How to Use PPPoE in W5300

(connect ADSL with W5300)

(Version 1.0.0)

WIZnet

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Document History Information

Revision	Data	Description
1.0.0	Mar. 17, 2008	First release

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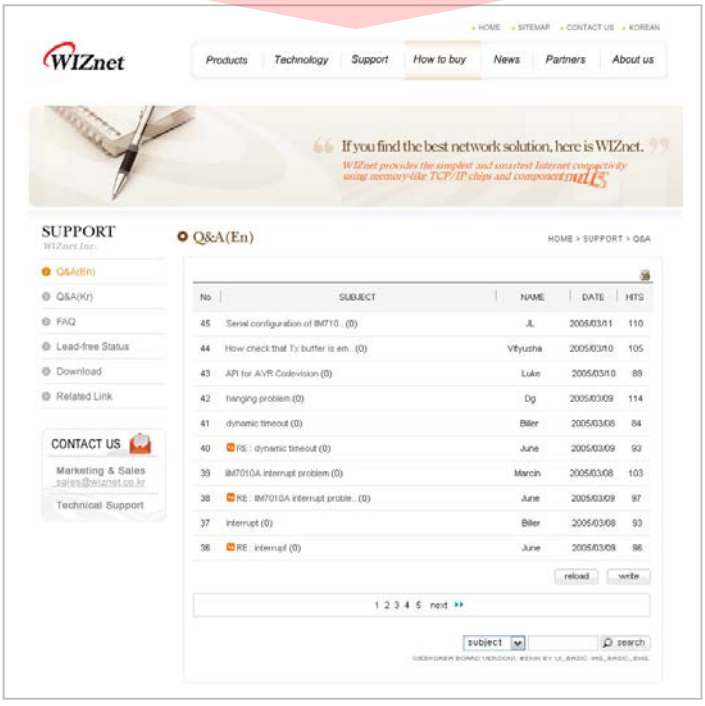


How to connect ADSL(PPP/PPPoE) with W5300

INTRODUCTION

W5300 supports PPP/PPPoE protocol to communicate at the ADSL. ADSL is the communication method using telephone line that is used for providing various services. PPP is the link-layer protocol to establish point-to-point connection with ISP device by using ADSL modem and transmit IP data packet. PPPoE is the link-layer protocol enabling PPP frame to communicate through Ethernet.

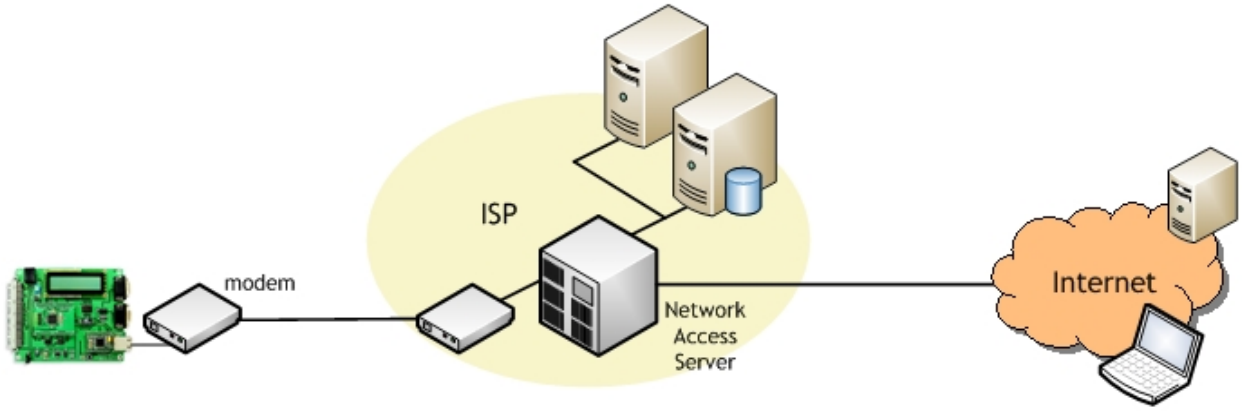


Figure 1. ADSL

This application note explains the PPP/PPPoE function of W5300 and describes steps of ADSL connection.

PPP/PPPoE function Registers

PPP/PPPoE related Registers are mentioned in below. For more detail, refer to W5300 datasheet.

MR (Mode Register) [R/W] [0x08000/----][0x3800 or 0xB800]

MR0	15	14	13	12	11	10	9	8
0x08000	DBW	MPF	WDF2	WDF1	WDF0	RDH	-	FS
----	U(R)	0(R)	1	1	1	0	0	0
MR1	7	6	5	4	3	2	1	0
0x08001	RST	-	MT	PB	PPPoE	DBS	-	IND
----	0	0	0	0	0	0	0	0

PPP/PPPoE mode enable bit

1: Enable PPP/PPPoE

0: Disable PPP/PPPoE

IR (Interrupt Register) [R/W] [0x08002/0x002] [0x0000]

IR0	15	14	13	12	11	10	9	8
0x08002	IPCF	DPUR	PPPT	FMTU	-	-	-	-
0x002	0	0	0	0	0	0	0	0
IR1	7	6	5	4	3	2	1	0
0x08003	S7_INT	S6_INT	S5_INT	S4_INT	S3_INT	S2_INT	S1_INT	S0_INT
0x003	0	0	0	0	0	0	0	0

PPP/PPPoE Terminate Interrupt bit

1: PPP/PPPoE connection close

IMR (Interrupt Mask Register) [R/W] [0x08004/0x004] [0x0000]

IMR0	15	14	13	12	11	10	9	8
0x08004	IPCF	DPUR	PPPT	FMTU	-	-	-	-
0x004	0	0	0	0	0	0	0	0
IMR1	7	6	5	4	3	2	1	0
0x08005	S7_INT	S6_INT	S5_INT	S4_INT	S3_INT	S2_INT	S1_INT	S0_INT
0x005	0	0	0	0	0	0	0	0

IR(PPPT) Interrupt mask bit

PATR (PPPoE Authentication Type Register) [R] [0x08032/0x032] [0x0000]

It notifies authentication method negotiated with PPPoE server.

W5300 supports 2 authentication method.

Value	Authentication method
0xC023	PAP
0xC223	CHAP

Ex) PATR = 'CHAP'

PATR(0x08032/0x032)	
PATR0(0x08032/0x032)	PATR1(0x08033/0x033)
0xC2	0x23

PTIMER(PPP Link Control Protocol Request Timer Register)[R/W][0x08036/0x036][0x--28]

It sets transmit timer of Link control protocol (LCP) echo request. Vaule 1 is about 25ms.

Ex) PTIMER = 200 (200 * 25ms = 5000ms = 5s)

PTIMER(0x08036/0x037)	
PTIMER0(0x08036/0x036)	PTIMER1(0x08037/0x037)
Reserved	200 (0xC8)

PMAGICR(PPP LCP Magic number Register)[R/W][0x08038/0x038][0x--00]

It sets 4byte "Magic Number" value to be used duing LCP negotiation with PPPoE server.

Ex) PMAGICR = 0x01

PMAGICR(0x08036/0x037)	
PMAGICR0(0x08038/0x038)	PMAGICR1(0x08039/0x039)
Reserved	0x01

Magic number = 0x01010101

PSIDR(PPPoE Session ID Register)[R][0x0803C/0x03C][0x0000]

It notifies PPP session ID that is acquired by PPPoE-process of W5300 and used for communication with PPPoE server.

Ex) PSIDR = 0x0017

PSIDR(0x0803C/0x03C)	
PSIDR0(0x0803C/0x03C)	PSIDR1(0x0803D/0x03D)
0x00	0x17

PDHAR(PPPoE Destination Hardware Address Register)[R][0x08040/0x040][00.00.00.00.00.00]

It notifies PPPoE server's hardware address acquired through PPPoE-process of W5300.

Ex) PDHAR = 00.01.02.03.04.05

PDHAR(0x08040/0x040)	
PDHAR0(0x08040/0x040)	PDHAR1(0x08041/0x041)
0x00	0x01
PDHAR2(0x08042/0x042)	
PDHAR2(0x08042/0x042)	PDHAR3(0x08043/0x043)
0x02	0x03
PDHAR4(0x08044/0x044)	
PDHAR4(0x08044/0x044)	PDHAR5(0x08045/0x045)
0x04	0x05

Sn_MR (SOCKETn Mode Register) [R/W] [0x08200+0x40n/0x200+0x40n] [0x0000]

It sets protocol type or option of SOCKET n.

Sn_MR0	15	14	13	12	11	10	9	8
0x08200	-	-	-	-	-	-	-	ALIGN
0x200	0	0	0	0	0	0	0	0
Sn_MR1	7	6	5	4	3	2	1	0
0x08201	MULTI	-	ND/MC	-	P3	P2	P1	P0
0x201	0	0	1	0	0	0	0	0

Symbol	P3	P2	P1	P0	Meaning
Sn_MR_CLOSE	0	0	0	0	Closed
Sn_MR_TCP	0	0	0	1	TCP

Sn_MR_UDP	0	0	1	0	UDP
Sn_MR_IPRAW	0	0	1	1	IP RAW
S0_MR_MACRAW	0	1	0	0	MAC RAW
S0_MR_PPPoE	0	1	0	1	PPP/PPPoE

S0_MR_PPPoE is valid only at the SOCKET 0. It is temporarily used for PPPoE server connection/termination. After connection is established, it can be used for other protocols.

S0_CR (SOCKET0 Command Register) [R/W] [0x08202/0x202]

As for command Registers for SOCKET 0, PPP/PPPoE commnad such as PCON, PDISCON, PCR, PCN, PCJ can be configured together with the general command such as Open, Close, Connect, Listn, Send or Recv.

S0_CR(0x08202/0x202)	
S0_CR0(0x08202/0x202)	S0_CR1(0x08203/0x203)
Reserved	Command

Value	Command	Description
0x23	PCON	It starts PPPoE connection by transmitting PPPoE discovery packet.
0x24	PDISCON	It closes PPPoE connection.
0x25	PCR	It transmits REQ message in each phase.
0x26	PCN	It transmits NAK message in each phase.
0x27	PCJ	It transmits REJECT message in each phase.

S0_IMR (SOCKET0 Interrupt Mask Register)[R/W] [0x08204/0x204] [0x--FF]

S0_IMR0	15	14	13	12	11	10	9	8
0x08204	-	-	-	-	-	-	-	-
0x204	0	0	0	0	0	0	0	0
Sn_IMR1	7	6	5	4	3	2	1	0
0x08205	PRECV	PFAIL	PNEXT	SENDOK	TIMEOUT	RECV	DISCON	CON
0x205	1	1	1	1	1	1	1	1

S0_IMR(7:0)/S0_IMR1(7:0)

Bit	Symbol	Description
7	PRECV	S0_IR(PRECV) Interrupt Mask
6	PFAIL	S0_IR(PFAIL) Interrupt Mask
5	PNEXT	S0_IR(PNEXT) Interrupt Mask

S0_IR (SOCKET0 Interrupt Register) [R/W] [0x08206/0x206] [0x--00]

S0_IR is the Register to notify the interrupt type of SOCKET0 such as Establishment, Termination,

Receiving data, or Timeout. Especially at the SOCKET 0, it informs the interrupt type occurring during PPP/PPPoE operation.

S0_IR0	15	14	13	12	11	10	9	8
0x08206	-	-	-	-	-	-	-	-
0x206	0	0	0	0	0	0	0	0
S0_IR1	7	6	5	4	3	2	1	0
0x08207	PRECV	PFAIL	PNEXT	SENDOK	TIMEOUT	RECV	DISCON	CON
0x207	0	0	0	0	0	0	0	0

S0_IR(7:0)/S0_IR1(7:0)

Bit	Symbol	Description
7	PRECV	**PPP Receive Interrupt** It sets in case of receiving not-supporting option data.
6	PFAIL	**PPP Fail Interrupt** It sets in case of failure of PAP authentication.
5	PNEXT	**PPP Next Phase Interrupt** It sets in case of chaning the Phase during PPPoE conncetion process.

S0_SSR (SOCKET0 SOCKET Status Register) [R] [0x08208/0x208] [0x--00]

It notifies the SOCKET status of SOCKET 0. At the SOCKET 0, it notifies the PPP connection status.

S0_SSR(0x08208/0x208)	
S0_SSR0(0x08208/0x208)	S0_SSR1(0x08209/0x209)
Reserved	Socket stauts

Sn_SSR(15:8)/Sn_SSR0(7:0) : All Reserved

Sn_SSR(7:0)/Sn_SSR1(7:0)

Value	Symbol	Description
0x5F	SOCK_PPPoE	It is the status that SOCKET 0 is open as PPPoE mode. In case of S0_MR(P3:P0) = S0_MR_PPPoE and S0_CR=OPEN, it is changed to the SOCK_PPPoE. It is temporarily used during PPPoE connection.

S0_DHAR (SOCKET0 Destination Hardware Address Register) [R/W]

[0x0820C/0x20C] [FF.FF.FF.FF.FF.FF]

At the PPPoE mode, PPPoE server hardware address is set to S0_DHAR.

Ex) S0_DHAR = 00.08.DC.01.02.10

S0_DHAR(0x0820C/0x20C)	
S0_DHAR0(0x0820C/0x20C)	S0_DHAR1(0x0820D/0x20D)
0x00	0x08
S0_DHAR2(0x0820E/0x20E)	
S0_DHAR2(0x0820E/0x20E)	S0_DHAR3(0x0820F/0x20F)
0xDC	0x01
S0_DHAR4(0x08210/0x210)	
S0_DHAR4(0x08210/0x210)	S0_DHAR5(0x08211/0x211)
0x02	0x10

S0_DPORTR (SOCKET0 Destination Port Register) [R/W] [0x08212/0x212] [0x0000]

At the PPPoE mode, PPP Session ID is set to S0_DPORTR.

PPP Session ID set in S0_DPORTR is applied to PSODR after OPEN command.

Ex) S0_DPORTR = 5000(0x1388)

S0_DPORTR(0x08212/0x212)	
S0_DPORTR0(0x08212/0x212)	S0_DPORTR1(0x08213/0x213)
0x13	0x88

S0_MSSR (SOCKET0 Maximum Segment Size Register) [R/W] [0x08218/0x218] [0x0000]

It sets MTU(Maximum Transfer Unit) of SOCKET 0 or informs the information of set MTU.

In case of using PPPoE (MR(PPPoE)='1'), the MTU of TCP or UDP mode is fixed in the range of MTU of PPPoE.

At the IPRAW or MACRAW mode, MTU is not internally processed and default MTU is used. So, the Host should divide the data manually into default MTU when sending the data bigger than default MTU.

Mode	**Normal** (MR(PPPoE)='0')		**PPPoE** (MR(PPPoE)='1')	
	Default MTU	Range	Default MTU	Range
TCP	1460	1 ~ 1460	1452	1 ~ 1452
UDP	1472	1 ~ 1472	1464	1 ~ 1464
IPRAW	1480		1472	
MACRAW	1514			

Ex) Sn_MSSR = 1460 (0x05B4)

Sn_MSSR(0x08218+0x40n/0x218+0x040n)	
Sn_MSSR0(0x08218+0x40n/0x218+0x040n)	Sn_MSSR1(0x08219+0x40n/0x219+0x040n)
0x05	0xB4

Connection Process

The ADSL connection is processed as below.

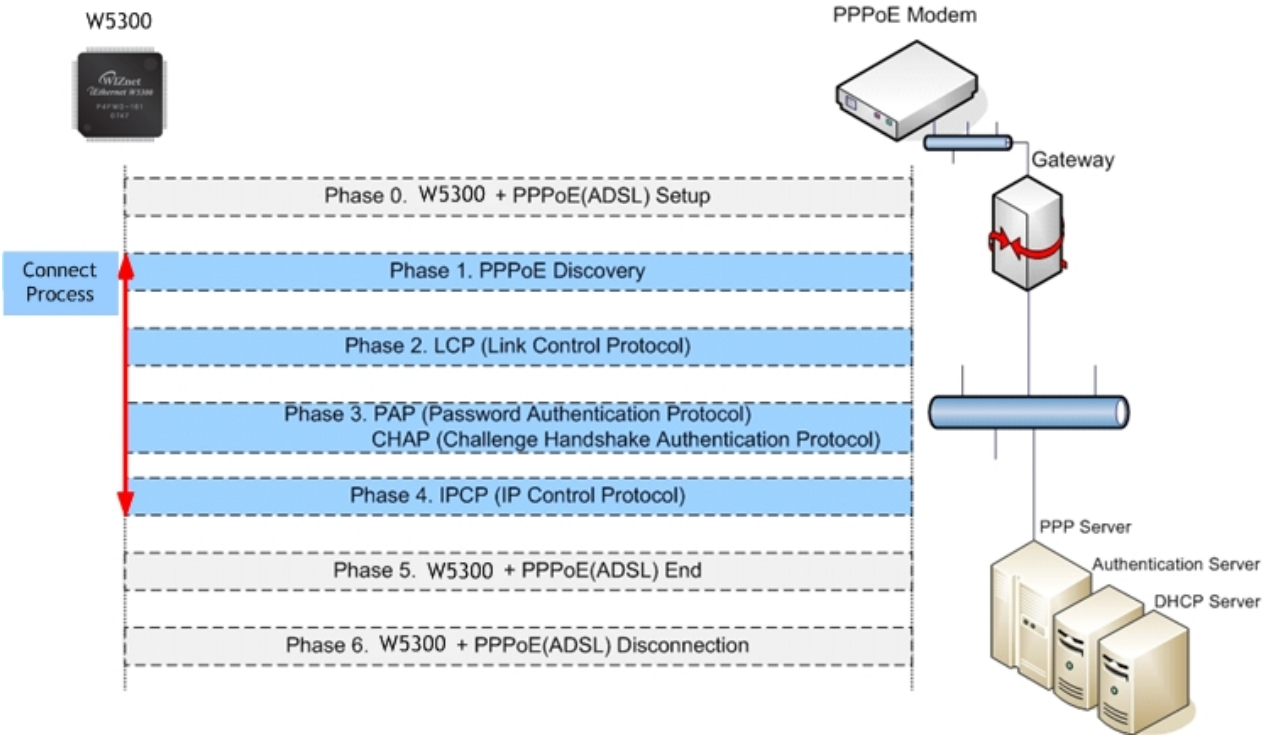


Figure 2. W5300 PPP/PPPoE Process

Phase 0. W5300 PPP/PPPoE(ADSL) Setup

Set up basic configuration for ADSL connection and communication.

Phase 1. PPPoE Discovery Process

Connect to PPPoE Server (NAS) for the start to PPP/PPPoE connection.

Phase 2. PPP LCP Configuration Process

Set basic configuration for PPP connection is set through the negotiation with PPP server.

Phase 3. PPP Authentication Process

It processes user authentication by using PAP or CHAP.

Phase 4 PPP IPCP configuration Process

It acquires IP address, Gateway address and DNS address to be used in IP protocol.

Phase 5 W5300 Connection Socket Close Process

After ADSL connection process, close the socket0.

Phase 6 PPPoE Disconnection Process

Close the connection with PPP/PPPoE server.

Phase 0. W5300 PPP/PPPoE(ADSL) Setup

It sets basic configuration for the connection with ADSL

- Enable the PPPoE bit of Mode Register, and assign the value to PTIMER and PMAGICR.
- Set the mode of SOCKET 0 and open the socket.

```
{
/* W5300 PPP/PPPoe(ADSL) initialization */
PHASE0 :
/* Set PPP/PPPoE bit in MR(Common Mode Register) */
    MR = 0x08;
/* Set the value of PTIMER and PMAGIC */
    PTIMER = 200; // set about 5 second
    PMAGICR = 0x01;
/* Set PPP/PPPoE mode on socket 0 mode register */
    S0_MR = 0x05;
/* Set OPEN command */
    S0_CR = OPEN;
}
```

Phase 1. PPPoE Discovery Process

Conntect to PPPoE server for start PPP/PPPoE connection process.

- It acquires IP address of PPP/PPPoE server.
- Through the negotiation with PPPoE Server, it acquires session ID.

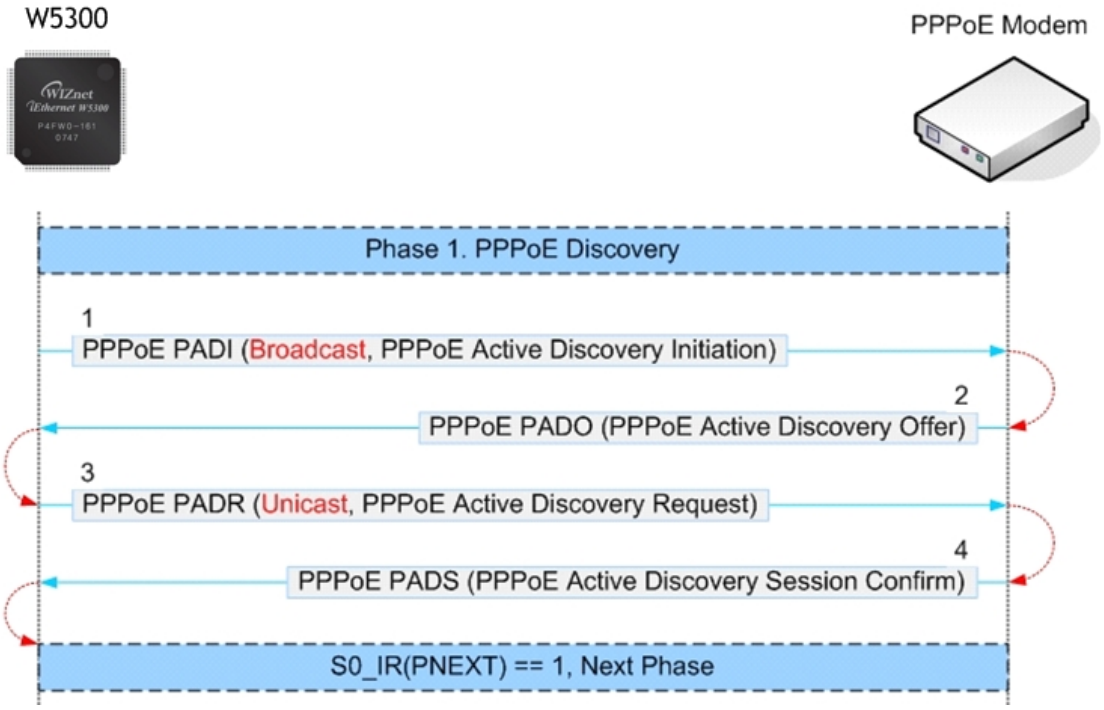


Figure 3. PPPoE Discovery Process

```
{
/* Set Socket 0 Command Register to PCON for starting to PPPoE(ADSL) connection
    PPPoE(ADSL) discovery process starts */
    S0_CR = PCON;
    while
    {
        wait some time
        /* check whether PNEXT bit of socket 0 Interupt Register is set
            If PNEXT bit is set, PPPoE(ADSL) discovery process ends */
        if (S0_IR(PNEXT) == '1')
        {
            goto Next Phase (Phase2);
        }
        if (overtime) goto PHASE0;
    }
}
```

Phase 2. PPP LCP Configuration Process

The basic information for PPP connection is acquired through the negotiation with PPP server.

By using LCP option, the required information is settled.

The values of Maximum Receive Unit, Authentication Protocol, Magic Number are settled.

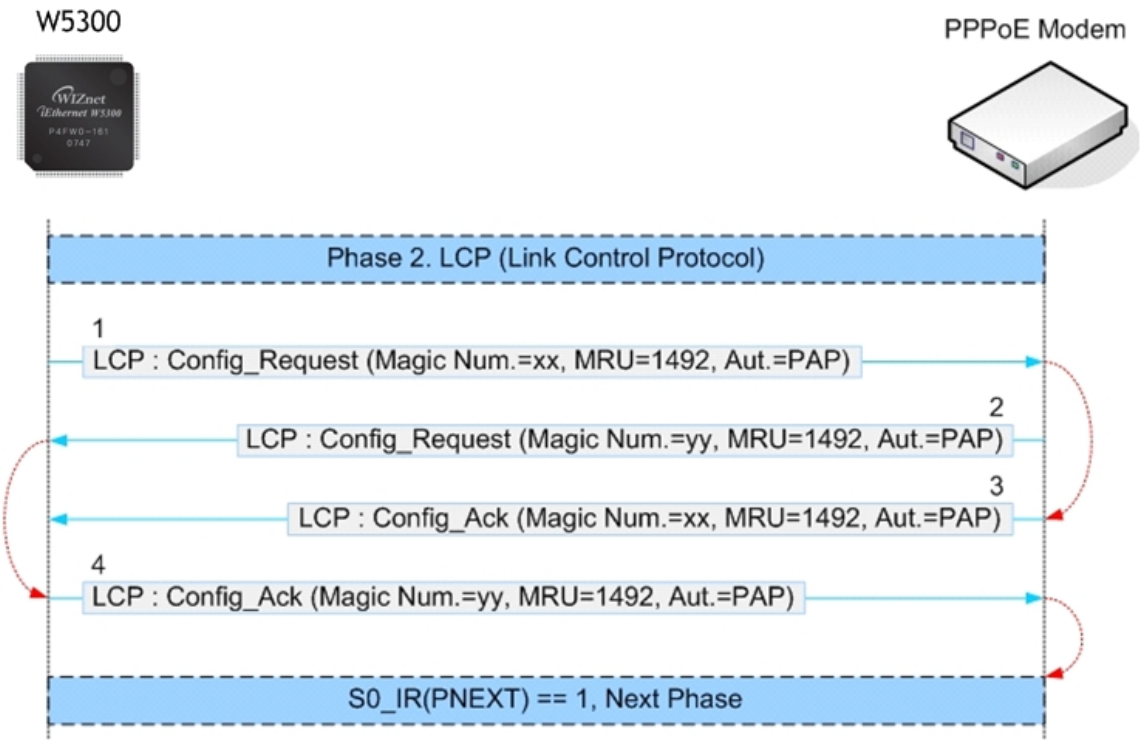
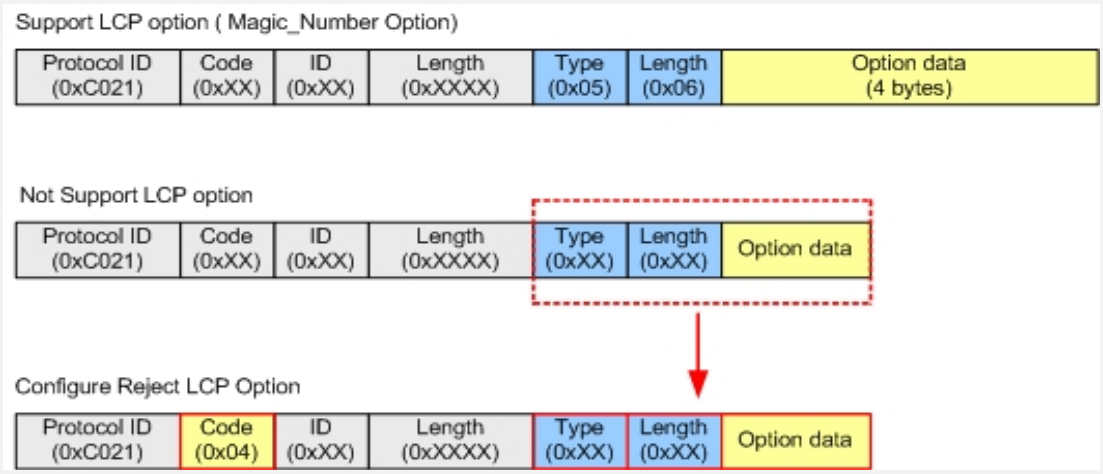


Figure 4. PPP LCP Configuration Process

W5300 support LCP options

Type	Name	Data
0x01	Maximum Receive Unit	2 Bytes
0x03	Authentication Protocol	PAP(0xC023), CHAP(0xC223)
0x05	Magic Number	4 Bytes

```
{
    /* prepare option field of LCP
       Type, Length and option values are comprised in LCP configuration option field
       Type(0x05, Magic number), Length(0x06, 6bytes), Magic number(4bytes) */
    option_array = {0x05, 0x06, PMAGIC, PMAGIC, PMAGIC, PMAGIC};
    copy option_array to socket 0 TX memory;
    /* for copying, refer to TCP sending process in 5.Functional description of datasheet.*/
    /* send LCP Config_REQ message */
    S0_CR = PCR;
    while
    {
        wait some time
        /* check PRECV bit of S0_IR is set */
        if (S0_IR(PRECV) == '1')
        {
            Get the option_array from RX memory of socket 0;
            /* for getting the data, refer to TCP receiving process in 5.Functional description
               of datasheet */
            Parsing option_array and save reject option to reject_option_array
```




```
        {
            Skip 6 bytes in option_array; // ppp header 6 bytes
            /* each option field consist of [ kind(1) | len(1) | value(n) ] */
            Parsing all option fields as below
            {
                while (exist option field)
                {
                    /* check support option kind */
                    if (option(kind) != {0x01, 0x03, 0x05})
                    save the option fields to reject_option_array;
                }
            }
        }
        Copy reject_option_array to socket 0 TX memory;
        /* send LCP Config_REJ message */
        S0_CR = PCJ;
    }
    /* check PNEXT bit of S0_IR is set */
    if (S0_IR(PNEXT) == '1') goto PHASE3;
    if (overtime) goto PHASE0;
  }
}
```

Phase 3. PPP Authentication Process

For the user authentication, W5300 supports PAP ro CHAP. The detailed process of PAP and CHAP is as below.

3.1 PAP(Password Authentication Protocol) Process

User authentication process of PAP is as below.

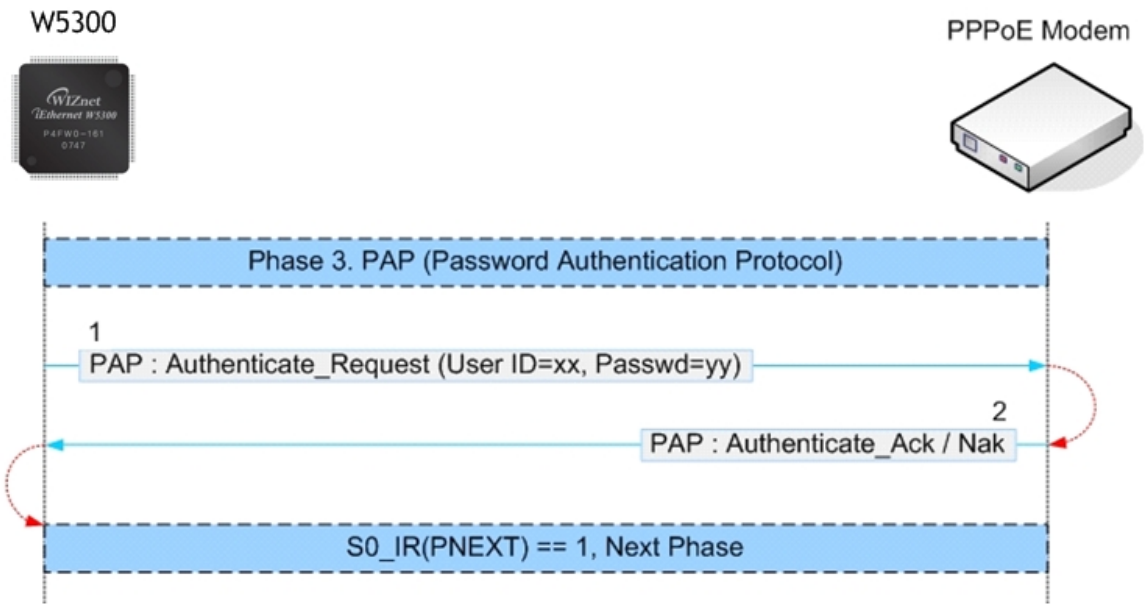


Figure 5. PAP Authentication Process

```
{
    /* prepare option field of PAP Auth_REQ */
    /* [ IDlen(1) | ID(IDlen) | PWDlen(1) | PWD(PWDlen) ] */
    Save { IDlen(1),ID(IDlen),PWDlen(1),PWD(PWDlen) } to option_array
    copy option_array to TX memory of socket 0;
    /* send PAP Auth_REQ */
    S0_CR = PCR;
    while
    {
        wait some time
        /* check PFAIL bit of S0_IR is set */
        if (S0_IR(PFAIL) == '1')
        {
            Re-check ID, Password
            goto PHASE0;
        }
        /* check PNEXT bit of S0_IR is set */
        if (S0_IR(PNEXT) == '1') goto IPCP;
        if (overtime) goto PHASE0;
    }
}
```

3.2 CHAP(Challenge Handshake Authentication Protocol) Process

User authentication process of CHAP is as below.

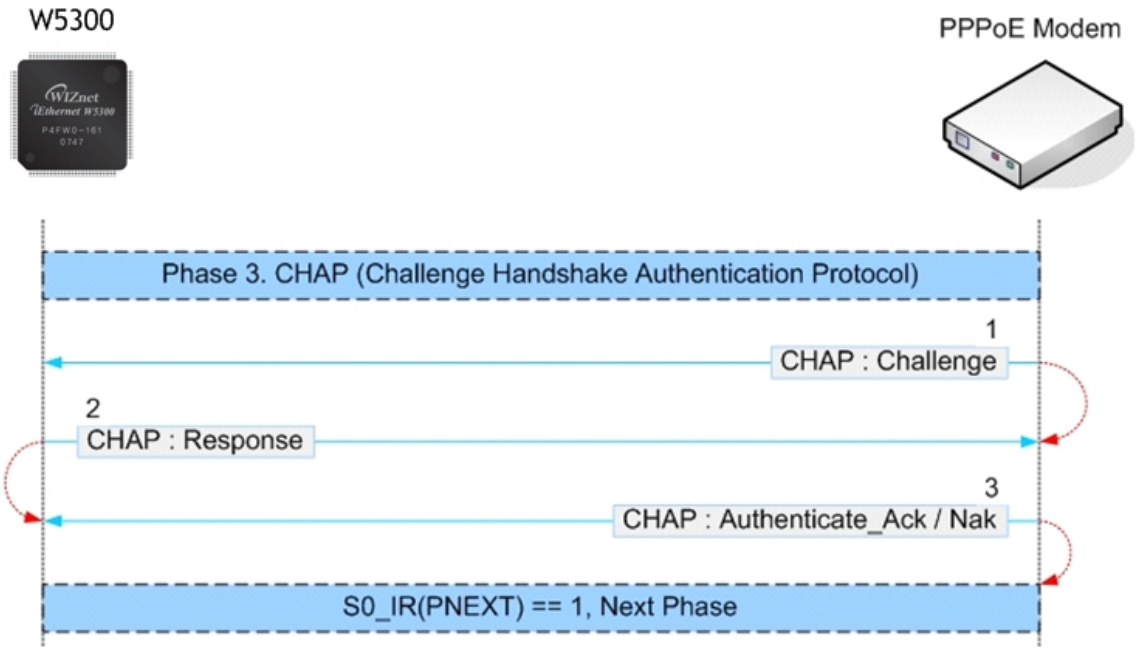


Figure 6. CHAP Authentication Process

```
{
    /* for copying, refer to TCP receiving process in 5.Functional description of datasheet.*/
    /* receive PPP Challenge packet from PPP server */
    S0_CR = CRECV;

    /* prepare CHAP Response packet to PPP server */
    /* [ CHAP_ID(1) | Length(2) | HV(n) with MD5(Message Digest 5) ] */
    /* for copying, refer to TCP sendign process in 5.Functional description of datasheet.*/
    /* send PAP Auth_REQ */
    S0_CR = PCR;
    while
    {
        wait some time
        /* check PFAIL bit of S0_IR is set */
        if (S0_IR(PFAIL) == '1')
        {
            Re-check ID, Password
            goto PHASE0;
        }
        /* check PNEXT bit of S0_IR is set */
        if (S0_IR(PNEXT) == '1') goto IPCP;
        if (overtime) goto PHASE0;
    }
}
```

Phase 4. PPP IPCP Configuration Process.

After acquiring IP addess, Gateway address, and DNS address by using IPCP, they are applied to W5300's network information

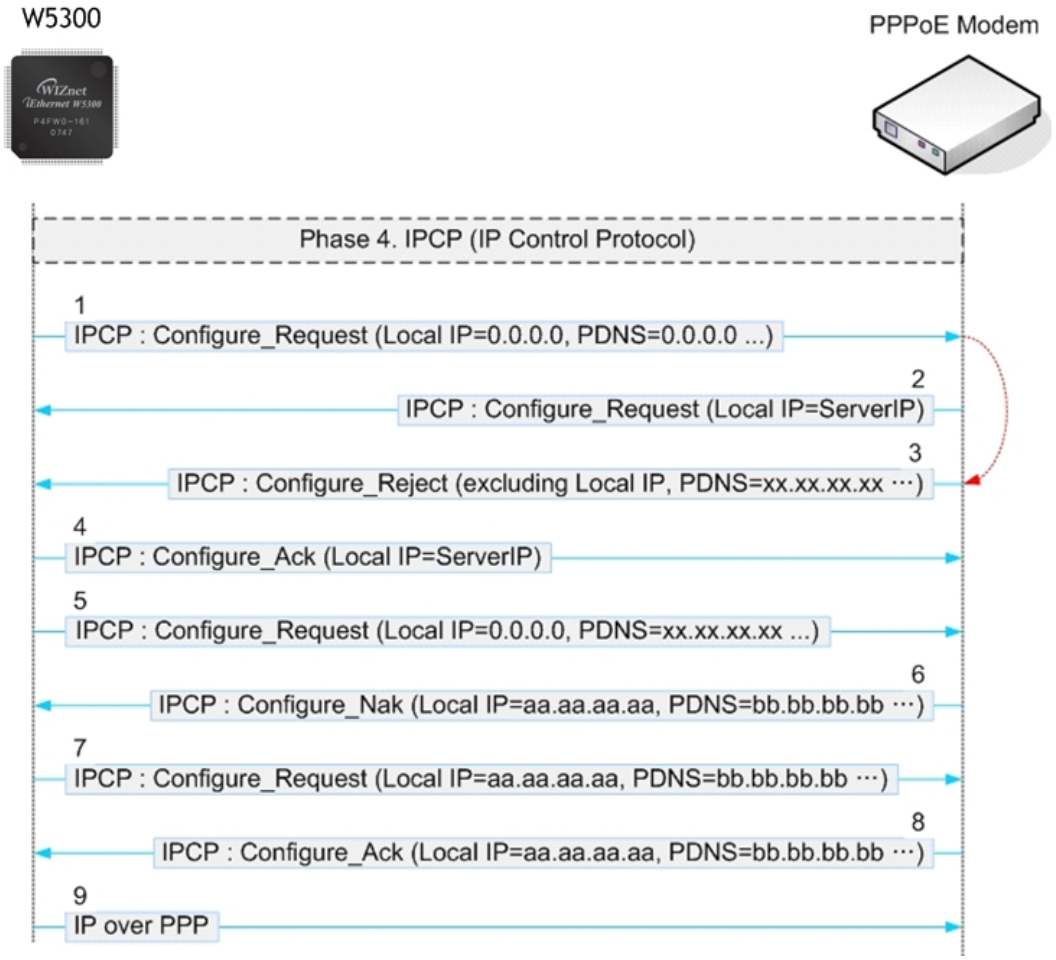


Figure 7. PPP IPCP configuration Process

```
{
    /* prepare option field of IPCP */
    option_array = {0x03, 0x06, 0x00, 0x00, 0x00, 0x00};
    copy option_array to socket 0 TX memory;
    /* send IPCP Config_REQ message */
    S0_CR = PCR;

    while
    {
        wait some time
        /* check PRECV bit of S0_IR is set */
        /* It is because IP address assigned to NAK message is sent from a server. */
        if (S0_IR(PRECV) == '1')
        {
            Get the received data of socket 0 RX memory and save to ip_option_array;
            {
                /* Parsing ip_option_array as below */
```

```
                Skip 6 bytes in ip_option_array; // ppp header 6 bytes
                {
                    /* Parsing all option fields as below */
                    /* each option field consist of [ kind(1) | len(1) | value(n) ] */
                    while (exist option field)
                    {
                        /* check ip option field */
                        if (option(kind) == 0x03)
                        {
                            save the option fields to option_array;
                            goto IPCP_END;
                        }
                    }
                }
            }
        }
        if (overtime) goto PHASE0;
    }
IPCP_END:
    Copy option_array to socket 0 TX memory;
    /* resend IPCP Config_REQ message */
    S0_CR = PCR;
    while
    {
        wait some time
        /* check PNEXT bit of S0_IR is set */
        if (S0_IR(PNEXT) == '1') goto PHASE5;
        if (overtime) goto PHASE0;
    }
}
```

Phase 5. W5300 Connection Socket Close Process

After finishing all connection process, all information related to PPP/PPPoE connection is saved in Registers. Therefore, the SOCKET 0 which was used for PPP/PPPoE connection, is not required any more, and can be utilized for another application.

```
{
    /* set CLOSE command */
    S0_CR = CLOSE;
}
```

Phase 6. PPPoE Disconnection Process

Close connection with PPP/PPPoE server.

```
{
    /* Set PPPoE bit in MR(Mode Register). */
    MR = 0x08;
    /* Set PPPoE mode on socket 0 mode register */
    S0_MR = 0x05;
    /* set the ADSL server information */
    S0_DHAR = PPPoE_Server ;
    S0_DPORT = PPPoE_Session_ID;
    /* Set OPEN command */
    S0_CR = OPEN;
    /* Set PDISCON command for starting to disconnect to ADSL server */
    S0_CR = PDISCON;
    /* set CLOSE command */
    S0_CR = CLOSE;
}
```