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(54) Abstract Title: **PPPoE client which experiences abnormal disconnection, terminates an open pre-disconnection session before starting new session, upon reconnection**

(57) A point to point protocol over Ethernet (PPPoE) system wherein a client which has experienced an abnormal disconnection due to a fault attempts a reconnection.

The client initiates the discovery process with a PPPoE Active Discovery Initiation packet (PADI) transmitted to a server, it assesses the returned packet to determine if it is a PPPoE Active Discovery Offer (PADO) packet. If it is discovery continues as normal.

If the packet is not a PADO packet the client extracts session information from it and inserts it into a PPPoE Active Discovery Termination (PADT) packet to terminate the open session. Once a corresponding PADT is received from the server discovery recommences with a new PADI.

The system allows rapid resumption of communication after a fault, even when the pre-fault session has not been terminated by timeout.

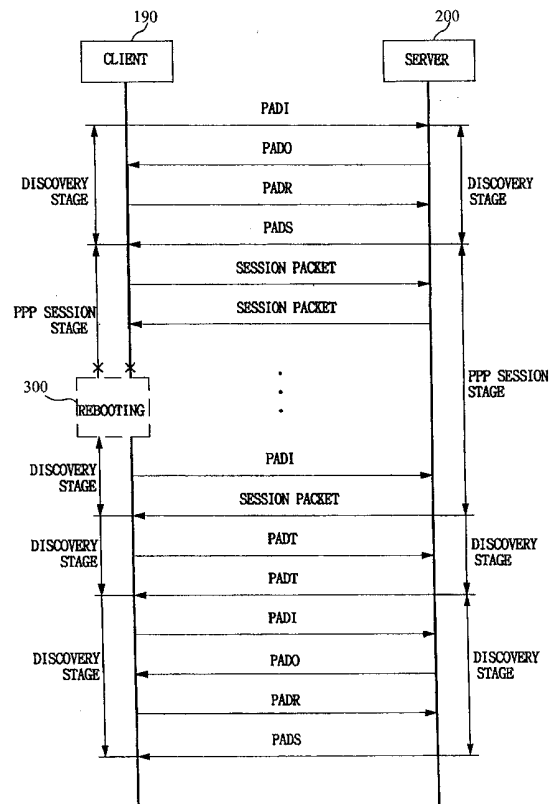


FIG. 4

At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

This print takes account of replacement documents submitted after the date of filing to enable the application to comply with the formal requirements of the Patents Rules 1995

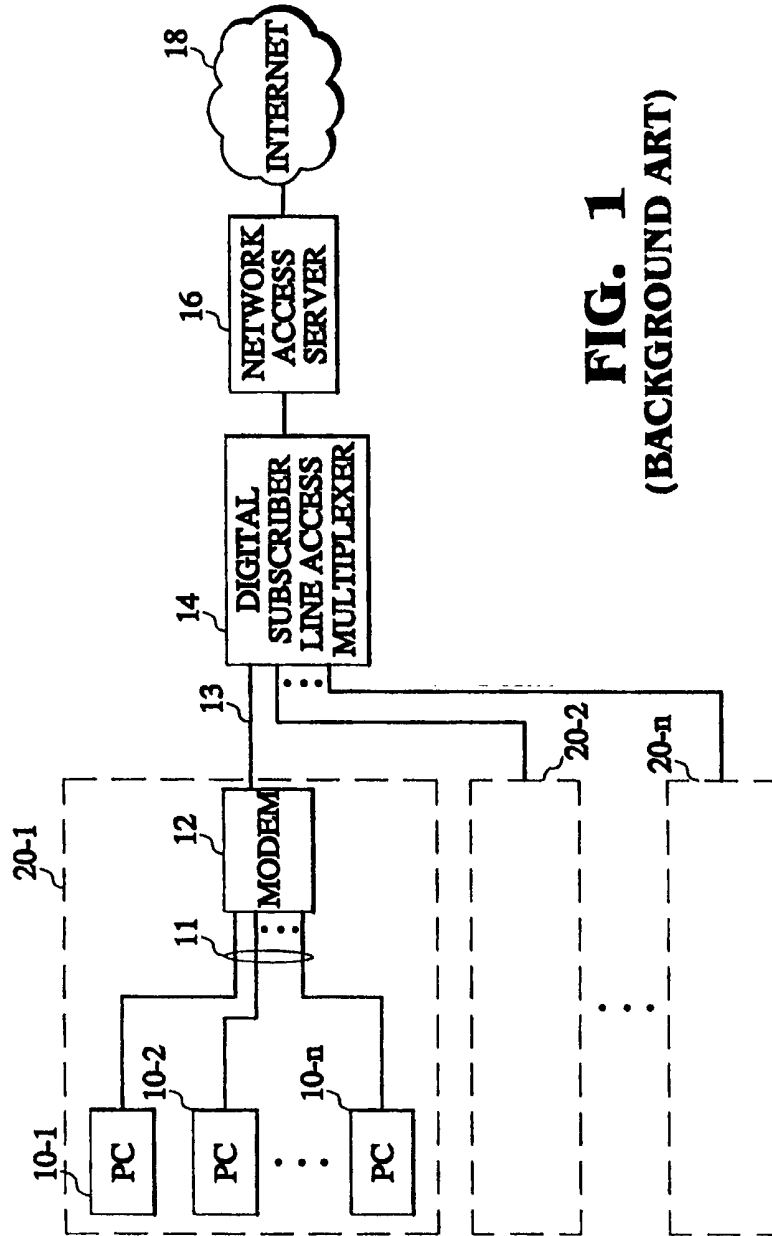
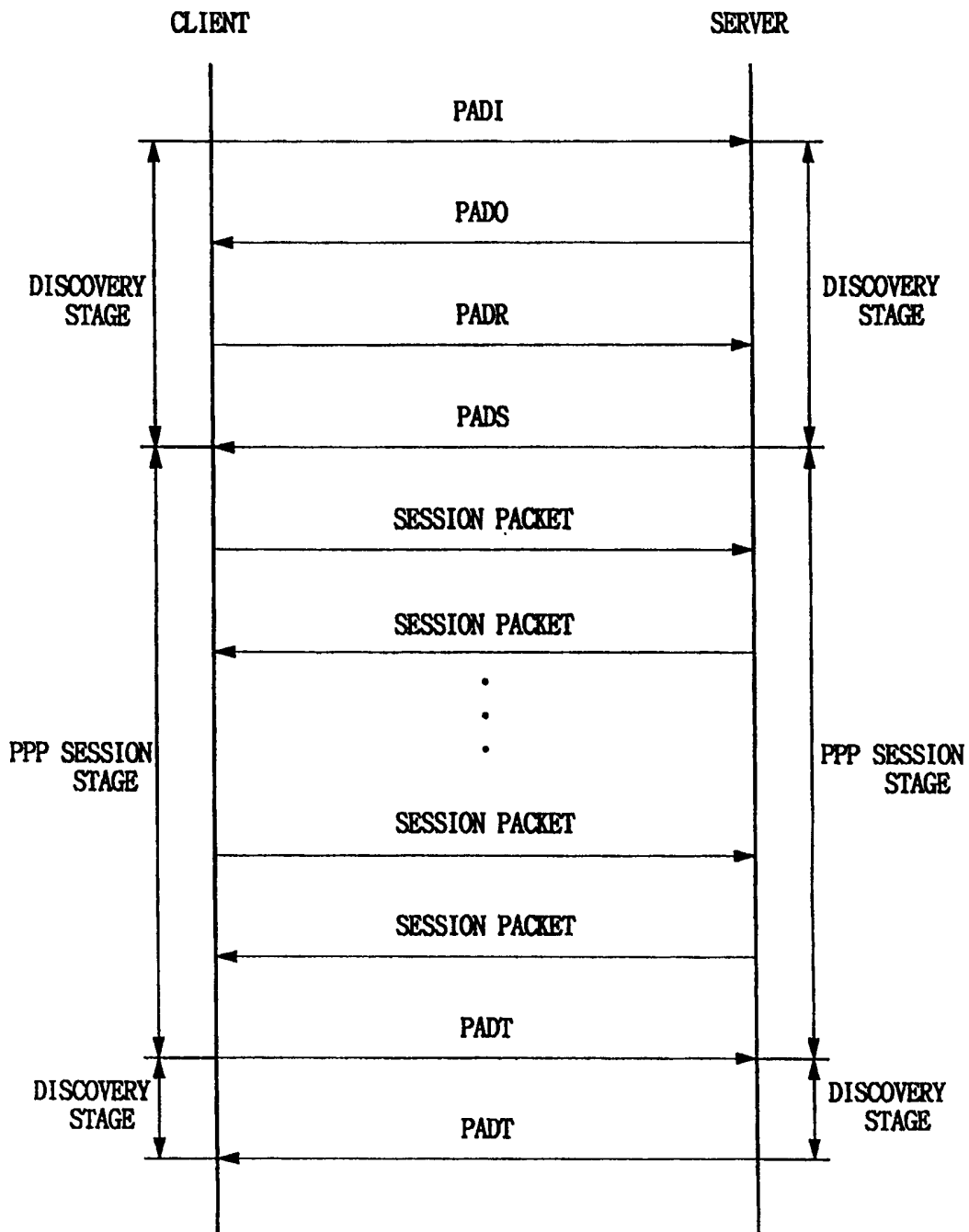
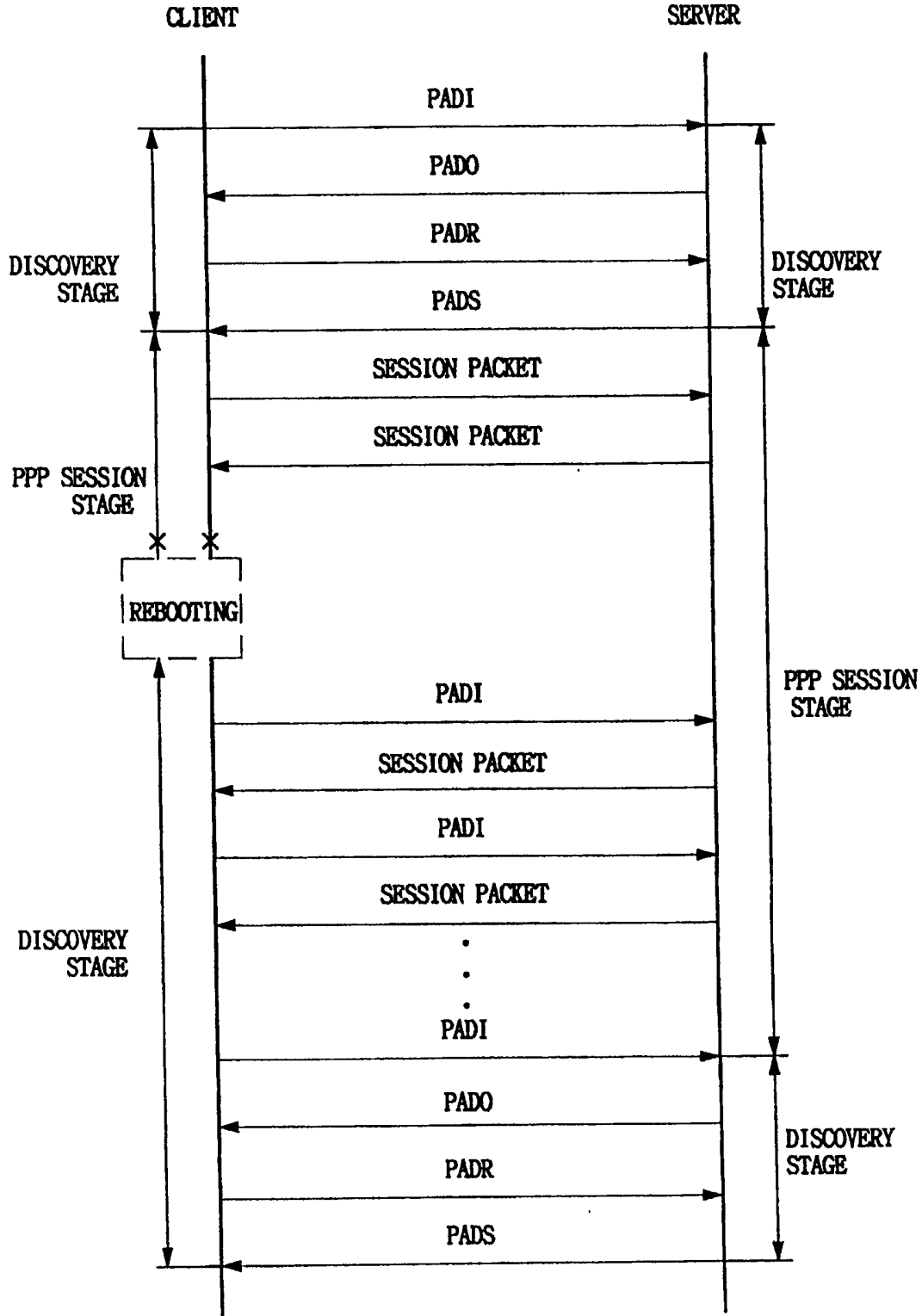
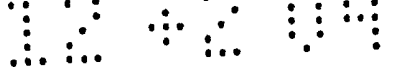


FIG. 1
(BACKGROUND ART)





(BACKGROUND ART)
FIG. 2



(BACKGROUND ART)
FIG. 3

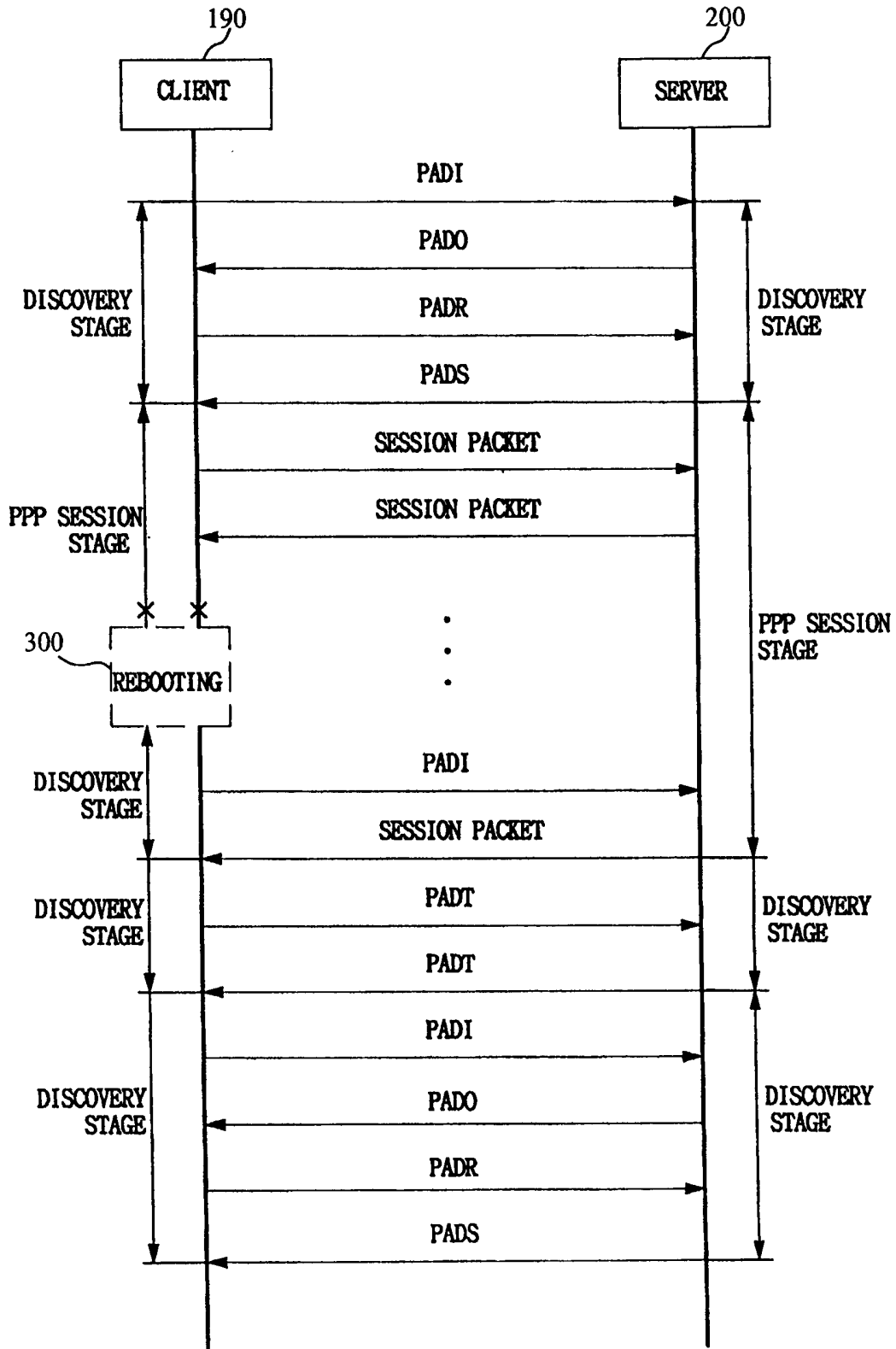
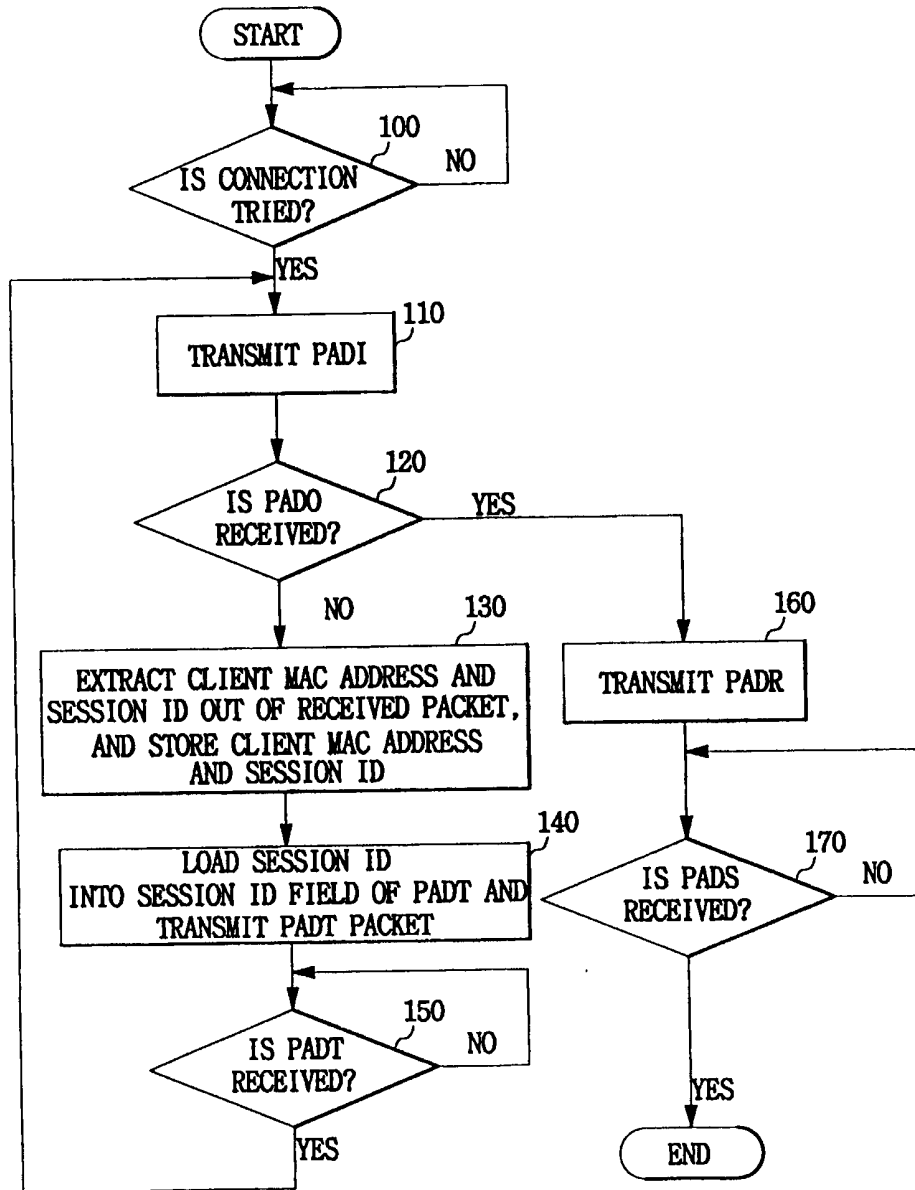
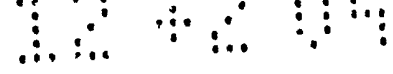


FIG. 4

FIG. 5





1				16				32			
SERVER MAC ADDRESS											
SERVER MAC ADDRESS (cont.)				CLIENT MAC ADDRESS							
CLIENT MAC ADDRESS (cont.)											
ETHERNET TYPE				VERSION		TYPE		CODE			
SESSION-ID				LENGTH							
TAG TYPE				TAG LENGTH							
• • •											

FIG. 6

1	16	32
CLIENT MAC ADDRESS		
CLIENT MAC ADDRESS (cont.)	SERVER MAC ADDRESS	
SERVER MAC ADDRESS (cont.)		
ETHERNET TYPE	VERSION	TYPE CODE
SESSION ID	LENGTH	
TAG TYPE	TAG LENGTH	
TAG TYPE	TAG LENGTH	
.		
.		
.		

FIG. 7

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2

PPPoE NETWORK SYSTEM AND**RECONNECTION METHOD THEREOF**

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6 The present invention relates to a PPPoE (Point-to-Point Protocol over Ethernet) network
7 system, and more particularly, to a PPPoE network system and a reconnection method thereof for
8 reconnection between a client and a server.

9 A PPPoE network system enables many clients using an Ethernet through equipment like
10 a modem to be connected to a server at a remote site. That is, the system is used for the purpose
11 of connecting every client in offices or buildings sharing a modem or wireless connection to an
12 Internet. PPPoE protocol, which is regulated by RFC (Request for Comments) 2516, is the
13 combination of PPP (Point-to-Point Protocol) that is typically used in dial-up connection and
14 Ethernet protocol for supporting many clients over a short-distance network.

15 In accordance with RFC 2516 standards, operation between a client (Host) and a server
16 (Access Concentrator) in the related art PPPoE network system consists of a discovery stage for
17 connecting the client to the server, a PPP session stage in which the client connects to a wanted
18 site over Internet and transmits/receives data, and a discovery stage for terminating the connection
19 between the client and the server.

20 When a client wishes to initiate a PPPoE session, it must first perform discovery to
21 identify the Ethernet MAC address of the peer and establish a PPPoE Session_ID. While PPP



22 defines a peer-to-peer relationship, discovery is inherently a client-server relationship. In the
23 discovery process, the client discovers the server. Based on the network topology, there may be
24 more than one server that the client can communicate with. The discovery stage allows the client
25 to discover all possible servers and then select one. When discovery completes successfully, both
26 the client and the selected server have the information they will use to build their point-to-point
27 connection over Ethernet.

28 However, the PPPoE network system has a problem in that the connection between the
29 client and the server is often disconnected due to abnormality in the client's device or at the
30 request of a user, in the middle of transmitting and receiving data in the PPP session stage. Then,
31 the user reboots the client's device and attempts reconnection.

32 At this time, the client tries the discovery stage for reconnection, on the other hand, the
33 server does not really know that its connection to the client has been disconnected, so the server
34 transmits a packet requested by the client or an echo packet while continually holding in the PPP
35 session stage. As a result, the client fails in the reconnection no matter how many times the client
36 tries.

37 Generally, a server is programmed to recognize no response from the client within a
38 predetermined time in the PPP session stage as disconnection. However, if rebooting the client's
39 device can be done faster than the server recognizes its disconnection to the client, the server
40 cannot recognize its disconnection to the client even though the client's device is rebooted and the
41 client tries to reconnect to the server. Therefore, the client fails in reconnection.

42 That is, the conventional PPPoE network system is disadvantageous in that when the
43 client's device is abnormal (or out of order) or the connection between the client and the server is



44 disconnected at the user's request, the client often fails in reconnection even though the client
45 reboots the device and attempts the reconnection to the server, and the reconnection to the server
46 is not done fast enough.

47 It is an aim of the present invention to at least partly mitigate the above-mentioned
48 problems.

49 It is a further aim of embodiments of the present invention to solve at least the above
50 problems and/or disadvantages and to provide at least the advantages described hereinafter.

51 It is a still further aim of embodiments of the present invention to provide PPPoE (Point-
52 to-Point Protocol over Ethernet) network system, capable of making connection between a client
53 and a server even when the connection to the server is abnormally disconnected due to an error on
54 the client side.

55 It is another aim of embodiments of the present invention to provide a connection method
56 of the system.

57 According to a first aspect of the present invention there is provided a PPPoE (Point-to-
58 Point Protocol over Ethernet) network system, comprising:

59 a client connected to a server via an Ethernet line;

60 said client transmitting a PADI (PPPoE Active Discovery Initiation) packet to said server
61 if said client becomes disconnected from said server in a manner other than by transmission of
62 PADT (PPPoE Active Discovery Terminate) packets between said client and said server;

63 said client checking a packet received from said server, following the transmission of said
64 PADI (PPPoE Active Discovery Initiation) packet, to determine whether the packet received from
65 said server was a PADO (PPPoE Active Discovery Offer) packet;

66 said client extracting a session-ID from said packet received from said server when it is
67 determined that the packet received from said server is not the PADO (PPPoE Active Discovery
68 Offer) packet;

69 said client loading said session-ID into a Session-ID field of a PADT (PPPoE Active
70 Discovery Terminate) packet and transmitting the PADT (PPPoE Active Discovery Terminate)
71 packet to said server and checking for a server transmitted PADT (PPPoE Active Discovery
72 Terminate) packet in response thereto; and

73 said client transmitting a new PADI (PPPoE Active Discovery Initiation) packet to said
74 server to reconnect said server and said client, when said client receives the server transmitted
75 PADT (PPPoE Active Discovery Terminate) packet.

76 Preferably said client checks a value of a Code field in said packet received from said
77 server, when checking whether the packet received from said server is the PADO (PPPoE Active
78 Discovery Offer) packet.

79 Conveniently said client transmits a PADR (PPPoE Active Discovery Request) packet to
80 said server when the client determines that the packet received from said server is the PADO
81 (PPPoE Active Discovery Offer) packet and checks for a server transmitted PADS (PPPoE Active
82 Discovery Session-confirmation) packet in response thereto; and

83 said client and said server begins a PPP (Point-to-Point Protocol) session stage when the
84 client receives the server transmitted PADS (PPPoE Active Discovery Session-confirmation)
85 packet.

86 Advantageously said client checks a value of a Code field in said packet received from
87 said server, when checking whether the packet received from said server is the PADO (PPPoE
88 Active Discovery Offer) packet.

89 Preferably said client also extracts a client MAC (Media Access Control) address from
90 said packet received from said server when it is determined that the packet received from said
91 server is not the PADO (PPPoE Active Discovery Offer) packet and stores the client MAC
92 (Media Access Control) address and session-ID in memory; and

93 said client loads said client MAC (Media Access Control) address as well as said session-
94 ID into the Session-ID field of the PADT (PPPoE Active Discovery Terminate) packet being
95 transmitted to said server.

96 According to a second aspect of the present invention there is provided a method of
97 establishing reconnection between a client and a server in PPPoE (Point-to-Point Protocol over
98 Ethernet) network system, said method comprising steps of:

99 transmitting a PADI (PPPoE Active Discovery Initiation) packet from said client to said
100 server if said client becomes disconnected from said server in a manner other than by
101 transmission of PADT (PPPoE Active Discovery Terminate) packets between said client and said
102 server;

103 checking a next packet received from said server, following the transmission of said PADI
104 (PPPoE Active Discovery Initiation) packet, to determine whether the next packet received from
105 said server is a PADO (PPPoE Active Discovery Offer) packet;

106 extracting a session-ID from said packet received from said server when it is determined
107 that the packet received from said server is not the PADO (PPPoE Active Discovery Offer)
108 packet;

109 loading said session-ID into a Session-ID field of a PADT (PPPoE Active Discovery
110 Terminate) packet and transmitting the PADT (PPPoE Active Discovery Terminate) packet to
111 said server;

112 checking for reception of a server transmitted PADT (PPPoE Active Discovery
113 Terminate) packet; and

114 transmitting a new PADI (PPPoE Active Discovery Initiation) packet to said server to
115 reconnect said server and said client, when said client receives the server transmitted PADT
116 (PPPoE Active Discovery Terminate) packet.

117 Preferably the method further comprises transmitting a PADR (PPPoE Active Discovery
118 Request) packet to said server, when it is determined that the next packet received from said
119 server after transmitting the PADI (PPPoE Active Discovery Initiation) packet to said server, is
120 the PADO (PPPoE Active Discovery Offer) packet;

121 checking for reception of a server transmitted PADS (PPPoE Active Discovery Session-
122 confirmation) packet in response to the PADR (PPPoE Active Discovery Request) packet; and

123 when the client receives the server transmitted PADS (PPPoE Active Discovery Session-
124 confirmation) packet, beginning a PPP (Point-to-Point Protocol) session stage between said client
125 and said server.

126 Conveniently said step of checking a next packet received from said server to determine
127 whether the next packet received from said server is a PADO (PPPoE Active Discovery Offer)

128 packet comprises checking a Code field of the next packet received from said server for a
129 predetermined code.

130 Advantageously said step of checking a next packet received from said server to determine
131 whether the next packet received from said server is a PADO (PPPoE Active Discovery Offer)
132 packet comprises checking a Code field of the next packet received from said server for a
133 predetermined code.

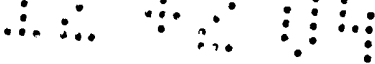
134 Preferably the method further comprises extracting a client MAC (Media Access Control)
135 address from said packet received from said server when it is determined that the packet received
136 from said server is not the PADO (PPPoE Active Discovery Offer) packet and storing the client
137 MAC (Media Access Control) address and session-ID in memory; and

138 loading said client MAC (Media Access Control) address as well as said session-ID into
139 the Session-ID field of the PADT (PPPoE Active Discovery Terminate) packet being transmitted
140 to said server.

141 According to a third aspect of the present invention there is provided a method of
142 establishing reconnection between a client and a server in PPPoE (Point-to-Point Protocol over
143 Ethernet) network system, said method comprising steps of:

144 transmitting a discovery stage initiation packet from said client to said server if said client
145 becomes disconnected from said server in an abnormal manner during a session stage of operation
146 between said client and said server;

147 checking a Code field of a next packet received from said server to determine whether the
148 received packet is a discovery stage offer packet;



149 transmitting a discovery stage request packet to said server, when it is determined that the
150 next packet received from said server was the discovery stage offer packet

151 checking for reception of a server transmitted discovery stage confirmation packet in
152 response to the discovery stage request packet; and

153 upon reception of the server transmitted discovery stage confirmation packet, beginning a
154 new session stage between said client and said server.

155 Preferably the method further comprises extracting a session-ID from said received
156 packet, when it is determined that the packet received from said server is not the discovery stage
157 offer packet;

158 loading said session-ID into a Session-ID field of a discovery stage terminate packet and
159 transmitting the discovery stage terminate packet to said server;

160 checking for reception of a server transmitted discovery stage terminate packet; and

161 transmitting a new discovery stage initiation packet to said server to reconnect said server
162 and said client, when said client receives the server transmitted discovery stage terminate packet.

163 Conveniently said step of checking the Code field checks for a predetermined value of
164 0x07 in said Code field.

165 Advantageously said step of checking the Code field checks for a predetermined value of
166 0x07 in said Code field. Preferably the method further comprises extracting a client MAC (Media
167 Access Control) address from said packet received from said server when it is determined that the
168 received packet is not the discovery stage offer packet and storing the client MAC (Media Access
169 Control) address and session-ID in memory; and

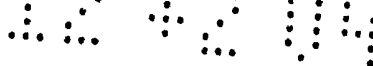


170 loading said client MAC (Media Access Control) address as well as said session-ID into
171 the Session-ID field of the discovery stage terminate packet being transmitted to said server.

172 Conveniently said abnormal manner is any manner other than by transmission of
173 respective discovery stage terminate packets between said client and said server.

174 Embodiments of the present invention provide a PPPoE network system, including: a
175 plurality of clients; a plurality of modems connected to the plurality of clients through Ethernet
176 lines; a plurality of servers; and a plurality of digital subscriber line access multiplexers for PPP
177 connection between of the plurality of modems and the plurality of servers, the plurality of
178 clients, if a connection is tried, transmitting a PADI (PPPoE Active Discovery Initiation) packet
179 to the plurality of servers to perform a discovery operation for connection, if a session packet
180 transmitted in a PPP session operation is transmitted from an already-connected server,
181 performing a discovery operation for terminating connection between the client and the server and
182 performing a discovery operation for reconnection and transmitting the PADI (PPPoE Active
183 Discovery Initiation) packet (initiation packet), and if a PADO (PPPoE Active Discovery Offer)
184 packet (offer packet) is received from the server capable of providing connection to the client
185 among the plurality of servers, transmitting a PADR (PPPoE Active Discovery Request) packet
186 (request packet) to the server, and receiving a PADS (PPPoE Active Discovery Session-
187 confirmation) packet (confirmation packet) transmitted from the server.

188 Embodiments of the present invention also provide a connection method of PPPoE
189 network system including steps of: if a connection is tried, transmitting a PADI (PPPoE Active
190 Discovery Initiation) packet to a plurality of servers by performing a discovery stage; after
191 transmitting the PADI (PPPoE Active Discovery Initiation) packet, deciding whether a packet



1 transmitted from a server is a session packet transmitted in a PPP session stage or a PADO
2 (PPPoE Active Discovery Offer) packet; and if the packet transmitted from the server is the
3 session packet, terminating connection between a client and an already-connected server by
4 performing a discovery stage for terminating the connection, and then reconnecting to the server
5 by performing a discovery stage for connection.

6 Preferably, the connection method of PPPoE network system further includes the step of:
7 if the packet transmitted from the server is the PADO (PPPoE Active Discovery Offer) packet,
8 establishing the connection by performing the discovery stage for connection.

9 Conveniently the deciding step decides the packet transmitted from the server is the
10 session packet or the PADO (PPPoE Active Discovery Offer) packet, on the basis of the code of
11 the code field in the packet transmitted from the server.

12 Advantageously the terminating and reconnecting step includes steps of: extracting a
13 session ID from the session identifier, and when performing the discovery stage for terminating
14 the connection; loading the extracted session ID into a session ID field of a PADT (PPPoE Active
15 Discovery Terminate) packet; and transmitting the PADT (PPPoE Active Discovery Terminate)
16 packet.

17 Preferably the terminating and reconnecting step includes steps of: deciding whether the
18 session packet is a corresponding packet by extracting a client MAC address from the session
19 packet, and if the session packet is the corresponding packet, extracting the session ID from the
20 session packet, when performing the discovery stage for terminating the connection, loading the
21 extracted session ID into a session ID field of a PADT (PPPoE Active Discovery Terminate)
22 packet, and transmitting the PADT (PPPoE Active Discovery Terminate) packet.



1 Advantageously the terminating and reestablishing connection step includes steps of:
2 when performing the discovery stage for connection, transmitting a PADI (PPPoE Active
3 Discovery Initiation) packet, deciding whether a PADO (PPPoE Active Discovery Offer) packet
4 is received after transmitting the PADI (PPPoE Active Discovery Initiation) packet, transmitting a
5 PADR (PPPoE Active Discovery Request) packet when the PADO (PPPoE Active Discovery
6 Offer) packet is received, and deciding whether a PADS (PPPoE Active Discovery Session-
7 confirmation) packet is received after the PADR (PPPoE Active Discovery Request) packet is
8 transmitted.

9 The terminating and reestablishing connection step includes steps of: when performing the
10 discovery stage for connection, transmitting a PADR (PPPoE Active Discovery Request) packet
11 in response to the PADO (PPPoE Active Discovery Offer) packet, and deciding whether a PADS
12 (PPPoE Active Discovery Session-confirmation) packet is received after the PADR (PPPoE
13 Active Discovery Request) packet is transmitted.

14 A more complete appreciation of the present invention, and many of the attendant
15 advantages thereof, will become readily apparent as the same becomes better understood by
16 reference to the following detailed description when considered in conjunction with the
17 accompanying drawings in which like reference symbols indicate the same or similar
18 components, wherein:

19 FIG. 1 is a block diagram illustrating a representative configuration of an exemplary
20 PPPoE network system;

21 FIG. 2 is a diagram describing an operation between a client and a server in the PPPoE
22 network system of FIG. 1;



1 FIG. 3 is a diagram describing a reconnection method between the client and the server in
2 the PPPoE network system of FIG. 1;

3 FIG. 4 is a diagram describing a reconnection method between a client and a server in
4 PPPoE network system according to the present invention;

5 FIG. 5 is a flow chart explaining an operation of the client for connection between the
6 client and the server in the PPPoE network system according to the present invention;

7 FIG. 6 illustrates a PADI (PPPoE Active Discovery Initiation) packet transmitted from
8 the client to the server; and

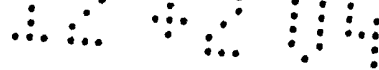
9 FIG. 7 illustrates a packet transmitted from the server to the client.

10 Reference will now be made in detail to exemplary embodiments of the present invention,
11 which are illustrated in the accompanying drawings.

12 Before discussing about PPPoE network system and connection method thereof according
13 to the present invention, PPPoE network system and connection method thereof according to the
14 related art will be first explained as follows.

15 FIG. 1 is a block diagram depicting the configuration of the related art PPPoE network
16 system. As shown in the drawing, the PPPoE network includes short-distance networks 20-1 ~
17 20-n equipped with personal computers 10-1 ~ 10-n, and modem 12, digital subscriber line
18 multiplexer 14, network access server 16, and Internet 18.

19 Each of the personal computers 10-1 ~ 10-n of the short-distance networks 20-1 ~ 20-n
20 and the modem 12 (e.g. ADSL or ISDN) are connected via Ethernet lines 11, and the modem 12
21 and the digital subscriber line multiplexer 14 are connected to each other through a line 13 (e.g.
22 telephone line).



1 When the client transmits data through the Ethernet lines 11, the data is to include a PPP
2 frame in an Ethernet frame, and the modem 12 extracts the PPP frame from the Ethernet frame
3 and transmits the PPP frame through the line 13. Also, the modem 12 transmits a PPPoE frame
4 through the Ethernet lines 11, the PPPoE frame is to include the Ethernet frame in a PPP frame
5 transmitted from the digital subscriber line access multiplexer 14 through the line 13.

6 FIG. 2 is a diagram describing an operation between the client and the server in the PPPoE
7 network system of FIG. 1, wherein the operation between the client and the server according to
8 RFC 2516 standards is shown.

9 In FIG. 2, clients corresponds to users' personal computers 10-1 ~ 10-n of FIG. 1, and the
10 server corresponds to the network access server 16 of FIG. 1.

11 Referring to FIG. 2, the operation between the client and the server includes a discovery
12 stage for connecting the client to the server, a PPP session stage for transmitting and receiving
13 data through Internet after the connection between the client and the server is complete, and a
14 discovery stage for terminating the connection between the client and the server.

15 To begin with, the discovery stage for connection is explained below.

16 The client transmits a PADI (PPPoE Active Discovery Initiation) packet to servers for
17 initiation.

18 A server, which is capable of providing connection to the client among the servers
19 received the PADI (PPPoE Active Discovery Initiation) packet, transmits the PADO (PPPoE
20 Active Discovery Offer) packet to the client.

21 After the client receives the PADO (PPPoE Active Discovery Offer) packet, the client
22 transmits a PADR (PPPoE Active Discovery Request) packet to the server, to request connection.



1 When the server receives the PADR (PPPoE Active Discovery Request) packet from the
2 client, the server transmits a PADS (PPPoE Active Discovery Session-confirmation) packet to the
3 client, to confirm the connection.

4 In this manner, the connection between the client and the server is complete. Then, the
5 client and the server proceed to the PPP session stage, and transmit and receive data each other.

6 Lastly, the discovery stage for terminating the connection is explained.

7 The client transmits a PADT (PPPoE Active Discovery Terminate) packet to the server.

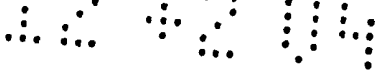
8 The server sends PADT (PPPoE Active Discovery Terminate) to the client to terminate
9 the session performed in the session stage in response to the PADT (PPPoE Active Discovery
10 Terminate) packet. Accordingly, the client and the server are disconnected from each other.

11 However, the foregoing PPPoE network system has a disadvantage in that its reconnection
12 is not easy when the disconnection is caused by, for example, an abnormality in the client's
13 device, or at the request of the user in the PPP session stage.

14 FIG. 3 is a diagram describing a reconnection method between the client and the server of
15 the PPPoE network system of FIG. 1.

16 Here, the operation in the discovery stage for connection is equal to that of FIG. 2, that is,
17 the server and the client are connected to each other by performing the discovery stage.

18 The client and the server proceed to the PPP session stage, the connection with the server
19 is disconnected if the client's device is abnormal or the user wants to disconnect while
20 transmitting and receiving a session packet in the PPP session stage. That is, the proper
21 termination procedure of transmitting a PADT (PPPoE Active Discovery Terminate) packet from
22 the client to the server was not followed.



1 In such case, the user reboots the client's device and tries to establish the reconnection.
2 When the reconnection is tried, the client proceeds to the discovery stage for connection, and
3 transmits the PADI (PPPoE Active Discovery Initiation) packet to the server.

4 Although the server is supposed to transmit the PADO (PPPoE Active Discovery Offer)
5 packet in response to the PADI (PPPoE Active Discovery Initiation) packet, the already-
6 connected server does not recognize that it is disconnected from the client, because the proper
7 termination procedure was not performed. Then, the server continuously performs the PPP
8 session stage and transmits the PPP session packet.

9 Of course, generally, the server is programmed to be able to recognize the disconnection if
10 there is no response from the client within a predetermined time during the PPP session stage. It
11 has been recommended in the RFC 2516 that the server occasionally send Echo-Request packets
12 to the client to determine the state of the session. Otherwise, if the client terminates a session
13 without sending a PADT (PPPoE Active Discovery Terminate) packet, the server will not be able
14 to determine that the session has gone away. However, if the client's device is rebooted before
15 the server transmits the Echo-Request packet, and the reconnection after rebooting cannot be
16 made sufficiently fast.

17 When a client does not receive a PADO packet within a specified amount of time, it
18 should resend it's PADI (PPPoE Active Discovery Initiation) packet and double the waiting
19 period. This is repeated as many times as desired. As a result, the client keeps transmitting the
20 PADI (PPPoE Active Discovery Initiation) packet, and the already-connected server continues
21 transmitting the PPP session packet. After the server transmits the Echo-Request packet and fails
22 to receive a proper response from the client, the server realizes that the client is terminated



1 (disconnected), so it goes to the discovery stage, and then, in response to the client's PADI
2 (PPPoE Active Discovery Initiation) packet, the server is reconnected with the client.

3 As discussed above, the disadvantage of the conventional PPPoE network system is that it
4 takes time to reconnect the client to the already-connected server, after the connection between
5 the client and the server is improperly disconnected by the abnormality in the client's device or at
6 the request of the user.

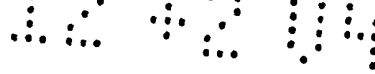
7 FIG. 4 is a diagram describing a reconnection method between the client 190 and the
8 server 200 in PPPoE network system according to the present invention.

9 As already described with reference to FIG. 3, the client and the server are sometimes
10 disconnected during the PPP session stage, due to the abnormality in the client's device or at the
11 request of the user. At this time, the user reboots the device for reconnection.

12 With respect to Fig. 4, if the user requests reconnection by rebooting at step 300, the client
13 190 performs the discovery stage for connection.

14 The client 190 transmits the PADI (PPPoE Active Discovery Initiation) packet to the
15 server 200. However, if the server 200 is not aware of the disconnection with the client 190, the
16 server 200 performs the PPP session stage, and transmits a session packet. Here, the session
17 packet is either data not being transmitted to the client 190 or an Echo-Request packet.

18 If there is no response from the client 190 within a predetermined time, and the server 200
19 regards it as disconnection with the client 190, the server 200 transmits the PADO (PPPoE Active
20 Discovery Offer) packet in response to the PADI (PPPoE Active Discovery Initiation) packet.



1 The client 190 then decides whether the packet from the server 200 was transmitted in the
2 discovery stage or in the PPP session stage. If the transmitted packet is transmitted in the
3 discovery stage, the client 190 performs the discovery stage.

4 On the other hand, if the transmitted packet is a packet transmitted in the PPP session
5 stage, the client 190 extracts and stores a client MAC (Media Access Control) address and a
6 session ID (Identifier) from the packet. The client MAC address is used for confirming whether
7 the transmitted packet is supposed to be sent to the client itself, and the session ID is used for
8 figuring out information about the existing session in process in the server 200.

9 Also, if the transmitted packet is transmitted in the PPP session stage, the client 190
10 performs the discovery stage in order to terminate the already- connected session. The client 190
11 transmits the PADT (PPPoE Active Discovery Terminate) packet to the server 200. At this time,
12 the extracted session ID is loaded in a session ID field of the PADT (PPPoE Active Discovery
13 Terminate) packet.

14 The server 200 transmits the PADT (PPPoE Active Discovery Terminate) packet to the
15 client 190 in response to the PADT (PPPoE Active Discovery Terminate) packet from the client
16 190.

17 Accordingly, the already-connected server and the client are properly disconnected to each
18 other, and the client 190 proceeds the discovery stage in order to reconnect with the server 200.

19 That is, in the reconnection method between the server 200 and the client 190 of the
20 present invention, after the client 190 transmits the PADI (PPPoE Active Discovery Initiation)
21 packet, when not receiving a PADO (PPPoE Active Discovery Offer) packet transmitted in the
22 discovery stage but instead, receiving the session packet from the server 200, the client 190



1 performs the discovery stage for terminating the session in process in the server 200.
2 Accordingly, the client 190 and the already-connected server 200 are properly disconnected from
3 each other. And then, the discovery stage for reconnecting with the server 200 is performed.

4 FIG. 5 is a flow chart explaining the operation of the client for connection between the
5 client and the server in the PPPoE network system according to the present invention.

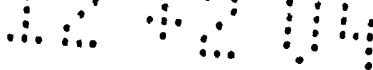
6 After a user boots the client's device, the client decides whether connection is tried, step
7 100.

8 If there is no connection attempt, the client returns to the step 100, but if there is a
9 connection attempt, the client proceeds to a next step 110. The client enters the discovery stage
10 for connection, and transmits the PADI (PPPoE Active Discovery Initiation) packet to the server,
11 step 110.

12 Now referring to FIG. 6, which illustrates the PADI (PPPoE Active Discovery Initiation)
13 packet being transmitted from the client to the server, in step 110, the client, for the configuration
14 of the PADI (PPPoE Active Discovery Initiation) packet, sets an address of a server MAC address
15 field as a broadcast address, 0xffffffff, 0xffff, a code of the code field as 0x09, and an ID of the
16 session ID field as 0x0000.

17 Then the client decides whether the PADO (PPPoE Active Discovery Offer) packet is
18 provided from the server, step 120.

19 FIG. 7 illustrates a packet being transmitted from the server to the client. In step 120, the
20 client decides whether the packet has been transmitted in the discovery stage or in the PPP session
21 stage by detecting the data (value) of the code field.



1 In other words, if the data of the code field is set as 0x07, the packet is the PADO (PPPoE
2 Active Discovery Offer). If the data of the code field is set as 0x00, however, the packet is a PPP
3 session packet.

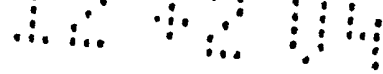
4 In step 120, if the code field of the packet is set as 0x07, the client decides the packet as
5 the PADO (PPPoE Active Discovery Offer) packet, and if the code field of the received packet is
6 set as 0x00, the client decides the packet as the session packet.

7 If the packet turns out to be the PADO (PPPoE Active Discovery Offer) packet, the client
8 proceeds to step 160. Meanwhile, if the packet turns out to be a session packet, the client
9 proceeds to a step 130.

10 In step 130, the client extracts and stores the client MAC address out of the client MAC
11 address field of the session packet illustrated in FIG. 7 and the session ID out of the session ID
12 field.

13 After the client extracts the client MAC address from the client MAC address field of the
14 session packet, it confirms whether the transmitted session packet from the server is a packet
15 corresponding to the client. Further, the client extracts and stores the session ID from the session
16 ID field having information about the session currently in process.

17 Alternatively, at this time, it does not matter if the client does not extract the client MAC
18 address from the client MAC address field of the session packet, but instead extracts only the
19 session ID of the session ID field. In other words, it is not absolutely required to extract and
20 confirm the client MAC address of the client MAC address field in the session packet.



1 The client loads the session ID being stored in step 130 into the session ID field of the
2 PADT (PPPoE Active Discovery Terminate) packet, and transmits the PADT (PPPoE Active
3 Discovery Terminate) packet, step 140.

4 In step 140, the reason why the client loads the session ID being stored in step 130 into the
5 session ID field of the PADT (PPPoE Active Discovery Terminate) packet and transmits the
6 PADT (PPPoE Active Discovery Terminate) packet is to terminate the session stage currently in
7 process by the server, that session having been abnormally ended by the client.

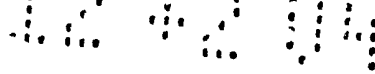
8 That is, in steps 130 and 140, the client recognizes that the server continues to perform
9 the PPP session. Hence, the client performs the discovery stage for terminating the connection to
10 terminate the session currently in process by the server.

11 Later, the client decides whether the PADT (PPPoE Active Discovery Terminate) packet
12 is received from the server, step 150.

13 If the PADT (PPPoE Active Discovery Terminate) packet is not received, the client
14 returns to the step 150. In the meantime, if the PADT (PPPoE Active Discovery Terminate)
15 packet is received, the client returns to the step 110 and performs the discovery stage for
16 connection.

17 If the PADO (PPPoE Active Discovery Offer) packet is received in the step 120, the client
18 transmits the PADR (PPPoE Active Discovery Request) packet in response to the PADO (PPPoE
19 Active Discovery Offer) packet, step 160.

20 Lastly, the client decides whether the PADS (PPPoE Active Discovery Session-
21 confirmation) packet is received at step 170. If the PADS (PPPoE Active Discovery Session-
22 confirmation) packet is received in the step 170, the client terminates the discovery stage for



1 connection and moves into the PPP session stage. However, if the PADS (PPPoE Active
2 Discovery Session-confirmation) packet is not received, the client returns to the step 170.

3 According to the connection method in PPPoE network system of the present invention,
4 when the connection between the client and the server is not properly terminated due to the
5 abnormality in the client's device or at the request of the user, the connection between the client
6 and the server can be reestablished. This becomes possible when the connection between the
7 client and the server is properly terminated, that is, the client makes a reconnection attempt and
8 transmits the PADI (PPPoE Active Discovery Initiation) packet, and if the packet from the server
9 is not the PADO (PPPoE Active Discovery Offer) packet, the client transmits the PADT (PPPoE
10 Active Discovery Terminate) packet to the server and receives the PADT (PPPoE Active
11 Discovery Terminate) packet from the server.

12 In conclusion, the PPPoE network system and connection method according to the present
13 invention can be established the connection between the client and the server faster and more
14 effectively, even when the disconnection between the client and the server is caused by some
15 errors on the client side.

16 While the present invention has been particularly shown and described with reference to
17 exemplary embodiments thereof, it will be understood by those skilled in the art that the
18 foregoing and other changes in form and details may be made therein without departing from the
19 spirit and scope of the present invention.



1

CLAIMS:

1

1. A PPPoE (Point-to-Point Protocol over Ethernet) network system, comprising:

2

a client connected to a server via an Ethernet line;

3

said client transmitting a PADI (PPPoE Active Discovery Initiation) packet to said server

4

if said client becomes disconnected from said server in a manner other than by transmission of

5

PADT (PPPoE Active Discovery Terminate) packets between said client and said server;

6

said client checking a packet received from said server, following the transmission of said

7

PADI (PPPoE Active Discovery Initiation) packet, to determine whether the packet received from

8

said server was a PADO (PPPoE Active Discovery Offer) packet;

9

said client extracting a session-ID from said packet received from said server when it is

10

determined that the packet received from said server is not the PADO (PPPoE Active Discovery

11

Offer) packet;

12

said client loading said session-ID into a Session-ID field of a PADT (PPPoE Active

13

Discovery Terminate) packet and transmitting the PADT (PPPoE Active Discovery Terminate)

14

packet to said server and checking for a server transmitted PADT (PPPoE Active Discovery

15

Terminate) packet in response thereto; and

16

said client transmitting a new PADI (PPPoE Active Discovery Initiation) packet to said

17

server to reconnect said server and said client, when said client receives the server transmitted

18

PADT (PPPoE Active Discovery Terminate) packet.



1 2. The system as set forth in claim 1, wherein said client checks a value of a Code
2 field in said packet received from said server, when checking whether the packet received from
3 said server is the PADO (PPPoE Active Discovery Offer) packet.

1 3. The system as set forth in claim 1, further comprising:
2 said client transmitting a PADR (PPPoE Active Discovery Request) packet to said server
3 when the client determines that the packet received from said server is the PADO (PPPoE Active
4 Discovery Offer) packet and checking for a server transmitted PADS (PPPoE Active Discovery
5 Session-confirmation) packet in response thereto; and
6 said client and said server beginning a PPP (Point-to-Point Protocol) session stage when
7 the client receives the server transmitted PADS (PPPoE Active Discovery Session-confirmation)
8 packet.

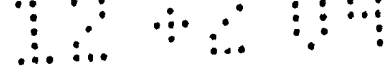
1 4. The system as set forth in claim 3, wherein said client checks a value of a Code
2 field in said packet received from said server, when checking whether the packet received from
3 said server is the PADO (PPPoE Active Discovery Offer) packet.

1 5. The system as set forth in claim 1, further comprising:
2 said client also extracting a client MAC (Media Access Control) address from said packet
3 received from said server when it is determined that the packet received from said server is not
4 the PADO (PPPoE Active Discovery Offer) packet and storing the client MAC (Media Access
5 Control) address and session-ID in memory; and



6 said client loading said client MAC (Media Access Control) address as well as said
7 session-ID into the Session-ID field of the PADT (PPPoE Active Discovery Terminate) packet
8 being transmitted to said server.

1 6. A method of establishing reconnection between a client and a server in PPPoE
2 (Point-to-Point Protocol over Ethernet) network system, said method comprising steps of:
3 transmitting a PADI (PPPoE Active Discovery Initiation) packet from said client to said
4 server if said client becomes disconnected from said server in a manner other than by
5 transmission of PADT (PPPoE Active Discovery Terminate) packets between said client and said
6 server;
7 checking a next packet received from said server, following the transmission of said PADI
8 (PPPoE Active Discovery Initiation) packet, to determine whether the next packet received from
9 said server is a PADO (PPPoE Active Discovery Offer) packet;
10 extracting a session-ID from said packet received from said server when it is determined
11 that the packet received from said server is not the PADO (PPPoE Active Discovery Offer)
12 packet;
13 loading said session-ID into a Session-ID field of a PADT (PPPoE Active Discovery
14 Terminate) packet and transmitting the PADT (PPPoE Active Discovery Terminate) packet to
15 said server;
16 checking for reception of a server transmitted PADT (PPPoE Active Discovery
17 Terminate) packet; and



18 transmitting a new PADI (PPPoE Active Discovery Initiation) packet to said server to
19 reconnect said server and said client, when said client receives the server transmitted PADT
20 (PPPoE Active Discovery Terminate) packet.

1 7. The method as set forth in claim 6, further comprising steps of:
2 transmitting a PADR (PPPoE Active Discovery Request) packet to said server, when it is
3 determined that the next packet received from said server after transmitting the PADI (PPPoE
4 Active Discovery Initiation) packet to said server, is the PADO (PPPoE Active Discovery Offer)
5 packet;
6 checking for reception of a server transmitted PADS (PPPoE Active Discovery Session-
7 confirmation) packet in response to the PADR (PPPoE Active Discovery Request) packet; and
8 when the client receives the server transmitted PADS (PPPoE Active Discovery Session-
9 confirmation) packet, beginning a PPP (Point-to-Point Protocol) session stage between said client
10 and said server.

1 8. The method as set forth in claim 6, said step of checking a next packet received
2 from said server to determine whether the next packet received from said server is a PADO
3 (PPPoE Active Discovery Offer) packet comprises checking a Code field of the next packet
4 received from said server for a predetermined code.

1 9. The method as set forth in claim 7, said step of checking a next packet received
2 from said server to determine whether the next packet received from said server is a PADO



3 (PPPoE Active Discovery Offer) packet comprises checking a Code field of the next packet
4 received from said server for a predetermined code.

1 10. The method as set forth in claim 6, further comprising:
2 extracting a client MAC (Media Access Control) address from said packet received from
3 said server when it is determined that the packet received from said server is not the PADO
4 (PPPoE Active Discovery Offer) packet and storing the client MAC (Media Access Control)
5 address and session-ID in memory; and
6 loading said client MAC (Media Access Control) address as well as said session-ID into
7 the Session-ID field of the PADT (PPPoE Active Discovery Terminate) packet being transmitted
8 to said server.

1 11. A method of establishing reconnection between a client and a server in PPPoE
2 (Point-to-Point Protocol over Ethernet) network system, said method comprising steps of:
3 transmitting a discovery stage initiation packet from said client to said server if said client
4 becomes disconnected from said server in an abnormal manner during a session stage of operation
5 between said client and said server;
6 checking a Code field of a next packet received from said server to determine whether the
7 received packet is a discovery stage offer packet;
8 transmitting a discovery stage request packet to said server, when it is determined that the
9 next packet received from said server was the discovery stage offer packet



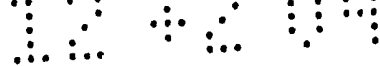
10 checking for reception of a server transmitted discovery stage confirmation packet in
11 response to the discovery stage request packet; and
12 upon reception of the server transmitted discovery stage confirmation packet, beginning a
13 new session stage between said client and said server.

1 12. The method as set forth in claim 11, further comprising steps of:
2 extracting a session-ID from said received packet, when it is determined that the packet
3 received from said server is not the discovery stage offer packet;
4 loading said session-ID into a Session-ID field of a discovery stage terminate packet and
5 transmitting the discovery stage terminate packet to said server;
6 checking for reception of a server transmitted discovery stage terminate packet; and
7 transmitting a new discovery stage initiation packet to said server to reconnect said server
8 and said client, when said client receives the server transmitted discovery stage terminate packet.

1 13. The method as set forth in claim 11, said step of checking the Code field checks
2 for a predetermined value of 0x07 in said Code field.

1 14. The method as set forth in claim 12, said step of checking the Code field checks
2 for a predetermined value of 0x07 in said Code field.

1 15. The method as set forth in claim 12, further comprising:



2 extracting a client MAC (Media Access Control) address from said packet received from
3 said server when it is determined that the received packet is not the discovery stage offer packet
4 and storing the client MAC (Media Access Control) address and session-ID in memory; and
5 loading said client MAC (Media Access Control) address as well as said session-ID into
6 the Session-ID field of the discovery stage terminate packet being transmitted to said server.

1 16. The method as set forth in claim 11, wherein said abnormal manner is any manner
2 other than by transmission of respective discovery stage terminate packets between said client and
3 said server.

4
5 17. A method substantially as hereinbefore described with reference to the
6 accompanying drawings.

7
8 18. Apparatus constructed and arranged substantially as hereinbefore described with
9 reference to the accompanying drawings.



INVESTOR IN PEOPLE

Application No: GB0402942.7

Examiner: Owen Wheeler

Claims searched: 1-10,17,18

Date of search: 23 June 2004

Patents Act 1977: Search Report under Section 17

Documents considered to be relevant:

Category	Relevant to claims	Identity of document and passage or figure of particular reference
A,P	-	EP 1357479 A2 [ORION]
A	-	JP 10229402 A [NTT]

Categories:

X Document indicating lack of novelty or inventive step	A Document indicating technological background and/or state of the art.
Y Document indicating lack of inventive step if combined with one or more other documents of same category.	P Document published on or after the declared priority date but before the filing date of this invention.
& Member of the same patent family	E Patent document published on or after, but with priority date earlier than, the filing date of this application.

Field of Search:

Search of GB, EP, WO & US patent documents classified in the following areas of the UKC^W :

H4P

Worldwide search of patent documents classified in the following areas of the IPC⁰⁷

G06F; H04L

The following online and other databases have been used in the preparation of this search report

EPODOC, JAPIO, WPI, Inspec