12. FUNCTIONAL DESCRIPTION

12.1. Medium Access and Data Protocol

Refer to the Functional Specification for Hermes WMAC controller.

12.2. Physical Layer Convergence Procedure

This section provides a convergence procedure in which MPDUs (MAC Protocol Data Units) are converted to and from PPDUs (PHY Protocol Data Units). During transmission, the MPDU is appended with a PLCP preamble and a PLCP header to create the PPDU. At the receiver, the PLCP preamble and the PLCP header are processed facilitating demodulation and delivery of the MPDU.

Figure 6 shows the PPDU format. The PLCP preamble contains synchronization (Sync) and Start Frame Delimiter (SFD) fields. The PLCP header contains the 802.11 signal (Signal), 802.11 service (Service), MPDU length (Length) and CCITT CRC-16 fields. Each of these fields will be described in detail in the following paragraphs.

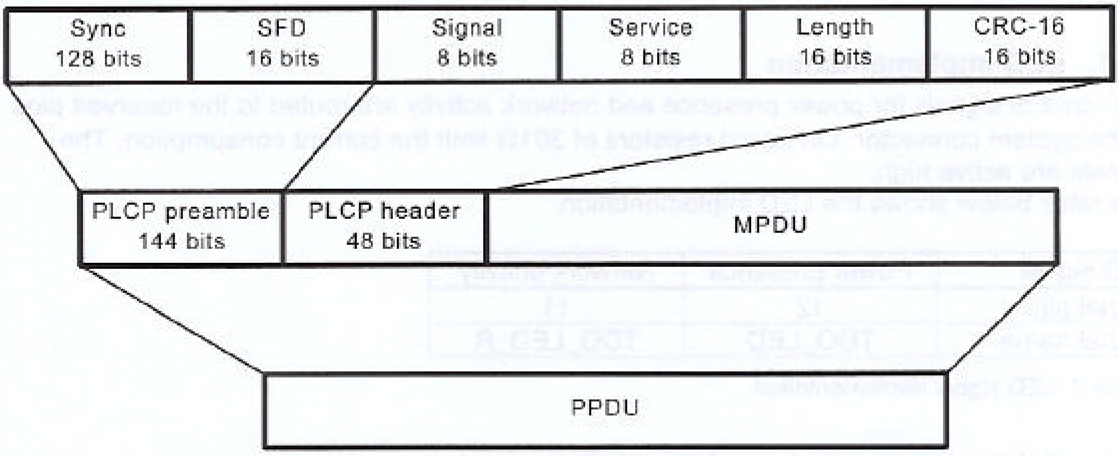

Figure 6. PLCP frame format.

12.2.1. PLCP synchronization

The Sync field consists of 128 1-bits. This field is provided facilitating the necessary operations for synchronization at the receiver. The PLCP preamble and PLCP header fields will not implement the short PLCP preamble and header fields at 11 Mbps and 5.5 Mbps as specified in the 802.11 final adopted specification.

12.2.2. PLCP Start Frame Delimiter

The Start Frame Delimiter is a unique word provided to indicate the start of PHY dependent parameters within the PLCP preamble. This unique word consists of a 16 bits field, F3A0h (MSB to LSB), where the LSB is transmitted first in time.

12.2.3. PLCP 802.11 signal field

The 8 bit Signal field indicates the modulation and data rate which will be used for transmission and reception of the MPDU. The data rate is equal to the Signal field value multiplied by 100kbit/s. This Network Interface supports four different bit-rates given by the following 8-bit words, where the LSB is transmitted first in time:

a) 0Ah (MSB to LSB) 1Mbit/s DBPSK
b) 14h 2Mbit/s DQPSK
c) 37h 5.5Mbit/s CCK
d) 6Eh 11Mbit/s CCK

12.2.4. PLCP 802.11 service field

The 8 bit Service field is reserved for future use. The value of 00h signifies 802.11 compliance. The LSB is transmitted first in time.

12.2.5. PLCP Length field

The PLCP Length field is an unsigned integer which indicates length of the MPDU in microseconds. The LSB is transmitted first in time. The Length field is calculated as follows:

a) 1Mbit/s DBPSK: Length = #bytes * 8.
b) 2Mbit/s DQPSK Length = #bytes * 4.
c) 5.5Mbit/s CCK Length = #bytes * 8 / 5.5, rounded up
d) 11Mbit/s CCK Length = #bytes * 8 / 11, rounded up

At the receiver, the number of bytes in the MPDU frame is calculated as follows:

a) 1Mbit/s DBPSK: #bytes = Length / 8.
b) 2Mbit/s DQPSK #bytes = Length / 4.
c) 5.5Mbit/s CCK #bytes = Length * 5.5 / 8, rounded down
d) 11Mbit/s CCK #bytes = Length * 11 / 8, rounded down

12.2.6. PLCP CRC16 field

The 802.11 signal, 802.11 service and length field is protected with a CCITT CRC-16 Frame Check Sequence (FCS). The CRC-16 FCS is the ones complement of the remainder generated by the module 2 division of the protected PLCP fields by the polynomial:

$$x^{16} + x^{12} + x^{5} + 1$$

The protected bits are processed in transmit order. All FCS calculations are made prior to data scrambling.

The SSFD is a single 0-bit following the 83 1bits in the SYNC field.
This field contains 8 data bits.

12.3. PHY Data Scrambler and Descrambler

The polynomial $1 + x^{-4} + x^{-7}$ is used to scramble the entire PPDU or short ACK. The feedthrough configuration of the scrambler is self initializing. No prior initializing of the scrambler is required for receive processing. The scrambler should be initialized to any state except all ones when transmitting.

12.4. Data modulation and modulation rate change

The PLCP preamble, PLCP header and an entire short ACK are transmitted using 1Mbit/s DBPSK modulation. The 802.11 signal field indicates the modulation and data rate used to transmit the MPDU. The transmitter and receiver initiates the modulation indicated by the 802.11 signal field starting with the first symbol (1 bit for DBPSK, 2bits for DQPSK) of the MPDU.

12.5. DSSS Spreading Sequence

The following 11 chip Barker sequence is used:

+1, −1, +1, +1, −1, +1, +1, +1, −1, −1, −1

The left most chip is output first in time. The first chip is aligned as the start of a transmitted symbol. The symbol duration is exactly 11 chips long.

12.6. DSSS Modulation and channel data rates

12.6.1. 1Mbps DBPSK modulation and 2Mbps DQPSK modulation

Four modulation formats and data rates are specified for the Network Interface. The lowest rate is based on 1Mbit/s DBPSK modulation. The BPSK encoder is specified in Table 3. The 2Mbit/s data rate is based on DQPSK. The DQPSK encoder is specified in Table 4. The initial phase of the (I,Q) vector (the first symbol in the PLCP) will be $\pi/4$.

Bit input	Phase change
0	0
1	π

Table 3. 1Mbit/s DBPSK modulation.

Dibit pattern (b0,b1) b0 is first in time	Phase change
00	0
01	$\pi/2$
11	π
10	$3\pi/2$ ($-\pi/2$)

Table 4. 2Mbit/s DQPSK modulation.

The DSP provides analog baseband signals where the output voltage is linearly related to these levels.

12.6.2. Modulation for Channel Data Rates of 5.5 and 11 Mbit/s

The extended Direct Sequence specification defines two additional data rates. The modulation scheme for 5.5 Mbit/s and 11 Mbit/s is Complementary Code Keying (CCK).

12.6.2.1. Spreading Codes

The spreading code length is 8 and based on complementary codes. The chipping rate is 11 MHz. The symbol duration shall be exactly 8 complex chips long.
The following formula shall be used to derive the CCK code words that shall be used for spreading both 5.5 and 11 Mbit/s:

$$c = \{e^{j(\varphi_1+\varphi_2+\varphi_3+\varphi_4)}, e^{j(\varphi_1+\varphi_3+\varphi_4)}, e^{j(\varphi_1+\varphi_2+\varphi_4)},$$
$$-e^{j(\varphi_1+\varphi_4)}, e^{j(\varphi_1+\varphi_2+\varphi_3)}, e^{j(\varphi_1+\varphi_3)}, -e^{j(\varphi_1+\varphi_2)}, e^{j\varphi_1}\}$$

This formula creates 8 complex chips (LSB to MSB) that are transmitted LSB first.
This is a form of the generalized Hadamard transform encoding where φ_1 is added to all code chips, φ_2 is added to all odd chips, φ_3 is added to all odd pairs of chips and φ_4 is added to all odd quads of code chips.
The phases $\varphi 1_i$ (i=1..4) modify the phase of all chips of the sequence and will be DQPSK encoded for 5.5 and 11 Mbit/s. This will take the form of rotating the whole symbol by the

appropriate amount relative to the phase of the preceding symbol. Note that the MSB chip of the symbol defined above is the chip that indicates the symbol's phase and it is transmitted last.

12.6.2.2. Cover codes

The 4^{th} and 7^{th} chips are rotated 180 degrees by a cover sequence to optimize the sequence correlation properties. This can be seen by the minus sign on the 4^{th} and 7^{th} terms in the equation in clause 12.6.2.1.

12.6.2.3. Bias suppression

All odd numbered symbols of the MPDU shall be given an extra 180 degree (π) rotation in addition to the DQPSK modulation. This is to prevent a DC bias in the modulation in the event that the scrambler hangs up on all '0s' or all '1s' packets. This shall apply to both the 5.5 and 11 Mbit/s modes. The symbols of the MPDU shall be numbered starting with "0" for the first symbol for the purposes of determining odd and even symbols. That is, the MPDU starts on an even numbered symbol. The phase shift for the symbol following the 'flipped' symbol shall depend on the 'flipped' phase, that is, the phase shifts shall be cumulative. To illustrate this behavior, consider the following example of the net carrier phases starting at the first symbol following an odd symbol which was at 0 phase:
for an all '0s' packet: 0 π π 0 0 π π 0 0 π π 0 0...............................
for an all '1s' packet: π π 0 0 π π 0 0 π π 0 0 π ....
For this example we assume that the scrambler is hung and the data is as shown.

12.6.2.4. 5.5 Mbit/s modulation

At 5.5 Mbit/s 4 bits (d0 to d3; d0 first in time) are transmitted per symbol..
The data bits d0 and d1 encode φ_1 based on DQPSK. The DQPSK encoder is specified in Table 5. (In the tables, +jω shall be defined as counterclockwise rotation.). The phase change for φ_1 is relative to the phase φ_1 of the preceding symbol. For the case of the preamble to header transition, the phase change for φ_1 is relative to the phase of the preceding DBPSK (1 Mbit/s) symbol. See the definition in clause 12.6.1 for the reference phase of this Barker symbol. A "+1" in the Barker code shall represent the same carrier phase as a "+1" in the CCK code. All odd numbered symbols of the MPDU shall be given an extra 180 degree (π/2) rotation in addition to the DQPSK modulation.

Dibit pattern (d(l0),d(1)) d(0) is first in time	**Phase Change (+jω)**
00	0
01	$\pi/2$
11	π
10	$3\pi/2$ ($-\pi/2$)

Table 5. DQPSK Encoding Table

The data dibits d2, and d3 CCK encode the basic symbol as specified in Table 6. This table is derived from the formula above by setting $\varphi_2 = (d2^*\pi) + \pi/2$, $\varphi_3 = 0$, and $\varphi_4 = d3^*\pi$. In the table d2 and d3 are in the order shown and the complex chips are shown LSB to MSB (left to right) with LSB transmitted first.

d2, d3									
00	:	1*j*	1	1*j*	−1	1*j*	1	−1*j*	1
01	:	−1*j*	−1	−1*j*	1	1*j*	1	−1*j*	1
10	:	−1*j*	1	−1*j*	−1	−1*j*	1	1*j*	1
11	:	1*j*	−1	1*j*	1	−1*j*	1	1*j*	1

Table 6. 5.5 Mbit/s CCK Encoding Table

12.6.2.5. 11 Mbit/s modulation

At 11 Mbit/s, 8 bits (d0 to d7; d0 first in time) are transmitted per symbol.

The first dibit (d0,d1) encodes φ_1 based on DQPSK. The DQPSK encoder is specified i
Table 6 above. The phase change for φ_1 is relative to the phase φ_1 of the preceding symb
In the case of rate change, the phase change for φ_1 is relative to the phase φ_1 of the preceding CCK symbol or relative to the phase of the preceding DBPSK symbol. See the definition in clause 12.6.1 for the reference phase of the Barker symbols used at 1 Mbit/s. "+1" in the Barker code shall represent the same carrier phase as a "+1" in the CCK code. All odd numbered symbols of the MPDU shall be given an extra 180 degree (π/2) rotation i
addition to the DQPSK modulation. Symbol numbering starts with "0" for the first symbol o
the MPDU.

The data dibits: (d2,d3), (d4,d5), (d6,d7) encode φ_2 , φ_3 , and φ_4 respectively based on QPSK as specified in Table 7. Note that this table is binary, not Grey, coded.

Dibit pattern (d(i),d(i+1)) d(i) is first in time	Phase
00	0
01	π/2
10	π
11	3π/2 (-π/2)

Table 7. QPSK Encoding Table.

12.7. RF channel frequencies

The Network Interface in the 2.4-2.5GHz ISM band uses the channel center frequencies a
defined by the IEEE802.11 PHY standard for DSSS. These channel frequencies and the countries of application. The mini PCI card uses subset channel 1 through 11 as listed in Table 8, which allows usage across the world.

Channel ID	FCC Channel Frequencies (MHz)
1	2412
2	2417
3	2422
4	2427
5	2432
6	2437
7	2442
8	2447

9	2452
10	2457
11	2462

Table 8. IEEE802.11 channel frequencies.

13. RASUI

The MTBF is 150,000 hours based on a workload of 2040 hours/year. This assumes the card does not exceed its ambient temperature ceiling of 60 degrees C.

Agere systems Wireless Communication Network Division

802.11b MiniPCI Driver installation manual

Driver Installation

Before You Start the Installation

Before you start the installation, you are advised to keep the Windows CD-ROM or software diskettes close at hand. If your computer came with a factory-installed Windows operating system, these files will be stored on your computer' s hard disk, in the form of cabinet (*.cab) files.

What You Need to Know

Installing a Mini-PCI Card requires the same level of expertise that you would need to install a standard Ethernet network adapter card. It is assumed that you have a working knowledge of standard Windows 95/98/2000/ME operations and of installing network adapter cards. Refer to the Windows Help when necessary (on the Windows task bar, press the **Start** button and select **Help**).

Driver Installation for Windows 95/98/2000/ME /2000/Millennium

Windows 95/98/2000/ME operating systems support "Plug & Play" for Mini-PCI Cards. Once you insert the Mini-PCI Card into your computer, these operating systems will automatically:

Detect the card, and enable the Driver, or

Start the **Add New Hardware** wizard and prompt you to install the driver, when the operating system cannot find the required driver. This would typically occur when inserting the Mini-PCI Card into your computer for the very first time.

To install the driver proceed as follows:

1. If Windows starts the **Add New Hardware** wizard follow the instructions of the **New Hardware Found** wizard to install the drivers.

When you are prompted to locate the driver installation files:

—Select the CD-ROM that was included with your Mini-PCI Card kit and.

Windows 95:D:\Drivers\Win_95

Windows 98:D:\Drivers\Win_98

Windows 2000:D:\Drivers\Win_98

Windows Millennium:D:\Drivers\Win_98

When finished installing the drivers, Windows automatically opens the **Add/Edit Configuration Profil** window.

2. Continue with setting the basic parameters

.

Windows Network Properties

If this is the very first time that Networking support is installed onto your computer, the Windows operating system will prompt you to enter a computer and workgroup name. These names will be use to identify your computer on the Microsoft Network Neighborhood.

1. The window will pop-up automatically.
2. In the **Computer Name** field, enter a unique name for your computer.
3. In the **Workgroup** field, enter the name of your workgroup.
4. (Optional)To provide a description of the computer in the **Computer Description** field.

For more information about setting your Windows Network Properties, consult your Window documentation or the Windows on-line help information.

Set Basic Parameters

After installing the drivers, Windows will open the Add/Edit Configuration Profile window for you Mini-PCI Card.

The Add/Edit Configuration Profile window enables you to specify one or more network connectio profiles.

For example you can setup profiles for:

Office, to connect to an Enterprise Network via an Access Point.

Workgroup Computing, to share files with colleagues or friends in small Peer-to-Peer workgroup without access point.

Home, to connect to a Residential Gateway (RG) that provides access to the Internet or your hom printers.

To connect your computer to a wireless network you will need to:

1. Assign a name to the network connection profile
2. Use the pull-down menu on the right to select how you wish to connect to the wireless network.
3. Click the **Edit Profile** button to view/modify the parameters for the selected profile.

For first-time installations, you are advised to setup the single profile using only the Basi

NOTE:

The number and type of parameters you need to specify may differ according to the select type.

For information about various option press the key F1 or click the **Help** button.

Basic Settings for Residential Gateway

If you wish to connect to a Home Network via a Residential Gateway, use the Add/Edit Profile window to:

Select to connect to a **Residential Gateway**.

Set the correct **Network Name** and **Encryption Key**.

1. In the field **Network Name** enter the 6-character RG ID to define the same of the wirele which you want to connect. The **Network Name** has to match the unique RG ID (which on the device).

2. In the **Encryption Key** field enter the last 5 digits of the RG ID (default).

NOTE:

If you changed the default Encryption Key on the Residential Gateway (RG) you will nee new value here as well.

3. Click **OK** to confirm and return to the Add/Edit Configuration Profile window.

4. Click **OK** again to finish the installation.

Basic Settings for Peer-to-Peer

Workgroups

If you wish to connect to a Peer-to-Peer workgroup, use the Add/Edit Configuration Profile

n Select to connect to a **Peer-to-Peer Workgroup**.

n Set the correct **Network Name** and **Encryption Key**.

1. In the field **Network Name** define the name of the wireless network to which you want t The Network Name can be any alphanumeric string in the range of "a" to "z", "A" to "Z" a

with a maximum of 32 characters (case-sensitive).

If there is already a Peer-to-Peer group with this name available your computer will automaticall connect to this workgroup.

n If there is not yet such a group available, your computer will automatically start one with this name.

2. Click **OK** to confirm and return to the Add/Edit Configuration Profile window.

3. Click **OK** again to proceed with the installation.

Finish the Installation

When you have finished " Set Basic Parameters" , click the **OK** button to close the Add/Edit Configuratic window and to proceed with the installation process. Windows will finish building the driver configuratic database and copy some files to your computer' s hard disk.

If the Windows operating system prompts you to identify the location of the Windows files, specify tl drive and directory of the Windows Installation CD-ROM or diskettes. When you had a Mini-PCI Ca installed on your computer before, most of these files are already available on your hard disk drive. you do not have the Windows CD-ROM available, you may try replacing the proposed path in the Co Files From dialog box with:

" C:\Windows\System" or " C:\Windows\"

If the Windows operating system prompts you to identify the location of the driver files (typically fi names starting with the characters wv*.v) specify the drive and directory of the Software:

— if installing from the CD-ROM specify the drive in one of the following directories on the Softwa CD-ROM.

Windows 95:D:\Drivers\Win_95

Windows 98:D:\Drivers\Win_98

Windows 2000:D:\Drivers\Win_98

Windows Millennium:D:\Drivers\Win_98

—if installing files that you downloaded from the Internet, point to the disk drive or directory where yc saved the downloaded files.

When Windows has finished the copying of files, it will prompt you to restart your computer. Click tl **OK** button to restart your computer.

After Restarting Your Computer

After you have restarted your computer, the Windows operating system will detect the Mini-PCI Ca Load the driver, in a dialog box enter a Windows user name and password. The password you en here will be the one used to login to the Windows Network Neighborhood.