there is provided a data conversion method comprising:  
a deletion step for performing octet deletion or bit deletion to data having a PPP frame configuration and being octet-inserted or bit-inserted; and

an additional information addition step for adding  
20 additional information including information for identifying a frame partition to the data octet-deleted or bit-deleted by the deletion step.

In a twenty-third aspect of the present invention, there is provided a data conversion method comprising:  
25 a flag deletion step for deleting a flag from data having a PPP frame configuration and being octet-inserted or bit-inserted; and

a deletion step for performing octet deletion or bit deletion to the data flag-deleted by the flag deletion  
30 step.

In a twenty-fourth aspect of the present invention, there is provided a data conversion method comprising:

a flag deletion step for deleting a flag from data having a PPP frame configuration and being octet-inserted or bit-inserted;

a deletion step for performing octet deletion or bit deletion to the data flag-deleted by the flag deletion step; and

an additional information addition step for adding additional information including information for identifying a frame partition to the data octet-deleted or bit-deleted by the deletion step.

In a twenty-fifth aspect of the present invention, there is provided a data conversion method performing octet insertion or bit insertion to data having a PPP frame configuration and being not octet-inserted or not bit-inserted.

In a twenty-sixth aspect of the present invention, there is provided a data conversion method comprising:

an additional information deletion step for deleting additional information from data having a PPP frame configuration to which the additional information including information for identifying a frame partition and being octet-inserted or bit-inserted is added; and an insertion step for performing octet insertion or bit insertion to the data additional information-deleted by the additional information deletion step.

In a twenty-seventh aspect of the present invention, there is provided a data conversion method comprising:

an insertion step for performing octet insertion or

bit insertion to data having a frame configuration flag-deleted from a PPP frame configuration and being not octet-inserted or not bit-inserted; and

5 a flag addition step for adding a flag to the data octet-inserted or bit-inserted by the insertion step.

In a twenty-eighth aspect of the present invention, there is provided a data conversion method comprising:

an additional information deletion step for deleting additional information from data having a frame  
10 configuration flag deleted from a PPP frame configuration to which the additional information including information for identifying a frame partition is added and being not octet-inserted or not bit-inserted;

an insertion step for performing octet insertion or  
15 bit insertion to the data additional information-deleted by the additional information deletion step; and

a flag addition step for adding a flag to the data octet-inserted or bit-inserted by the insertion step.

In a twenty-ninth aspect of the present invention,  
20 there is provided a data conversion method converting data having a PPP frame configuration and being not octet-inserted or not bit-inserted into data having a frame configuration of data link layer protocol other than PPP.

In a thirtieth aspect of the present invention, there  
25 is provided a data conversion method converting data having a frame configuration in which additional information including information for identifying frame partition is added to a PPP frame configuration and being not octet-inserted or not bit-inserted into data having a frame  
30 configuration of data link layer protocol other than PPP.

In a thirty-first aspect of the present invention, there is provided a data conversion method for converting data having a frame configuration flag-deleted from a PPP frame configuration and being not octet-inserted or not  
5 bit-inserted into data having a frame configuration of data link layer protocol other than PPP.

In a thirty-second aspect of the present invention, there is provided a data conversion method converting data having a frame configuration in which additional  
10 information including information for identifying frame partition is added to a frame configuration flag-deleted from a PPP frame configuration and being not octet-inserted or not bit-inserted into data having a frame configuration of data link layer protocol other than PPP.

15 In a thirty-third aspect of the present invention, there is provided a data conversion method converting data having a frame configuration of data link layer protocol other than PPP into data having a PPP frame configuration and being not octet-inserted or not bit-inserted.

20 In a thirty-fourth aspect of the present invention, there is provided a data conversion method converting data having a frame configuration of data link layer protocol other than PPP into data having a frame configuration in which additional information including information for  
25 identifying frame partition is added to a PPP frame configuration and being not octet-inserted or not bit-inserted.

In a thirty-fifth aspect of the present invention, there is provided a data conversion method converting data  
30 having a frame configuration of data link layer protocol

other than PPP into data having a frame configuration flag-deleted from a PPP frame configuration and being not octet-inserted or not bit-inserted.

In a thirty-sixth aspect of the present invention,  
5 there is provided a data conversion method converting data having a frame configuration of data link layer protocol other than PPP into data having a frame configuration flag-deleted from a PPP frame configuration to which additional information including information for  
10 identifying frame partition is added and being not octet-inserted or not bit-inserted.

In a thirty-seventh aspect of the present invention, there is provided a DCE transmitting a LCP echo reply to one of two apparatus performing data communication based  
15 on PPP, when the DCE receives a LCP echo request transmitted by the one apparatus to the other apparatus.

In a thirty-eighth aspect of the present invention, there is provided a DCE discarding a LCP discard request, when the DCE receives the LCP discard request transmitted  
20 by one of two apparatus performing data communication based on PPP to the other.

In a thirty-ninth aspect of the present invention, there is provided a gateway transmitting a LCP echo reply to one of two apparatus performing data communication based  
25 on PPP, when the gateway receives a LCP echo request transmitted by the one apparatus to the other apparatus.

In a fortieth aspect of the present invention, there is provided a gateway discarding a LCP discard request, when the gateway receives the LCP discard request  
30 transmitted by one of two apparatus performing data

communication based on PPP to the other.

In a forty-first aspect of the present invention,  
there is provided a communication apparatus located  
between another communication apparatus of self-node and  
5 a communication apparatus of other node,

producing a setting request packet according to a  
setting rejection packet or a setting negation packet and  
transmitting the setting request packet to the another  
communication apparatus of self-node, when the  
10 communication apparatus receives the setting rejection  
packet or the setting negation packet from the another  
communication apparatus of self-node, after  
intermediating a setting request packet from the  
communication apparatus of other node to the another  
15 communication apparatus of self-node.

Here, the communication apparatus may notify setting  
rejection or setting negation to the communication  
apparatus of other node by transmitting only information  
included in a setting rejection packet or a setting  
20 negation packet to the communication apparatus of other  
node, when the communication apparatus receives the  
setting rejection packet or the setting negation packet  
from the another communication apparatus of self-node,  
after intermediating a setting request packet from the  
25 communication apparatus of other node to the another  
communication apparatus of self-node.

Here, the communication apparatus may terminate a  
setting identification packet when the communication  
apparatus receives the setting identification packet after  
30 intermediating a setting request packet from the

communication apparatus of other node to the another  
communication apparatus of self-node and receiving a  
setting rejection packet or a setting negation packet from  
the another communication apparatus of self-node, and the  
5 communication apparatus is able to not terminate a setting  
identification packet when the communication apparatus  
receives the setting identification packet without  
receiving a setting rejection packet or a setting negation  
packet from the another communication apparatus of  
10 self-node after intermediating a setting request packet  
from the communication apparatus of other node to the  
another communication apparatus of self-node.

In a forty-second aspect of the present invention,  
there is provided a communication apparatus located  
15 between another communication apparatus of self-node and  
a communication apparatus of other node,

terminating a setting request packet, when the  
communication apparatus receives the setting request  
packet after intermediating a setting request packet from  
20 the another communication apparatus of self-node to the  
other node communication apparatus and a notification of  
setting rejection or setting negation from the other node  
communication apparatus to the another communication of  
self-node.

25 Here, the communication apparatus may produce a  
setting rejection packet or a setting negation packet and  
transmit it to the another communication apparatus of  
self-node, when the communication apparatus receives a  
notification of setting rejection or setting negation from  
30 the communication apparatus of other node after

intermediating a setting request packet from the another communication apparatus of self-node to the other node communication apparatus.

Here, the communication apparatus may produce a  
5 setting identification packet and transmit it to the  
another communication apparatus of self-node, when the  
communication apparatus receives from the another  
communication apparatus of self-node, all of setting  
request packets according to notifications of setting  
10 rejection or setting negation from the communication  
apparatus of other node to the another communication of  
self-node after intermediating setting request packets  
from the another communication apparatus of self-node to  
the other node communication apparatus and the  
15 notifications.

In a forty-third aspect of the present invention,  
there is provided a communication apparatus located  
between another communication apparatus of self-node and  
a communication apparatus of other node,

20 producing an end identification packet and  
transmitting it to the another communication apparatus of  
self-node after intermediating a notification of end  
request from the another communication apparatus of  
self-node to the other node communication.

25 Here, the communication apparatus may produce an end  
request signal and transmit it to the communication  
apparatus of other node, when the communication apparatus  
receives an end request packet from the another  
communication apparatus of self-node.

30 Here, the communication apparatus may produce an end

request packet and transmit it to the another communication  
apparatus of self-node, when the communication apparatus  
receives a notification of end identification from the  
communication apparatus of other node after intermediating  
5 a notification of end request from the another  
communication apparatus of self-node to the communication  
apparatus of other node.

Here, the communication apparatus may terminate an  
end identification packet, when the communication  
10 apparatus receives the end identification packet from the  
another communication apparatus of self-node after  
transmitting the produced end request packet.

In a forty-fourth aspect of the present invention,  
there is provided a communication apparatus located  
15 between another communication apparatus of self-node and  
a communication apparatus of other node,

terminating an end identification packet, when the  
communication apparatus receives the end identification  
packet from the another communication apparatus of  
20 self-node after intermediating a notification of end  
request from the other node communication apparatus to the  
another communication apparatus of self-node.

Here, the communication apparatus may produce an end  
request packet and transmit it to the another communication  
25 apparatus of self-node, when the communication apparatus  
receives a notification of end request from the other node  
communication apparatus.

Here, the communication apparatus may produce an end  
identification signal and transmit it to the communication  
30 apparatus of other node, when the communication apparatus

receives an end request packet from the another  
communication apparatus of self-node after intermediating  
a notification of end request from the other node  
communication apparatus to the another communication  
5 apparatus of self-node.

Here, the communication apparatus may produce an end  
identification packet and transmit it to the another  
communication apparatus of self-node after transmitting  
the produced end identification signal.

10 In a forty-fifth aspect of the present invention,  
there is provided a communication apparatus located  
between another communication apparatus of self-node and  
a communication apparatus of other node,

terminating an echo request, producing an echo  
15 response packet and transmits it to the another  
communication apparatus of self-node, when the  
communication apparatus receives the echo request packet  
from the another communication apparatus of self-node to  
the other node communication apparatus.

20 Here, the communication apparatus may be a mobile  
station.

With the above configuration, during PPP-based  
communication, in a section not requiring octet/bit  
insertion, octet/bit insertion is not performed so that  
25 data transmission amount is reduced, thereby improving the  
throughput. When the data transmission amount can be  
reduced, the users can be provided with various services  
at low cost.

Further, control packet on the communication line can  
30 be reduced.

The above and other objects, effects, features and advantages of the present invention will become more apparent from the following description of embodiments thereof taken in conjunction with the accompanying  
5 drawings.

#### BRIEF DESCRIPTION OF THE DRAWINGS

- Fig. 1 is a diagram showing PPP frame construction;  
10 Fig. 2 is a diagram showing an example of communication between DTEs through a communication network and PSTN;  
Fig. 3 is a diagram showing an example of improved frame construction according to a first embodiment of the present invention;  
15 Fig. 4 is a diagram for explaining data communication between DTE 2 and DTE 14;  
Fig. 5 is a diagram showing construction example of a first data conversion apparatus;  
Fig. 6 is a diagram showing construction example of  
20 a second data conversion apparatus;  
Fig. 7 is a diagram showing a negotiation processing example when data is generated in DTE 2;  
Fig. 8 is a diagram showing a processing example of DTE 2 and DCE 4 when transferring data from DTE 2 to DTE  
25 14;  
Fig. 9 is a diagram showing a practical example of octet insertion processing performed in DTE 2;  
Fig. 10 is a diagram showing a practical example of octet deletion processing performed in DCE 4;  
30 Fig. 11 is a diagram showing a processing example of

DTE 2 and DCE 4 when transferring data from DTE 14 to DTE 2;

Fig. 12 is a diagram showing a practical example of octet insertion processing performed in DCE 4;

5 Fig. 13 is a diagram showing a practical example of octet deletion processing performed in DTE 2;

Fig. 14 is a diagram for explaining data communication between DTE 2 and gateway 10;

Fig. 15 is a diagram for explaining bit insertion;

10 Fig. 16 is a diagram for explaining processing performed in DCE;

Fig. 17 is a diagram showing a communication example;

Fig. 18 is an explanation diagram showing field construction of PPP frame;

15 Fig. 19 is an explanation diagram showing outline of PPP procedure;

Fig. 20 is a sequence diagram showing a PPP link establish sequence example;

20 Fig. 21 is a sequence diagram showing a PPP link cut-off sequence example;

Fig. 22 is a sequence diagram showing a PPP keep alive operation;

25 Fig. 23 is a sequence diagram when the present invention is applied to the link establish sequence example of Fig. 20;

Fig. 24 is a sequence diagram when the present invention is applied to the link cut-off sequence example of Fig. 21; and

30 Fig. 25 is a sequence diagram when the present invention is applied to the keep alive sequence example

of Fig. 22.

#### DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

5        In the following, embodiments of the present invention will be described in detail with reference to the drawings.

      In the first and second embodiments, an example of communication between DTEs through the communication network and PSTN shown in Fig. 2 will be described.

10

##### [First Embodiment]

      In the first embodiment of the present invention, data communication between DTE 2 and DTE 14 is performed on the basis of PPP.

15        Fig. 3 is a diagram showing an example of improved PPP frame construction according to the present embodiment. The improved PPP frame has an additional information field, an address field, a control field, a protocol field, an information field and a FCS field. That  
20 is, the frame has a frame construction in which additional information is added to a frame construction with the flag deleted from the PPP frame construction. The additional information includes identification information for identifying frame partition. In the present embodiment,  
25 frame length (number of bytes of the frame) is used as the identification information.

      Further, a frame construction with a flag added to the frame construction of Fig. 3 can also be used. That is, it is also possible that, without deleting the flag  
30 from the PPP frame construction, but the additional

information is simply added.

Fig. 4 is a diagram for explaining data communication between DTE 2 and DTE 14. When transmitting a data signal from DTE 2 to DTE 14, octet insertion is performed in DTE 2 to the data as in the prior art, and then the result is transmitted. In DCE 4, a special processing (this processing will be described below) is performed, in which the data having the PPP frame construction and octet inserted is converted to data which has an improved frame construction (Fig. 3) and is not octet inserted. In the gateway 10 (indicated by NW in Fig. 4), a special processing is performed, whereby the data having the improved PPP frame construction and not octet inserted is converted to data which has the PPP frame construction and is octet inserted. After the data conversion, the gateway 10 transmits the signal including the converted data to DTE 14. Then, in DTE 14, octet deletion is performed as in the prior art.

On the other hand, when transmitting a data signal from DTE 14 to DTE 2, octet insertion is performed in DTE 14 to the data as in the prior art, and the data transmitted. In the gateway 10, a special processing is performed, in which the data having the PPP frame construction and octet inserted is converted to data which has an improved frame construction and is not octet inserted. In DCE 4, a special processing is performed, whereby the data having the improved PPP frame construction and not octet inserted is converted to data which has the PPP frame construction and is octet inserted. Then, in DTE 2, octet deletion is performed as in the prior art.

As described above, between DCE 4 and gateway 10, a signal including data having the improved PPP frame construction shown in Fig. 3 and not octet inserted is transmitted. With this method, data transmission amount is reduced and the throughput improved.

In DCE 4 and gateway 10, to perform the above special processing, a first data conversion apparatus 20 and a second data conversion apparatus 30.

Fig. 5 is a diagram showing construction example of the first data conversion apparatus. The first data conversion apparatus 20 comprises a flag deletion part 22, an octet deletion part 24 and an additional information addition part 26. When using a frame construction in which between DCE 4 and gateway 10, a flag is added (remained) to the frame construction of Fig. 3, the flag deletion part 22 is unnecessary.

Fig. 6 is a diagram showing a construction example of the second data conversion apparatus. The second data conversion apparatus 30 comprises an additional information deletion part 32, an octet insertion part 34 and a flag addition part 36. When using a frame construction in which a flag is added between DCE 4 and gateway 10 of the frame construction of Fig. 3, the flag addition part 36 is unnecessary.

Fig. 7 is a diagram showing a negotiation processing example when data is generated in DTE 2. DTE 2, when data is generated, to establish PPP link, transmits LCP link setting request to PPP termination (DTE 14) ((1) of Fig. 7). PPP termination is DTE 14, however, it can be gateway 10 or the like. A case where the PPP termination is gateway

10 will be described in a second embodiment of the present invention. DCE 4 monitors response of LCP and, when ACCM (Async Control Character Map) is included in the response from the DTE 14 side, stores it, receives PPP frame from the DTE 14 side, and utilizes it for octet insertion processing when transmitting to the DTE 2 side (Fig. 7(2)). In the network layer protocol phase after the verification phase (this can be omitted), negotiation of what is used for the network layer protocol (for example, IP (Internet Protocol) is performed in NCP (Network Control Protocol (Fig. 7(3)). As a result, network layer packet becomes usable. In the present embodiment, IP is used as network layer protocol, however, another protocol may be used. After that, data transfer is performed using IP packet (Fig. 7(4)). Negotiation processing when data is generated in DTE 14 can be performed by the above-described same negotiation processing as well.

Fig. 8 is a diagram showing a processing example of DTE 2 and DCE 4 when transferring data from DTE 2 to DTE 14. In DTE 2, data received from the network layer (NW layer) is provided with an address (A), control (C), protocol (P) and FCS fields, octet insertion processing is performed according to LCP negotiation (Fig. 8(1)), and, after adding flag (F) field, data transfer is performed. Here, since, in the octet insertion, a processing of increasing 1 byte to 2 bytes is performed, the data after octet insertion is greater than the original data. Further, before completion of negotiation, default octet insertion is performed.

30 In DCE 4, data portion surrounded by flag of data

received from DTE 2 is taken out (flag is deleted) by the flag deletion part 22. In the octet deletion part 24, octet deletion processing which is quite the reverse to the octet insertion processing performed by DTE 2 is performed to the taken-out data portion (Fig. 8(2)). In the additional information addition part 26, additional information including identification information for identifying the partition of that 1 frame (information for recognizing that 1 frame) is added (Fig. 8 (3)). In the present embodiment, only identification information is added as the additional information. Further, frame length is used as the identification information. The data provided with the additional information is transferred towards DTE 14.

When a frame construction in which a flag is added (remained) between DCE 4 and gateway 10 in the frame construction of Fig. 3, flag deletion by the flag deletion part 22 is not performed.

Fig. 9 is a diagram showing a practical example of octet insertion processing performed in DTE 2. In Fig. 9, octet insertion processing is shown using an example of a case where all of 00h to 1Fh (h indicates hexadecimal notation) are escape processed with escape character (7Dh) by LCP negotiation. In addition to 00h to 1Fh, escape processing is also performed for escape character (7Dh) and flag value (7Eh). In the present embodiment, escape processing is performed by adding escape character (7Dh) before subject data and exclusive ORing subject data with 20h. For example, when octet insertion processing is performed on data 00h, data 7D20h is formed. When performing such octet processing, the original data of 1

byte becomes a 2-byte data.

Fig. 10 is a diagram showing a practical example of  
octet deletion processing performed in DCE 4. In the octet  
deletion processing, the quite reverse processing to the  
5 octet insertion processing performed in DTE 2 is performed.

Fig. 11 is a diagram showing a processing example of  
DTE 2 and DCE 4 when transferring data from DTE 14 to DTE  
2. In DCE 4, data portion other than additional  
information of the received signal is taken out (additional  
10 information is deleted) in the additional information  
deletion part 32 (Fig. 11(1)). To the taken-out data, in  
the octet insertion part 34, octet insertion is performed  
according to ACCM negotiation result performed in LCP (Fig.  
11(2)), and, after adding a flag in flag addition part 36,  
15 data transfer is performed. Here, since octet insertion  
performs a processing for changing 1 byte to 2 bytes, the  
data after octet insertion is greater than the original  
data. Further, before completion of negotiation, default  
octet insertion is performed.

20 When using a frame construction in which between DCE  
4 and gateway 10, a flag is added (remained) to the frame  
construction of Fig. 3, the flag deletion part 36 is  
unnecessary.

In DTE 2, as in the past, octet deletion processing  
25 is performed according to the ACCM negotiation result  
performed in LCP (Fig. 11(3)).

Fig. 12 is a diagram showing a practical example of  
octet insertion processing performed in DCE 4. The octet  
insertion processing performed in DCE 4 is the same as the  
30 octet insertion processing (Fig. 9) performed in DTE 2.

Fig. 13 is a diagram showing a practical example of octet deletion processing performed in DTE 2. In the octet deletion processing, the quite reverse processing to the octet insertion processing performed in DCE 4 is performed.

5       The processing (octet insertion processing or the like) performed in gateway 10 when transferring data from DTE 2 to DTE 14 is the same as the processing performed in DCE 4 (Figs. 11 and 12) when transferring data from DTE 14 to DTE 2.

10       Further, the processing (octet deletion processing or the like) performed in gateway 10 when transferring data from DTE 14 to DTE 2 is the same as the processing performed in DCE 4 (Figs. 8 and 10) when transferring data from DTE 2 to DTE 14.

15       Fig. 16 is a diagram for explaining processing performed in DCE.

As codes in LCP format, there are LCP Echo-Request (code: 09h) and LCP Discard-Request (code: 0Bh).

20       In DCE 4, when one (for example, DTE 2) of two apparatus performing data communication according to PPP receives a LCP echo-request transmitted to the other (for example, DTE 14), a LCP Echo-Reply) (code: 0Ah) is transmitted to the one apparatus. This inhibits transmission of LCP echo-request to the other apparatus (transmitted in the  
25   past), thereby reducing the data transmission amount.

Further, in DCE 4, when one of two apparatus performing data transmission according to PPP receives a LCP Discard-Request transmitted to the other, the LCP Discard-Request is discarded (deleted). This inhibits  
30   transmission of LCP discard-request to the other apparatus

(transmitted in the past), thereby reducing the data transmission amount.

Similarly, in gateway 10, when one (for example, DTE 14) of two apparatus performing data communication according to PPP receives a LCP echo-request transmitted to the other (for example, DTE 2), a LCP echo-reply is transmitted to the one apparatus. This inhibits transmission of LCP echo-request to the other apparatus (transmitted in the past), thereby reducing the data transmission amount.

Further, in gateway 10, when one of two apparatus performing data transmission according to PPP receives a LCP Discard-Request transmitted to the other, the LCP Discard-Request is discarded (deleted). This inhibits transmission of LCP discard-request to the other apparatus (transmitted in the past), thereby reducing the data transmission amount.

In the present embodiment, DCE 4 and gateway 10 comprise the first data conversion apparatus 20 and the second data conversion apparatus 30, however, it is also possible that, for example, only the first data conversion apparatus 20 is provided in DCE 4 and gateway 10 is provided with only the second data conversion apparatus 30, so as to use a PPP frame construction improved for use only in one-way data communication.

Still further, in the present embodiment, a special processing (octet insertion, deletion or the like) is performed in gateway 10, however, alternatively, this processing can be performed, for example, in the exchange 8.

[Second Embodiment]

In the second embodiment of the present invention, data communication between DTE 2 and gateway 10 is performed according to PPP.

Fig. 14 is a diagram for explaining data communication between DTE 2 and gateway 10. The gateway 10 and DTE 14 are connected with a dedicated line. In the present embodiment, negotiation processing (Fig. 7) is performed between DTE 2 and gateway 10.

When transmitting data signal from DTE 2 to DTE 14, octet insertion is performed in DTE 2 to the data as in the past, and the result transmitted. In DCE 4, the same processing as in the first embodiment is performed, so that data having PPP frame construction and octet inserted is converted into data which has improved PPP frame construction (Fig. 3) and is not octet inserted.

Gateway 10 (indicated as NW in Fig. 14) converts data having improved PPP frame construction and not octet inserted into data which has a data link layer protocol frame construction other than PPP. The data conversion can be performed same as in the case of converting data having PPP frame construction into data having frame construction of data link layer protocol other than PPP. In the improved PPP frame construction, instead of the flag, an identification information for identifying a frame partition. After the data conversion, gateway 10 transmits a signal including the converted data to DTE 14.

On the other hand, when transmitting a data signal from DTE 14 to DTE 2, in gateway 10, the data having data

link layer protocol frame construction other than PPP is converted into data having improved frame construction and not octet inserted. The data conversion can be performed same as in the case of converting data having data link  
5 layer protocol frame construction other than PPP into data having PPP frame construction. After the data conversion, gateway 10 transmits the signal including the converted data to DCE 4.

In DCE 4, the same processing as in the first  
10 embodiment is performed, so that data having improved PPP frame construction and not octet inserted is converted into data having PPP frame construction and octet inserted. After that, octet deletion is performed in DTE 2 same as in the past.

15 As described above, between DCE 4 and gateway 10, a signal including data having improved PPP frame construction and not octet inserted as shown in Fig. 3 is communicated. With this operation, data transmission amount is reduced and the throughput is improved.

20 Also in the present embodiment, as in the first embodiment, PPP frame construction improved for use in only one-way data communication can be used.

Further, in the present embodiment, a special processing (conversion to data having different frame  
25 construction) is performed in gateway 10, however, alternatively, this processing can also be performed, for example, in the exchange 8 as well.

Still further, also in the present embodiment, DCE 4 and gateway 10 perform the processing shown in Fig. 16.

[Others]

The first and second embodiments use additional information, however, if a construction is available which is capable of identifying 1 PPP in a lower layer than PPP, such additional information is unnecessary. In such a case, the additional information addition part 26 and the additional information deletion part 32 are unnecessary.

In the first and second embodiments, the present invention is described in conjunction with octet insertion and deletion, however, the present invention can also be applied to the case of bit insertion and deletion.

Fig. 15 is a diagram for explaining bit insertion. Example of performing octet insertion in DTE 2 is described in Fig. 9, when bit insertion is performed in DTE 2, operation is as shown, for example, in Fig. 15. In the example of Fig. 15, bit insertion is performed, when five "1"s continue to data other than flag, by inserting "0" after that. Since bit deletion is the reverse processing of bit insertion, in bit deletion, when five "1"s continue to data other than flag, "0" after that is deleted.

As described above, with the present invention, during communication according to PPP, in a section not requiring octet/bit insertion, the octet/bit insertion is inhibited, so that the data transmission amount can be reduced, and the throughput be improved. When the data transmission amount can be reduced, the users can be provided with various services at low cost.

[Third Embodiment]

Fig. 23 shows a sequence diagram when the present

invention is applied to LCP or NCP link establish sequence example of Fig. 20. A (communication) apparatus 71 and a (communication) apparatus 72 belong to node A, and a (communication) apparatus 73 and a (communication) apparatus 74 to node B, which may be physically different apparatus or same apparatus. Between the apparatus and the apparatus 73 is connected with a communication line. For example, DTE 2 of Fig. 17 can be corresponded to the apparatus 71, DCE 4 to the apparatus 72, DEC 8 to the apparatus 73, and DTE 10 to the apparatus 74, whereby a redundant packet between DCE 4 and DCE 8 can be deleted.

The procedures will be described below.

(a) A setting request packet was transmitted from the apparatus 71, passed through the apparatus 72, and disappeared before arrival to node B.

(b) The apparatus 71, since a response packet to the setting request packet of (a) is not received for a certain period of time, transmitted again the setting request packet. In this case, only the ID value was set to a value different from the setting request packet of (a).

(c) A setting request packet was transmitted from the apparatus 74, passed through the apparatus 73, and disappeared before arrival to node A.

(d) The apparatus 74, to the setting request packet of (b) received through the apparatus 73, since Opt\_C, Opt\_D and Opt\_E cannot be recognized, in a setting rejection packet made a response including these options.

(e) The apparatus 73 did not transfer the setting rejection packet of (d) to the apparatus 72, removed Opt\_C, Opt\_D and Opt\_E to produce a setting request packet with

changed ID value and transmitted to the apparatus 74.

(f) The apparatus 74, because all options in the received setting request packet of (e) and these values are all tolerable, made a response in a setting  
5 identification packet. The apparatus 73, when receiving the setting identification packet from the apparatus 74, transmits only information included in the packet of (d) to the apparatus 72. As in the present example, when the setting identification packet was received after receiving  
10 the setting rejection packet or the setting negation packet from the apparatus 74, that setting identification packet is terminated. However, when the setting identification packet was received while not receiving the setting rejection packet or the setting negation packet from the  
15 apparatus 74, that setting identification packet is not terminated. In this case, that the setting identification packet is simply received is notified to the apparatus 72 (for example, by transmitting the setting identification packet).

20 (g) The apparatus 72 transmits the setting rejection packet produced from information included in the packet of (d) to the apparatus 71. The apparatus 71, on receiving the setting rejection packet from the apparatus 72, removes Opt\_C, Opt\_D and Opt\_E and transmits the setting request  
25 packet with changed ID value. The packets of (e) and (g), even though differing in ID value, are setting request packets having the same options.

(h) The apparatus 72 does not transfer the setting request packet of (g) to the apparatus 73, but makes a  
30 response in setting identification packet. The packets

of (f) and (h), even though differing in ID value, are setting identification packets having the same options.

(i) The apparatus 74, since a response packet to the setting request packet of (c) is not received for a certain  
5 period of time, transmits again setting request packet of the same format as the setting request packet of (c).

(j) The apparatus 71, since option Opt\_G of the received setting request packet of (i) cannot be recognized, in the setting rejection packet makes a  
10 response including the option.

(k) The apparatus 72 does not transfer the setting rejection packet of (j) to the apparatus 73, transmits the setting request packet with the option Opt\_G removed and the ID value changed to the apparatus 71.

15 (l) The apparatus 71, since the value w2 of the option Opt\_A in the received setting request packet of (k) is tolerable, however, it is tolerable if the value of the option Opt\_F is not z1 but z2, in the setting negation packet the value of the option Opt\_F is changed to z2 and  
20 transmitted.

(m) The apparatus 72 does not transfer the setting negation packet of (l) to the apparatus 71, but changes the value of the option Opt\_F to z2, and transmits the setting request packet to the apparatus 71.

25 (n) The apparatus 71, since all options in the received setting request packet of (m) can be recognized and these values are all tolerable, makes a response in the setting identification packet. The apparatus 72, on receiving the setting identification packet, transmits only information  
30 included in the packets of (j) and (l) to the apparatus

73.

(o) The apparatus 73, on receiving information included in the packets of (j) and (l) from the apparatus 72, first transmits setting rejection packet produced from information of (j) to the apparatus 74. The packets of (j) and (o) are setting rejection packets having the same options.

(p) The apparatus 74 removes the option Opt\_G in the received setting rejection packet of (o), and transmits setting request packet with changed ID value. The packets of (k) and (p), even though differing in ID value, are setting request packets having the same options.

(q) The apparatus 73 does not transfer the setting request packet of (p) to the apparatus 72, since it is known from information included in the packet of (l) that the value w2 of the option Opt\_A is tolerable, however, it is tolerable if the value of the option Opt\_F is not z1 but z2, in the setting negation packet changes the value of the option Opt\_F to z2 and transmits it to the apparatus 74. The packets of (l) and (q), even though differing in ID value, are setting negation packets having the same options.

(r) The apparatus 74 changes the value of the option Opt\_F in the received setting negation packet of (q) to z2 and transmits setting request packet. The packets of (m) and (r), even though differing in ID value, are setting request packets having the same options.

(s) The apparatus 73 does not transmit the setting request packet of (r) to the apparatus 72, since all options in the setting request packet can be recognized and these

values are all tolerable, in the setting identification packet makes a response to the apparatus 74. The packets of (n) and (s), even though differing in ID value, are setting identification packets having the same options.

5        Fig. 24 shows a sequence diagram when the present invention is applied to the LCP link cut-off sequence example of Fig. 21. The procedures will be described below.

         (a) The apparatus 71 transmits end request packet to  
10        request link release. The apparatus 72, on receiving the end request packet, transmits a communication end request signal to the apparatus 73. The apparatus 73 on receiving the communication end request signal, produces an end request packet and transmits it to the apparatus 74.

15        (b) The apparatus 72 on receiving the end request packet from the apparatus 71, transmits end identification packet to the apparatus 71. The apparatus 71 receiving the end identification packet becomes a link close state. On the other hand, the apparatus 74 receiving the end  
20        request packet from the apparatus 73 transmits end identification packet. The apparatus 73 does not transfer the end identification packet to the apparatus 72.

         (c) The apparatus 74, after the passage of a time from the end identification packet transmission, transmits end  
25        request packet. The apparatus 73, on receiving the end request packet, transmits a communication end identification signal to the apparatus 72. The apparatus 72 receiving the communication end identification signal produces end request packet and transmits it to the  
30        apparatus 71.

(d) The apparatus 73 receiving the end request packet transmits end identification packet to the apparatus 74. The apparatus 74 receiving the end identification packet transfers to the link close state, and after cutting the physical link, becomes a link stop phase state. On the other hand, the apparatus 71 receiving the end request packet from the apparatus 72 transmits end identification packet, and after cutting the physical link, becomes link stop phase state. The apparatus 72 does not transfer the end identification packet to the apparatus 73.

Fig. 25 shows a sequence diagram when the present invention is applied to the LCP keep alive sequence example of Fig. 22. The procedures will be described below.

(a) The apparatus 71, to confirm whether or not the LCP link is maintained, transmits LCP echo request packet.

(b) The apparatus 72 does not transfer the received LCP echo request packet of (a) to the apparatus 73 but transmits LCP echo response packet to the apparatus 71.

(c) The apparatus 74, to confirm whether or not the LCP link is maintained, transmits LCP echo request packet.

(d) The apparatus 73 does not transfer the received LCP echo request packet of (c) to the apparatus 72 but transmits LCP echo response packet to the apparatus 74.

As described above, no signal is transferred between the apparatus 72 and the apparatus 73.

In the present embodiment, an example where the present invention is applied to communication according to PPP protocol, however, the present invention can also be applied to communication based on similar protocol.

As described above, with the present invention,

control packet on the communication line can be reduced.

With this configuration, redundant packets, for example, in end-to-end PPP link establish procedure, cut-off procedure, and PPP link continuity identification  
5 procedure are terminated in the same node, whereby control packet amount transferred on the communication line can be reduced, communication fees and communication cost be reduced, and subscriber capacity be increased in association with reduction of communication traffic  
10 amount.

The present invention has been described in detail with respect to preferred embodiments, and it will now be apparent from the foregoing to those skilled in the art that changes and modifications may be made without  
15 departing from the invention in its broader aspects, and it is the invention, therefore, in the appended claims to cover all such changes and modifications as fall within the true spirit of the invention.

WHAT IS CLAIMED IS:



1. A data conversion apparatus performing octet deletion  
or bit deletion to data having a PPP configuration and being  
5 octet-inserted or bit-inserted.

2. A data conversion apparatus characterized by  
comprising:

deletion means for performing octet deletion or bit  
10 deletion to data having a PPP frame configuration and being  
octet-inserted or bit-inserted; and

additional information addition means for adding  
additional information including information for  
identifying a frame partition to the data octet-deleted  
15 or bit-deleted by said deletion means.

3. A data conversion apparatus characterized by  
comprising:

flag deletion means for deleting a flag from data  
20 having a PPP frame configuration and being octet-inserted  
or bit-inserted; and

deletion means for performing octet deletion or bit  
deletion to the data flag-deleted by said flag deletion  
means.

25

4. A data conversion apparatus characterized by  
comprising:

flag deletion means for deleting a flag from data  
having a PPP frame configuration and being octet-inserted  
30 or bit-inserted;



deletion means for performing octet deletion or bit deletion to the data flag-deleted by said flag deletion means; and

additional information addition means for adding  
5 additional information including information for identifying a frame partition to the data octet-deleted or bit-deleted by said deletion means.

5. A data conversion apparatus performing octet deletion  
10 or bit deletion to data having a PPP frame configuration and being not octet-inserted or not bit-inserted.

6. A data conversion apparatus characterized by comprising:

15 additional information deletion means for deleting additional information from data having a frame configuration in which said additional information including information for identifying a frame partition is added to a PPP frame configuration and being not  
20 octet-inserted or not bit-inserted; and

insertion means for performing octet insertion or bit insertion to the data deleted of additional information by said additional information deletion means.

25 7. A data conversion apparatus characterized by comprising:

insertion means for performing octet insertion or bit insertion to data having a frame configuration flag-deleted from a PPP frame configuration and being not  
30 octet-inserted or not bit-inserted; and



flag addition means for adding a flag to the data  
octet-inserted or bit-inserted by said insertion means.

8. A data conversion apparatus characterized by  
5 comprising:

additional information deletion means for deleting  
additional information from data having a frame  
configuration in which said additional information  
including information for identifying frame partition is  
10 added to a frame configuration flag-deleted from a PPP  
frame configuration and being not octet-inserted or not  
bit-inserted;

insertion means for performing octet insertion or bit  
insertion to the data additional information-deleted by  
15 said additional information deletion means; and

flag addition means for adding a flag to the data  
octet-inserted or bit-inserted by said insertion means.

9. A data conversion apparatus converting data having  
20 a PPP frame configuration and being not octet-inserted or  
not bit-inserted into data having a frame configuration  
of data link layer protocol other than PPP.

10. A data conversion apparatus converting data having  
25 a frame configuration in which additional information  
including information for identifying a frame partition  
is added to a PPP frame configuration and being not  
octet-inserted or not bit-inserted into data having a frame  
configuration of data link layer protocol other than PPP.



11. A data conversion apparatus converting data having a frame configuration flag-deleted from a PPP frame configuration and being not octet-inserted or not bit-inserted into data having a frame configuration of data link layer protocol other than PPP.
12. A data conversion apparatus converting data having a frame configuration in which additional information including information for identifying frame partition is added to a frame configuration flag-deleted from a PPP frame configuration and being not octet-inserted or not bit-inserted into data having a frame configuration of data link layer protocol other than PPP.
13. A data conversion apparatus converting data having a frame configuration of data link layer protocol other than a PPP into data having a PPP frame configuration and being not octet-inserted or not bit-inserted.
14. A data conversion apparatus converting data having a frame configuration of data link layer protocol other than a PPP into data having a frame configuration in which additional information including information for identifying frame partition is added to a PPP frame configuration and being not octet-inserted or not bit-inserted.
15. A data conversion apparatus converting data having a frame configuration of data link layer protocol other than a PPP into data having a frame configuration



flag-deleted from a PPP frame configuration and being not  
octet-inserted or not bit-inserted.

16. A data conversion apparatus converting data having  
5 a frame configuration of data link layer protocol other  
than a PPP into data having a frame configuration  
flag-deleted from a PPP frame configuration to which  
additional information including information for  
identifying frame partition is added and being not  
10 octet-inserted or not bit-inserted.

17. A signal having a PPP frame configuration and  
including data not octet-inserted or not bit-inserted.

15 18. A signal having a PPP frame configuration to which  
additional information including information for  
identifying frame partition is added and including data  
not octet-inserted or not bit-inserted.

20 19. A signal having a frame configuration of flag-deleted  
from a PPP frame configuration and including data not  
octet-inserted or not bit-inserted.

20. A signal having a frame configuration of flag-deleted  
25 from a PPP frame configuration to which additional  
information including information for identifying frame  
partition is added and including data not octet-inserted  
or not bit-inserted.

30 21. A data conversion method performing octet deletion



or bit deletion to data having a PPP frame configuration and being octet-inserted or bit-inserted.

22. A data conversion method characterized by comprising:

5       a deletion step for performing octet deletion or bit deletion to data having a PPP frame configuration and being octet-inserted or bit-inserted; and

          an additional information addition step for adding additional information including information for  
10       identifying a frame partition to the data octet-deleted or bit-deleted by said deletion step.

23. A data conversion method characterized by comprising:

          a flag deletion step for deleting a flag from data  
15       having a PPP frame configuration and being octet-inserted or bit-inserted; and

          a deletion step for performing octet deletion or bit deletion to the data flag-deleted by said flag deletion step.

20

24. A data conversion method characterized by comprising:

          a flag deletion step for deleting a flag from data having a PPP frame configuration and being octet-inserted or bit-inserted;

25       a deletion step for performing octet deletion or bit deletion to the data flag-deleted by said flag deletion step; and

          an additional information addition step for adding additional information including information for  
30       identifying a frame partition to the data octet-deleted

or bit-deleted by said deletion step.



25. A data conversion method performing octet insertion  
or bit insertion to data having a PPP frame configuration  
5 and being not octet-inserted or not bit-inserted.

26. A data conversion method characterized by comprising:  
an additional information deletion step for deleting  
additional information from data having a PPP frame  
10 configuration to which said additional information  
including information for identifying a frame partition  
and being octet-inserted or bit-inserted is added; and  
an insertion step for performing octet insertion or  
bit insertion to the data additional information-deleted  
15 by said additional information deletion step.

27. A data conversion method characterized by comprising:  
an insertion step for performing octet insertion or  
bit insertion to data having a frame configuration  
20 flag-deleted from a PPP frame configuration and being not  
octet-inserted or not bit-inserted; and  
a flag addition step for adding a flag to the data  
octet-inserted or bit-inserted by said insertion step.

25 28. A data conversion method characterized by comprising:  
an additional information deletion step for deleting  
additional information from data having a frame  
configuration flag deleted from a PPP frame configuration  
to which said additional information including information  
30 for identifying a frame partition is added and being not



octet-inserted or not bit-inserted;

an insertion step for performing octet insertion or bit insertion to the data additional information-deleted by said additional information deletion step; and

5 a flag addition step for adding a flag to the data octet-inserted or bit-inserted by said insertion step.

29. A data conversion method converting data having a PPP frame configuration and being not octet-inserted or not  
10 bit-inserted into data having a frame configuration of data link layer protocol other than PPP.

30. A data conversion method converting data having a frame configuration in which additional information  
15 including information for identifying frame partition is added to a PPP frame configuration and being not octet-inserted or not bit-inserted into data having a frame configuration of data link layer protocol other than PPP.

20 31. A data conversion method for converting data having a frame configuration flag-deleted from a PPP frame configuration and being not octet-inserted or not bit-inserted into data having a frame configuration of data link layer protocol other than PPP.

25

32. A data conversion method converting data having a frame configuration in which additional information including information for identifying frame partition is added to a frame configuration flag-deleted from a PPP  
30 frame configuration and being not octet-inserted or not



bit-inserted into data having a frame configuration of data link layer protocol other than PPP.

33. A data conversion method converting data having a  
5 frame configuration of data link layer protocol other than  
PPP into data having a PPP frame configuration and being  
not octet-inserted or not bit-inserted.

34. A data conversion method converting data having a  
10 frame configuration of data link layer protocol other than  
PPP into data having a frame configuration in which  
additional information including information for  
identifying frame partition is added to a PPP frame  
configuration and being not octet-inserted or not bit-  
15 inserted.

35. A data conversion method converting data having a  
frame configuration of data link layer protocol other than  
PPP into data having a frame configuration flag-deleted  
20 from a PPP frame configuration and being not octet-inserted  
or not bit-inserted.

36. A data conversion method converting data having a  
frame configuration of data link layer protocol other than  
25 PPP into data having a frame configuration flag-deleted  
from a PPP frame configuration to which additional  
information including information for identifying frame  
partition is added and being not octet-inserted or not  
bit-inserted.



37. A DCE transmitting a LCP echo reply to one of two apparatus performing data communication based on PPP, when said DCE receives a LCP echo request transmitted by said one apparatus to the other apparatus.

5

38. A DCE discarding a LCP discard request, when said DCE receives said LCP discard request transmitted by one of two apparatus performing data communication based on PPP to the other.

10

39. A gateway transmitting a LCP echo reply to one of two apparatus performing data communication based on PPP, when said gateway receives a LCP echo request transmitted by said one apparatus to the other apparatus.

15

40. A gateway discarding a LCP discard request, when said gateway receives said LCP discard request transmitted by one of two apparatus performing data communication based on PPP to the other.

20

41. A communication apparatus located between another communication apparatus of self-node and a communication apparatus of other node,

producing a setting request packet according to a setting rejection packet or a setting negation packet and transmitting said setting request packet to said another communication apparatus of self-node, when said communication apparatus receives said setting rejection packet or said setting negation packet from said another communication apparatus of self-node, after

25

30



intermediating a setting request packet from said communication apparatus of other node to said another communication apparatus of self-node.

5 42. The communication apparatus as claimed in Claim 41,  
characterized in that said communication apparatus  
notifies setting rejection or setting negation to said  
communication apparatus of other node by transmitting only  
information included in a setting rejection packet or a  
10 setting negation packet to said communication apparatus  
of other node, when said communication apparatus receives  
said setting rejection packet or said setting negation  
packet from said another communication apparatus of  
self-node, after intermediating a setting request packet  
15 from said communication apparatus of other node to said  
another communication apparatus of self-node.

43. The communication apparatus as claimed in Claim 41,  
characterized in that said communication apparatus  
20 terminates a setting identification packet when said  
communication apparatus receives said setting  
identification packet after intermediating a setting  
request packet from said communication apparatus of other  
node to said another communication apparatus of self-node  
25 and receiving a setting rejection packet or a setting  
negation packet from said another communication apparatus  
of self-node, and said communication apparatus does not  
terminate a setting identification packet when said  
communication apparatus receives said setting  
30 identification packet without receiving a setting



rejection packet or a setting negation packet from said  
another communication apparatus of self-node after  
intermediating a setting request packet from said  
communication apparatus of other node to said another  
5 communication apparatus of self-node.

44. A communication apparatus located between another  
communication apparatus of self-node and a communication  
apparatus of other node,  
10 terminating a setting request packet, when said  
communication apparatus receives said setting request  
packet after intermediating a setting request packet from  
said another communication apparatus of self-node to said  
other node communication apparatus and a notification of  
15 setting rejection or setting negation from said other node  
communication apparatus to said another communication of  
self-node.

45. The communication apparatus as claimed in Claim 44,  
20 characterized in that said communication apparatus  
produces a setting rejection packet or a setting negation  
packet and transmits it to said another communication  
apparatus of self-node, when said communication apparatus  
receives a notification of setting rejection or setting  
25 negation from said communication apparatus of other node  
after intermediating a setting request packet from said  
another communication apparatus of self-node to said other  
node communication apparatus.

30 46. The communication apparatus as claimed in Claim 44,



characterized in that said communication apparatus produces a setting identification packet and transmits it to said another communication apparatus of self-node, when said communication apparatus receives from said another communication apparatus of self-node, all of setting request packets according to notifications of setting rejection or setting negation from said communication apparatus of other node to said another communication of self-node after intermediating setting request packets from said another communication apparatus of self-node to said other node communication apparatus and said notifications.

47. A communication apparatus located between another communication apparatus of self-node and a communication apparatus of other node,

producing an end identification packet and transmitting it to said another communication apparatus of self-node after intermediating a notification of end request from said another communication apparatus of self-node to said other node communication.

48. The communication apparatus as claimed in Claim 47, characterized in that said communication apparatus produces an end request signal and transmits it to said communication apparatus of other node, when said communication apparatus receives an end request packet from said another communication apparatus of self-node.

49. The communication apparatus as claimed in Claim 47,



characterized in that said communication apparatus produces an end request packet and transmits it to said another communication apparatus of self-node, when said communication apparatus receives a notification of end  
5 identification from said communication apparatus of other node after intermediating a notification of end request from said another communication apparatus of self-node to said communication apparatus of other node.

10 50. The communication apparatus as claimed in Claim 49, characterized in that said communication apparatus terminates an end identification packet, when said communication apparatus receives said end identification packet from said another communication apparatus of  
15 self-node after transmitting said produced end request packet.

51. A communication apparatus located between another communication apparatus of self-node and a communication  
20 apparatus of other node,

terminating an end identification packet, when said communication apparatus receives said end identification packet from said another communication apparatus of self-node after intermediating a notification of end  
25 request from said other node communication apparatus to said another communication apparatus of self-node.

52. The communication apparatus as claimed in Claim 51, characterized in that said communication apparatus  
30 produces an end request packet and transmits it to said



another communication apparatus of self-node, when said communication apparatus receives a notification of end request from said other node communication apparatus.

5 53. The communication apparatus as claimed in Claim 51,  
characterized in that said communication apparatus  
produces an end identification signal and transmits it to  
said communication apparatus of other node, when said  
communication apparatus receives an end request packet  
10 from said another communication apparatus of self-node  
after intermediating a notification of end request from  
said other node communication apparatus to said another  
communication apparatus of self-node.

15 54. The communication apparatus as claimed in Claim 53,  
characterized in that said communication apparatus  
produces an end identification packet and transmits it to  
said another communication apparatus of self-node after  
transmitting said produced end identification signal.

20 55. A communication apparatus located between another  
communication apparatus of self-node and a communication  
apparatus of other node,

terminating an echo request, producing an echo  
25 response packet and transmits it to said another  
communication apparatus of self-node, when said  
communication apparatus receives said echo request packet  
from said another communication apparatus of self-node to  
said other node communication apparatus.

56. The communication apparatus as claimed in Claim 41, 44, 47, 51, or 55, characterized in that said communication apparatus is a mobile station.

