SNAP2410/2414/2420 Spread Spectrum Network Access Points

Installation Guide

April 20, 2000

Transmitter Module FCCID: HSW-2410M.

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INTRODUCTION

The SNAP2410 family of products from Digital Wireless Corporation provides Ethernet connectivity to networks of WIT2410 radios. Built around the WIT2410, SNAP products provide a 10BaseT connection to Ethernet networks and function as base stations for remote devices containing WIT2410 transceivers. By supporting seamless roaming, multiple SNAPs can be connected to a network to provide practically unlimited coverage area. To simplify system installation some SNAPs have built-in 4-port hubs with an uplink port. In addition, these SNAPs allow for power to be distributed through the hub ports.

Depending on the model, SNAPs have one or two WIT2410 transceivers. Each radio can support 62 simultaneous remotes. Thus SNAPs can support up to 124 simultaneous remotes. Each remote radio has a unique ID number, so the number of remotes that can communicate with a SNAP is unlimited, subject to a limit of 62 remotes at any one time.

The communication between the SNAP and the WIT2410 remotes is performed using the WIT2410 over-the-air protocol. Thus the SNAP products are 802.3 compatible but not 802.11 compatible. By using the 460Kbps over-the-air data rate the WIT2410 protocol, the full range of WIT2410 radios is realized, three times the range of most 802.11 products.

The SNAPs enjoy the same benefits of frequency-hopping spread spectrum technology that the WIT2410s do. Namely, the immunity to multipath fading and resistance to jamming that is provided by changing frequency every few milliseconds. Operating in the 2.4GHz ISM band, SNAPs can be used license-free worldwide and are not subject to the congestion in the 900MHz band caused by cordless telephones.

The SNAP has two modes of operation, AP and PPP. The default mode is the AP mode. In this mode the SNAP uses a special protocol mode called SDP(SNAP Datagram Protocol). In order to send receive or transmit data from the SNAP, the application software must use this protocol. The user may use the API roam library included with the SNAP to help shorten software development.

The SNAP can also be configured as a PPP server. This allows any computer with a remote to connect to the same network as the SNAP. These computers then could access any files on the network and support browser-based applications.

GETTING STARTED

The SNAP family of wireless Ethernet modems are easy to install and operate. In most instances, the only installation steps will be setting IP addresses, selecting one modem as the master and connecting the antenna, power and Ethernet cable.

Connecting the SNAP

Figure 1 identifies the various connectors on the rear of the SNAP2410.
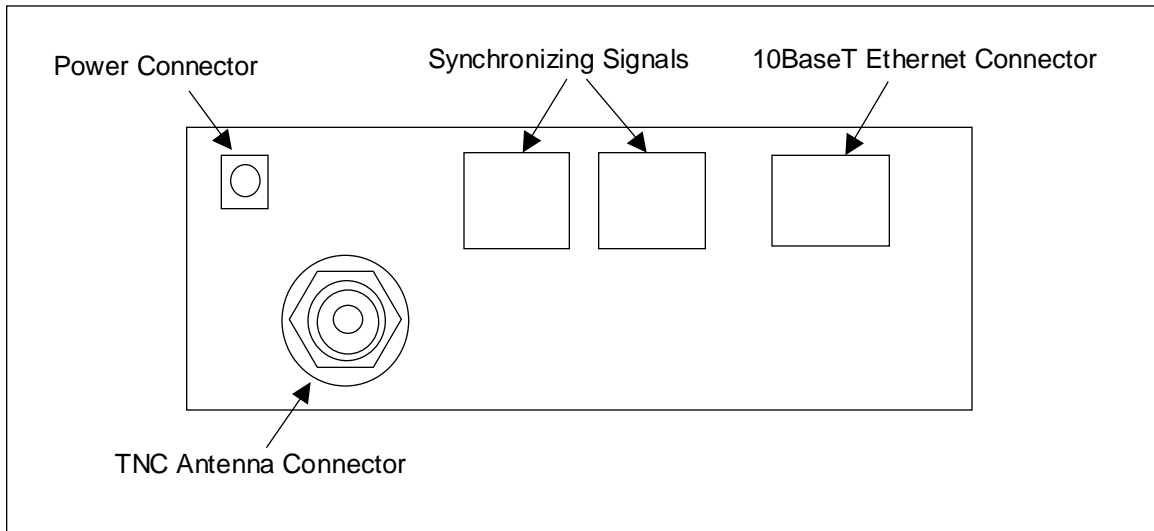
Figure 1. SNAP Rear Panel Diagram

The antenna connector is a TNC type connector. An antenna may be connected directly to this connector. Alternatively, an antenna may be located away from the SNAP using RF cable to connect the SNAP to the antenna. Digital Wireless does not recommend using RF cables longer than 5 feet. If more distance is required between the SNAP and the antenna, high-quality, low-loss RF feed line must be used.

The 10BaseT Ethernet connector is the standard RJ-45 connector. The connector is wired to be able to connect directly to an Ethernet hub using a straight-through cable. If it is desired to connect the SNAP directly to a PC without a hub, the SNAP must be connected with a cross-over cable.

The synchronizing signals are provided for special applications where multiple master SNAPs are employed in an environment with slave SNAPs that are moving. The synchronizing signals are RS-485 levels and may be connected using an RJ-11 connector. In most instances the synchronizing signals are not required and may be left unconnected.

The power connector is a 2-pin DIN type connector. The provided AC adapter provides a 9 volt power level to the SNAP. The SNAP can accept DC voltages ranging between 7VDC and 26VDC if alternative power supplies are to be used.
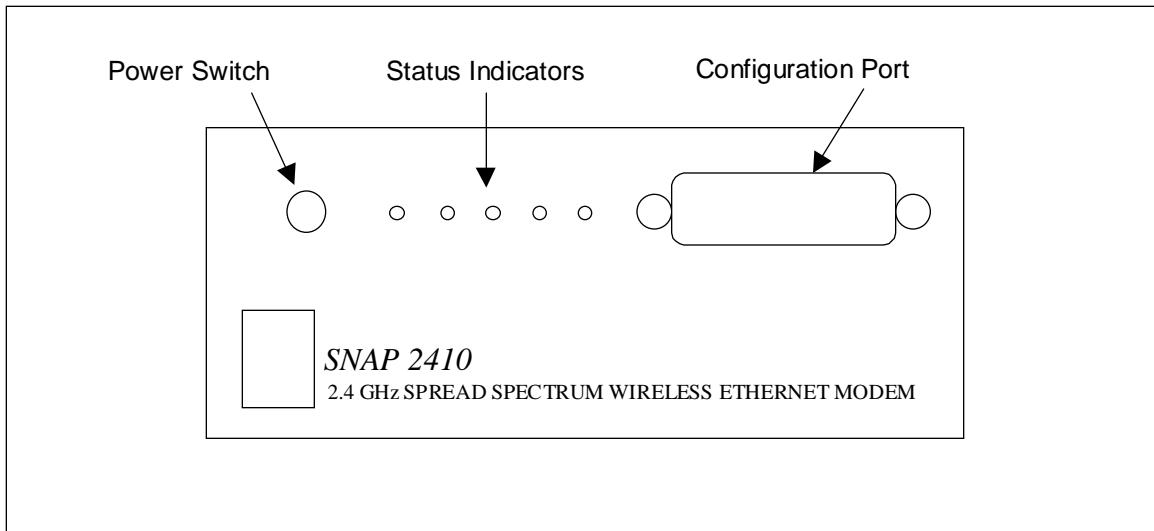
Figure 2. SNAP2410 Front Panel Diagram

The Configuration Port is an RS-232 serial port that may be used to configure the SNAP. This is useful when the default IP address of the SNAP cannot be used with the existing network preventing configuration through a telnet session. See the section *Configuring the SNAP* for details of using this port.

SNAP Status Indicators

The PWR indicator on the front panel indicates that power is applied to the SNAP and that the power switch is in the ON position.

TXD and RXD are indicators of data activity. They indicate the transmission and reception of data over the Ethernet connection. Note that these LEDs can be active even when the SNAP has no remote radios registered.

The COLL indicator is illuminated whenever packets collide on the network segment to which the SEM is connected. As such, this is rough indicator of the level of traffic on the network segment. If this LED is glowing brightly on a continuous basis, the throughput of the SEM may appear to be reduced.

The LINK indicator when illuminated indicates a good connection to the Ethernet network. If this LED is not on, it can indicate a cross-wired connection between the SNAP and the network. It may also indicate a faulty cable connection.

Configuring the SNAP

SNAPs are shipped from the factory with default settings that include a default IP address of 192.168.0.254. The network that the SNAP is connecting to must be compatible with 10BaseT products. The SNAP **will not** work if the network only supports 100BaseT products. Before connecting a default configured SNAP to an active network, ask the network system administrator to make sure that the default IP number will not cause any

problems on the network and that the SNAP will be recognized by the network. If the default IP address conflicts with a device on the existing network, the SNAP will need to be configured through the serial port.

The SNAP can be configured two ways. The first is through the serial port. The settings for the serial port are 38400 baud, 8 data bits, 1 stop bit, and no parity. WinSNAP will automatically find the appropriate serial port and configure the serial port settings for you. The software will inform you of its progress and any problems that arise. After a few seconds the SNAP firmware version is displayed followed by the `SNAP>` prompt.

The second configuration method is through a telnet session. Most telnet programs work with the SNAP. Windows 95/98/NT/2000 have a telnet program that works with the SNAP. If there are no conflicts with the default IP number, initiate a telnet session to the SNAP. A telnet session can be started by clicking on Start->Run if you have Windows 95/98/NT/2000 and the TCP/IP client has been installed. Enter the following information in the dialog box:

```
telnet 192.168.0.254
```

A telnet window will open up. The first line is the version of the SNAP firmware followed by the prompt:

```
SNAP>
```

To change the IP number of the SNAP, use the *ip* command.

```
ip <xxx.xxx.xxx.xxx> {yyy.yyy.yyy.yyy}
```

Where x is the new IP address, and y is the optional netmask number.

Store the changed configuration parameters in non-volatile memory with the *save* command:

```
save<CR>
```

The SNAP will report back the time it took to the save the information. Reset the SNAP by typing:

```
reset<CR>
```

The SNAP can also be reset by cycling power. Whenever a reset is executed on the SNAP, the telnet session will be lost. It will take the SNAP about 30 seconds to reinitialize after a reset or after cycling power.

Note: The save and reset commands must be entered after modifying the default configuration. Failure to do so will result in the factory defaults to be used.

SNAP OPERATION

Overview

At the most basic level, SNAPs can be thought of as Ethernet-to-serial interface adapters. That is, they take data from a host application over a 10BaseT Ethernet connection, remove the Ethernet header information, format the data for WIT2410 radios and transmit the data to the on-board WIT2410 through a high-speed serial interface. In the other data flow direction, the on-board WIT2410 receives data from a remote WIT2410 device. The SNAP takes this data and provides the necessary Ethernet datagram encapsulation and transmits the datagram to the host application over the connected network.

A SNAP can be used standalone, or a group of SNAPs can be connected together through a 10BaseT hub to provide seamless roaming over a larger area. When seamless roaming operation is desired, the SNAPs must be synchronized with each other. This synchronization is accomplished either over the Ethernet network or through a differential Sync signal when time delay devices (such as routers) are between SNAPs. See the section on Synchronization for details.

Communication between the host application SNAPs can occur at one of two levels. Provided with the SNAP is a library of C routines that constitute a high level API for workstation-based applications. Alternatively, host applications can communicate with a SNAP using the SNAP Datagram Protocol (SDP). This protocol is described in detail later in this manual.

The SNAP has a serial Configuration port in addition to the 10BaseT port. This port allows configuration of the SNAP without having to connect it to a network. The WinSNAP configuration utility provided with the SNAP is used to configure the SNAP through the serial Configuration port. Any configuration of the SNAP can be performed using either the Configuration port or over the network.

TCP/IP Addresses

Each SNAP must be configured with a unique IP address that is appropriate for the network where the SNAP will be used. The IP address can be set using the *ip* command through the serial-port interface. The *ip* command takes one or two parameters. The first parameter specifies the IP address for the SNAP, and the second optional parameter, if present, specifies the netmask for the SNAP. If the second parameter is not used, the netmask is set to the default netmask for the IP address specified. For example, the command:

```
ip 192.168.0.1
```

will set the SNAP's IP address to 192.168.0.1 and the netmask will remain 255.255.255.0.

The command:

```
ip 192.168.1.233 255.255.255.192
```

will set the SNAP's IP address to 192.168.1.233 and will change the netmask to 255.255.255.192. The *ip* command without any parameters will display the current setting of the IP address and netmask. The SNAP includes a simple *ping* command that can be used to test the IP address and routing table settings.

The SNAP can also obtain its IP address from a BOOTP server if one is present in the network. The BOOTP server will require the Ethernet hardware MAC address to be able to assign the IP address to the SNAP. The Ethernet hardwate MAC address of the SNAP is configured as 00:30:66:XX:YY:ZZ, where XX:YY:ZZ is the unique ID of the SNAP's "radio A".

The *route* command can be used to modify and display the IP routing table entries. To display the routing table, use the *route list* command. There will always be one entry in the routing table that corresponds to the IP address of the SNAP. For most applications, if any routing table entries are required, it will be sufficient to set a default route. To set the default route, use the command:

```
route add default <gwaddr>
```

where <gwaddr> is the IP address of the default gateway (usually a router or routing host). To remove the default route, use the command "route del default". To add a route to a particular network or host, use the command "route add <dest> <gw> [<netmask>]", where "<dest>" is the destination network or host IP address, "<gw>" is the IP address of the gateway, and the optional "<netmask>" is the netmask which defines the destination network.

Seamless Roaming

The SNAP2410 allows remote radios to seamlessly roam between multiple SNAP2410. The remote radios can also be configured not to roam if this is the required operating condition. In order for the remote to be able to roam seamless the <wg> parameter must be set to 2. When the RSSI (receive signal strength indictor) of the remote reaches a certain threshold, the remote will start looking for another SNAP with a higher RSSI. The SNAP will be notified with a CONNECT and DISCONNECT packet when a remote leaves or connects with a SNAP.

To facilitate seamless roaming among a group of SNAPs, the SNAPs use Ethernet packets to synchronize time relative to each other. A single "master" SNAP will broadcast (or multicast) special UDP datagrams to the "slave" SNAPs to deliver timing information through the network. The SNAPs can also synchronize with one another by RJ-11 cable (telephone cable). The RJ-11 method of synchronization uses a daisy chain fashion to connect the SNAPs together. The SNAPs need to be synchronized this way if

the ethernet packets can not be transmitted in a timely manner, such as going through a router.

Synchronization

The SNAP uses broadcast or multicast datagrams for time synchronization. The default is for the master SNAP to broadcast datagrams to the 255.255.255.255 all-hosts IP broadcast address. Using the "sys xcast <ipaddr>", SNAPs can be configured to use a more limited IP broadcast address, or a multicast address. All SNAPs in a network should be configured with the same "xcast" address. The use of multicast addresses is preferred so that synchronization datagrams do not interfere with hosts other than the SNAPs. Note that the SNAPs use UDP port 2410 as the source and destination UDP port numbers in the synchronization packets.

The command "sync master" is used to set a SNAP to the master for time synchronization, and the command "sync slave" is used to set a SNAP to be a slave for time synchronization. There should be one master in a given network, even if there is only one SNAP in the network.

There may be a time when there will be SNAP on different sides of a network router. This situation could cause the SNAPs not to be synchronized. This is where the RJ-11 sync connectors can be used. If the remotes will need to be able to roam between the SNAP located on different sides of the network router, the SNAP will have to be connected together using the RJ-11 connectors. The cable will only need to be two twisted pair. This is the same as regular phone cable. If there are more than two SNAPs in the network, the SNAPs will need to be daisy chained together.

AP Mode Operation

The default operating mode of the SNAP is AP mode. This mode is optimized for communications between a workstation or workstations on an Ethernet network and a network of WIT2410-based devices. The AP mode assumes that there is limited intelligence in the remote host. The AP mode is designed to allow the remote host devices to send and receive data to the remote WIT2410 in transparent mode.

Data exchanges between the SNAP and workstations on the network are made using the SDP protocol. This protocol is described in detail later on in this manual. To shorten software development time, a C library is included that will help with the SNAP protocol. **roamlib** will help in the developing the software needed to talk to the remote radios from the SNAP. Also included is a simple multi-window (one per remote) ethernet chat program, **roam.exe**. This program allows the user to send data to the SNAP and to the remote. This program is based on the **roamlib**. In order for roam.exe to work the "sys xcast" must be 224.5.5.5, the "sdp" must be 224.1.2.3 and the source and destination port numbers must be 2411 and 2412 respectively. These are the default settings. Using the roam library requires the use of winsock.dll. This file should already be included on any Windows 95/98/NT PC that has TCP/IP installed as a protocol.

PPP Operation

The SNAP can be configured to operate as a PPP (Point-Point Protocol) server. PPP is a dial-in network connection that allows TCP/IP communication. A PPP connection allows a remote connected to a computer to be connected to network that the SNAP is on using the TCP/IP protocol. In order to operate the SNAP as a PPP server, the following sequence of commands must be entered.

sys mode PPP
save
reset

The SNAP will also allow the user to specify the starting IP address for the remotes that logon. The first remote to logon will receive the IP address specified below. The SNAP will then add one to the IP address for the next remote to login.

ppp base <IP address>

Included in the appendix is a listing of a Windows modem definition file. This inf file will work on Windows 95/98/2000/NT for a remote WIT2410 modem device connected to a serial port. The WIT2410-based modem device needs to be added as a new modem using the standard Windows procedures. When installed, Windows dial-up networking can be used to create a PPP session between the remote PC and the SNAP. The PPP mode of the SNAP also works with various versions of UNIX and LINUX. Contact Digital Wireless Technical Support for details.

4-Port Hub

The SNAP2414 model includes a built-in 4-port hub. Even though there are 5 ethernet ports, only four of them can be used. There is an uplink port that can be used to connect to another SNAP or hub. This uplink port is connected to the 4th ethernet port. The hub will not work correctly if a connection is made to both of these ports. This hub will only support 10BaseT networks.

SNAP COMMAND SET

The SNAP supports a series of commands that allow for configuring the Ethernet interface as well as the radio parameters of the on-board WIT2410. These commands can be entered during a telnet session or by using the WinSNAP24 utility when the SNAP> prompt is displayed. The commands are summarized here with detailed explanations following.

SNAP System Commands

Command	Description
echo	Toggles user screen echo mode
help	Displays command help screen
reset	Resets the SNAP activating changed configuration parameters
save	Stores current configuration to memory
sys [help	Displays help screen for command
mode [AP|PPP]	Sets SNAP to Access Point or PPP server mode
outmax <1-212>	Set maximum transmit packet length
xcast [	Shows broadcast/multicast address
<b/mcastaddr>]	Sets broadcast/multicast address
version	Diplays SNAP firmware version

echo   Toggles the user screen mode to echo characters typed by the user. Default is on. If echo is turned off, characters typed will not be displayed on the screen unless echoed by the terminal program.

help   Displays a list of all the SNAP commands. Most commands that require a parameter also have a help mode that displays the help screen for that command.

reset   Resets the SNAP and loads saved parameters into active memory. Also causes the SNAP to reinitialize which can take 30 seconds. If reset is issued before the save command, the new parameters are lost and the last saved parameters are used.

save   Saves changed parameters in non-volatile memory to be loaded on power up. Must be issued before the reset command or cycling power to have changed parameters take effect. (An exception is the sys outmax command which becomes active immediately after it is entered.)

sys   These commands modify system operation parameters. The **mode** subcommand is used to select the AP or PPP mode of operation. **outmax** sets the length in bytes of the packets the processor in the SNAP will send to the internal radio. This value cannot be longer than the **pktlen** value set in the radio. Refer to the section on radio commands for details of the *Set Base Slot*

Size command. The xcast subcommand is used to set the multicast address to be used when the SNAP puts data out on the network.

version   Displays the SNAP firmware version.

Ethernet Commands

Command	Description
arp –a	Displays arp table
-d <ipaddr>	Deletes arp entry
-s <ipaddr> <eaddr>	Adds arp entry
ip [	Displays current SNAP IP address
<ipaddr> <netmask>]	Sets SNAP IP address and optionally the netmask
password	Sets password for telnet sessions
ping <ipaddr>	Pings TCP/IP host
route [help	Displays help screen for command
add <ipaddr|default> <gwaddr> <netmask>	Adds IP address and netmask to route list
del <ipaddr>	Deletes IP address from route list
list	Lists route IP addresses
socks	Displays network socket information

arp   Manipulates the address resolution procedure table. This command is provided primarily as a debugging tool for setting up networks. **ipaddr** is the device IP address and **eaddr** is the physical Ethernet address of the device

ip   Sets the IP address of the SNAP. The default IP address is 192.168.0.254. When specified **netmask** sets the netmask number. The default netmask is 255.255.255.0.

password   Allows a password to be set to restrict the ability to initiate telnet sessions with the SNAP. When this command is entered, the user is prompted for a new password which is then prompted for a second time for verification. If this password is forgotten, a new password must be entered through the configuration port.

ping   sends inquiry packets to TCP/IP host specified in <ipaddr> and displays the amount of time that elapsed before a response was received. Continuously sends requests until a key is pressed.

route   Displays and manipulates gateway IP addresses to route IP traffic off the subnet. *Default* sets the default gateway IP address. When an IP address is entered instead of *default*, the gateway IP address specified will be used only for traffic destined for that IP address. The route table always has an entry associated with the IP address assigned to the SNAP.

socks   Displays the network socket information.

SNAP Radio Commands

Command	Description

`hop [help`
`    length <hoplen>`
`    sequence [75|25]`
	Displays help screen for command
	Informs SNAP of radio hop dwell time
	Informs SNAP of number of frequencies in radio hop pattern

`radio [A|B] [ help`
`          banner`
`          network`
`          cfg]`
	Displays help screen for command
	Displays the banner of the specified radio
	Displays the network number (wn) of specified radio
	Enters radio command mode

`remote [help`
`      list`
`      send <handle> <data>]`
	Displays help screen for command
	Displays remotes currently registered with the SNAP
	Sends data to the remote specified by the handle

`sync [help`
`    ether`
`    master`
`    override`
`    settings`
`    slave`
`    wire]`
	Displays help screen for command
	Sets synchronization mode to use Ethernet packets
	Sets SNAP as synch master
	Toggles master backup override
	Displays synchronization settings
	Sets SNAP as synch slave
	Sets synchronization mode to use RS-485 wire ports

hop   Used to inform the SNAP of the hop dwell time or the number of frequencies in the hop pattern of the radio in the SNAP. The parameter entered for **length** is in $625\mu s$ increments. The hop time specified by **length** should agree with the time specified by the **ph** parameter in the radio. **ph** is the hexadecimal value of the number of 69.4 μsec ticks in the dwell time. Thus for each increment in **length**, the **ph** parameter should be increased by 9. A value of **16D** corresponds to a hop dwell time of 10 msec and is the default. The **sequence** is the number of hop frequencies in the hop pattern in the radio in the SNAP. The default is 75 for US/ETSI operation. All other frequency bands, as set in the radio by the `pe` command, have 25 frequencies in their hop patterns. This value is entered as a decimal number. Neither the length nor the sequence need to be modified unless they are modified in the radio in the SNAP.

radio   Displays information about the configuration of the radio in the SNAP or puts the radio in configuration mode. `A` or `B` must be specified to identify to which of the two possible radios in the SNAP the command is directed. The `banner` command returns the firmware version number and the serial number of the radio in the SNAP. When cfg is entered, the specified radio is put into configuration mode. The SNAP> is replaced with just a > prompt. At this point radio configuration commands may be entered. Refer to the section on radio commands in this manual for the radio commands pertaining to the SNAP. Refer to the WIT2410 Integration Guide for a complete listing of radio commands.

remote   This command lists the currently registered remotes by the serial number of the remote radio and the assigned handle. The send subcommand will send the specified data to the remote with handle specified in the command. This is intended as a debugging mode and not an operational mode.

sync   These commands set the operation of the synchronization signal used in multi-SNAP networks implementing seamless roaming. `ether` and `wire` are mutually exclusive commands and set the synchronization to occur over the Ethernet or over the RS-485 signal lines. One SNAP must be configured as the sync master and all others must be configured as sync slaves. `override` toggles the master backup override on and off.

AP Mode Commands

These commands are unique to the AP mode of operation. Each command is preceded by `sdp`.

Command		Description
sdp	help	Displays help screen for command
	add <sdp> <ipaddr> <dstprt> <srcprt>	Add an SDP entry
	cache <size>	Set number of cached SDP output packets
	delete <sdp>	Delete an SDP entry
	list	List SDP entries
	max <size>	Set SDP maximum packet size

help   Lists the various commands available under the sdp top level command.

add   Defines the IP address and port numbers that the SNAP will use when sending and receiving SDP messages. A maximum of 4 SDP entries may be set up. They can be either unicast or multicast addresses.

cache   Allows the number of datagrams cached by the SNAP to be modified. Cached datatgrams may be requested to be retransmitted by workstations.

delete   Removes an SDP entry.

list   List SDP entries and their associated IP addresses and port numbers.

max   Sets the maximum number of bytes of data that will be included in a SDP datagram before the datagram is sent. If 20ms elapses since the last byte received, the datagram will be sent regardless of the number of bytes in the datagram.

PPP Mode Commands

These commands are unique to the PPP mode. They are preceded by **ppp**.

Command		Description
ppp	help	Displays help screen for command
	acct method `[local|radius]`	Displays accounting method currently in use Sets accounting method to local or Radius
	auth method `[local|radius]`	Displays authentication method currently in use Set authentication method to local or Radius
	base `<ipaddr>`	Sets base IP address for SNAP
	count `<1-62>`	Displays PPP base allocation count Set to max number of remotes parameter of radio

	radius help
	     add `[auth|acct]`
	         `<ipaddr> [port]`
	     delete `[auth|acct] <ipaddr>`
	     port `[auth|acct] <ipaddr>`
	         `<port-number>`
	     secret `[auth|acct] <ipaddr>`
	         `<secret>`
	     settings
		Displays help screen for command
		 Adds IP address of Radius server for
		 authentication or accounting
		
		 Deletes IP address of Radius server
		 Sets the port number for a Radius server
		
		 Sets the secret for a Radius server
		
		 Displays Radius servers settings

	status	Displays status of registered users
	timeout `<time>`	Sets idle time timer in tenths of seconds

	user help
	     add `<usr>`
	     delete `<usr>`
	     disable `<usr>`
	     enable `<usr>`
	     list
	     password `<usr> <pwd>`
		Displays help screen for command
		 Adds a PPP user
		 Deletes a PPP user
		 Disables a PPP user
		 Enables a PPP user
		 List current PPP users, both enabled and disabled
		 Set PPP user password

help   Displays the subcommands for the PPP mode.

acct   Displays/sets the accounting method to be used for IP traffic. When set to
            local, the SNAP keeps track of the amount of data traffic and time used by
            each user. When set to radius, the accounting information is sent to the
            designated accounting Radius server.

auth   Displays/sets the authentication method to be used when users sign on. When
            set to local, the password entered by the user when establishing the PPP
            session must agree with the password entered for that user in the SNAP.
            When set to Radius, the password entered by the user is sent to the
            designated authentication Radius server.

base | Sets base IP address for IP addresses to be assigned to remotes when in PPP server mode. The base address is assigned to the first remote that registers with the SNAP. The next remote to register is assigned the base IP address incremented by one.

count | Displays/sets the PPP base allocation count. This number must be equal or larger than the maximum number of remotes the radio as it determines the number of buffers the SNAP will set up to assemble SNAP datagrams.

radius | These commands are used to set up one or more Radius servers to perform authentication and accoutning functions. Separate servers may be used for each function.

status | This command displays the status for all currently registered users including the IP address assigned to the user, the serial number of the remote radio, the number of bytes and packets received and sent as well as bad packets.

timeout | This command allows the SNAP to terminate the PPP session of an idle remote after the specified amount of time. Time is specified in tenths of seconds, thus a value of 600 corresponds to one minute. If the value is set to zero, the timeout feature is disabled.

user | Manipulates users that are entitled to connect to the SNAP. Also sets the password for each entered user. `usr` and `pwd` can be any alphanumeric string up to 32 bytes in length. When a new user is added, a password must be assigned and the user must be `enabled` before access will be granted. A password must be assigned even if a Radius server is to perform authentication. There is no way to display passwords. If a password is forgotten, a new password must be entered.

RADIO MODEM CONFIGURATION

The "radio" command provides access to several sub-commands that are useful in configuring the WIT2410(s) in the SNAP. The format for the radio commands is `radio {A|B} <sub-cmd> [<sub-cmd-args>]`, where the `{A|B}` is either of the letters 'A' or 'B' used to specify to which radio the sub-command should be applied. The SNAP2410/2414 uses only radio 'A' and the SNAP2420 uses both radios 'A' and 'B'. The command `radio {A|B} banner` can be used to display the banner from the radio. This is useful in determining the unique ID of the radio and the version of firmware running in the radio.

The command `radio {A|B} cfg` gives access to the configuration mode of the WIT2410. When configuration mode is entered, the `SNAP>` prompt becomes just a `>` prompt. To exit radio configuration mode, press the ESC key on the upper left portion of the keyboard. The `SNAP>` prompt will return.

Radio Commands

The radios in the SNAP are set with factory defaults which should be sufficient for most applications. For other applications, the following radio commands can be used to fine tune the performance of the SNAP.

Command	Description
`dx [?|0-62]`	Set range optimization
`ph [?|0-fe]` (base only)	Sets the hop duration in 69.4us increments. `90H` = 10ms (default)
`pw [?|0-35]` (base only)	Set Base Slot Size 35H = 212 bytes (default)
`wn [?|0-63]`	Sets the network number (hopping pattern) 0 = default

Set Range Optimization
For ranges in excess of 0.9 miles, this command optimizes the over-the-air timing to provide the most robust communications. The diagram below illustrates how the parameter works:

$$x\text{-}0.6 \qquad\qquad\qquad\qquad x \qquad\qquad\qquad\qquad x\text{+}0.9$$
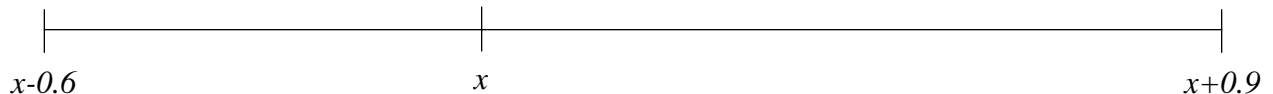
where x is 10 times the number of miles (mod 64) around which the 1.5 mile range is desired.

Set Hop Duration
Sets the length of time the transceiver spends on each frequency channel. A smaller value will allow the remote to lock on to the base signal faster at startup and will generally decrease packet latency. A larger value increases network capacity due to decreased overhead in channel switching. The hop duration is specified in 69.4us increments. The

default value of **90H** corresponds to a duration of 10ms. The maximum value of **FEH** is 17.627ms. For best results do not specify a duration of less than 3ms. This value only needs to be changed in the master SNAP radio which broadcasts the parameter to all slave device radios. However, the SNAP command **hop length <hoplen>** must be used to set the new hop duration in the SNAP processor of each slave SNAP. Initial link time can be reduced if this value is set in the slave radios which will use it as a starting value when scanning for a master.

Set Base Slot Size (master radio only)
Sets the amount of time allocated for transmission on each hop for the SNAP radio time slot in 69.4us increments. Each increment corresponds to 4 bytes. Maximum value is **35H** which corresponds to 212 bytes. This is the default value and should only be changed to provide more throughput for the slave device(s) at the expense of the master device throughput.

Set Network Number (hopping pattern)
The radio in the SNAP has 64 preprogrammed hopping patterns or network numbers. By using different network numbers, nearby co-located networks can avoid interfering with each others' transmissions. Even if both networks tried to use the same frequency, on the next hop they would be at different frequencies.

SNAP DATAGRAM PROTOCOL (SDP)

Overview

The SNAP Datagram Protocol (SDP) is a UDP (datagram) protocol implemented in the SNAP to communicate remote radio data to and from workstations on the network. The use of UDP datagrams permits the SNAP to unicast, multicast, or broadcast remote radio data to multiple workstations on the network. The SDP datagrams transmitted by the SNAP are sequenced so that a receiving workstation can detect datagrams that do not get delivered. The SNAP caches *SdpCache* number of datagrams so that a receiving workstation can request a retransmit of a particular datagram. The number of cached datagrams, *SdpCache*, defaults to eight and can be configured on the SNAP.

A specific unit of information regarding the SDP or a remote radio is referred to as a "message" and are defined in detail below. Each SDP datagram consists of a header and one or more messages. The sum of the lengths of the header and all of the messages within the datagram will not exceed *SdpMax* bytes, which is a configurable parameter and defaults to 512 bytes. The SNAP builds a datagram as the messages accumulate. As the SNAP builds a datagram, if the next message to be added to the datagram will cause the datagram to exceed *SdpMax* bytes in length, the datagram currently being built is transmitted by the SNAP to all recipients. The SNAP then begins building a new datagram with the current message. If 20 milliseconds elapse after the last message is added to the datagram being built, then that datagram is transmitted by the SNAP to all recipients. If there are no messages to send for 500 milliseconds after the last datagram has been transmitted, the last datagram is retransmitted by the SNAP to all recipients. If there are still no messages to send for 1 second after this, the last datagram is once again transmitted by the SNAP to all recipients. The retransmission of the last datagram aids in the detection of datagrams that fail to be delivered.

Datagrams that are sent by workstations to the SNAP(s) have a similar format to those sent by the SNAP to the workstations. There is currently no provision for acknowledgement or request-for-retransmit of datagrams sent by workstations to the SNAP. One of the messages that a workstation may send to a SNAP in a datagram is used to request the retransmission of a datagram. If the datagram indicated by the sequence number in the request is currently cached by the SNAP, that datagram will be transmitted by the SNAP directly to the host requesting the retransmission.

SDP Header

The header for an SDP datagram is eight bytes long. The first four bytes are a magic number in network byte order which is used to identify/qualify the datagram. When transmitting a datagram, the SNAP places the value SDP_SNAP_MAGIC in the magic field of the header. When receiving a datagram, the SNAP expects the value SDP_USER_MAGIC in the magic field of the header. The next byte is the sequence number which increments for each datagram transmitted by the SNAP. The next three bytes of the header are the unique-ID of the "radio A" for the SNAP.

```
#define SDP_SNAP_MAGIC  (0x736470030l)   /* 'sdp0' */
#define SDP_USER_MAGIC  (0x534450030l)   /* 'SDP0' */

typedef unsigned char byte;

typedef struct {
   ulong magic;
   byte seq;
   byte base_id[3];
} sdphdr_t;
```

SDP Messages

Each "message" that is contained within an SDP datagram consists of a *type* byte, a *length* byte, and some number of parameter bytes depending upon the type of the message. The values for the *type* byte are specified below. The *length* byte specifies the length of the message and includes the type and length bytes. There are seven message types defined for SDP:

TYPE	*SENT-BY*	*Function*
SDP_SM_STARTUP	SNAP	indicates SNAP startup / SDP initialization
SDP_SM_CONNECT	SNAP	Remote radio has connected
SDP_SM_INPUT	SNAP	Data from remote radio
SDP_SM_DISCONNECT	SNAP	Remote radio has disconnected
SDP_UM_STARTUP	Workstation	Indicates workstation startup
SDP_UM_RESEND	Workstation	Requests retransmission of SDP datagram
SDP_UM_OUTPUT	Workstation	Data for remote radio

SDP_SM_STARTUP

Byte	*Value*
0	Type = 's' (0x73)
1	Length = 4
2	<cache> (The number of datagrams the SNAP will cache)
3	<user-request>

When the SNAP is powered on, it will transmit an SM_STARTUP message. The value for <user-request> at this time is 0. When a workstation starts-up (or an application on the workstation which uses SDP to talk to the SNAP) it will send a UM_STARTUP message. At this time, the SNAP will transmit an SM_STARTUP message with a <user-request> value of 1 followed by an SM_CONNECT message for each remote radio currently "connected" to the SNAP. [In future releases, this will be followed by an

SM_STARTUP message with a <user-request> value of 2].   This allows the workstation software to become aware of remotes that are present in the network. This message will always be the first message in an SDP datagram.

SDP_SM_CONNECT

Byte(s)   Value
0   Type = 'c' (0x63)
1   Length = 7
2-4   Unique-ID of remote radio
5   Receive sequence number for remote radio
6   Transmit sequence number for remote radio

The SM_CONNECT message is transmitted by the SNAP when each remote radio connects to a base radio in the SNAP. This message type is also transmitted by the SNAP for each radio currently connected to the base radio(s) in the SNAP following a UM_STARTUP message from a workstation.

SDP_SM_INPUT

Byte(s)   Value
0   Type = 'i' (0x69)
1   Length = 7 + <number of data bytes>
2-4   Unique-ID of remote radio
5   Sequence number for data (modulo 16)
6   Length of data to follow (perhaps redundant)
7-N   Data bytes from remote radio

The SM_INPUT message is transmitted by the SNAP to communicate remote radio data to the workstations.

SDP_SM_DISCONNECT

Byte(s)   Value
0   Type = 'd' (0x64)
1   Length = 5
2-4   Unique-ID of remote radio

The SM_DISCONNECT message is transmitted by the SNAP to indicate that a remote radio has disconnected from the base radio in the SNAP. Note that the remote may have already roamed to another SNAP. The workstation should only act on the SM_DISCONNECT message if it currently has the source of this message as the SNAP that owns this remote radio.

SDP_UM_STARTUP

Byte   Value
0   Type = 'S' (0x53)
1   Length = 2

A workstation application will transmit this message (as a unicast, broadcast, or multicast) when it initializes, prompting the SNAPs on the network to send the current state of remote radios currently connected to each SNAP (i.e. an SM_STARTUP message followed by SM_CONNECT messages). For multicasting UM_STARTUP messages, the workstation should use the multicast address as set by the "sys xcast" command (see the section above on Synchronization), as the SNAP will be receiving datagrams at this multicast address.

SDP_UM_RESEND

Byte   Value
0   Type = 'R' (0x52)
1   Length = 3
2   Sequence number of datagram to retransmit

A workstation will use this message to request that a SNAP retransmit an SDP datagram that the workstation may not have received. The third byte of this message indicates the sequence number of the SDP datagram that the workstation did not receive. The workstation will detect that it has not received an SDP datagram when it receives a datagram out of sequence but within the window defined by the "cache" setting of the SNAP. This message should be unicast to the particular SNAP from which the workstation has missed a datagram.

SDP_UM_OUTPUT

Byte(s) Value
0   Type = 'O' (0x4F)
1   Length = 6 + <number of data bytes>
2-4   Unique-ID of remote radio
5   Number of data bytes to follow (perhaps redundant)
6-N   Data to be transmitted to remote radio

A workstation uses the UM_OUTPUT message to send data to a remote radio. The number of data bytes specified and contained in this message must not exceed the base radio's setting for the maximum transmit packet size. This message may be broadcast or multicast to multiple SNAPs as the SNAP will ignore this message if the remote radio with the Unique-ID contained in the message is not currently connected.

TROUBLESHOOTING

Connect LED is not on.
Check the power LED on the SNAP. Check the ethernet cable, making sure that it is fully connected. Check

Cannot telnet to SNAP.
Check the power LED on the SNAP. Check the ethernet cable, making sure that it is fully connected.   Make sure the SNAP has a unique IP number on the network and one that is valid for the network, ie, that can be seen through switches, hubs and routers.

Cannot communicate with a remote radio.
Check the list of registered remotes on the SNAP to make sure the remote is registered. If the remote is not registered, check that the remote is not is sleep mode. Verify that the remote is in range of the SNAP.

Technical Support

Technical Support is available from Digital Wireless from 8:30am to 5:30pm Eastern Time, Monday through Friday. Contact Technical Support at (770) 564-5540 or by email at techsup@digiwrls.com.

QUICK REFERENCE

SNAP System Commands

```
echo                            Toggles user screen echo mode
help                            Displays command help screen
reset                           Resets the SNAP to activate new parameters
save                            Stores current configuration in non-volatile memory
sys   help
      outmax <1-212>            Sets maximum transmit packet length
      mode [AP|PPP]             Sets SNAP operating mode
      xcast <b/mcastaddr>       Sets SNAP multicast address
version                         Displays SNAP firmware version number
```

Ethernet Commands

```
arp   -a                        Displays arp table
      -d <ipaddr>               Deletes arp entry
      -s <ipaddr> <eaddr>       Adds arp entry
ip    <ipaddr> <netmask>        Sets SNAP IP address and optional netmask
password                        Sets password for telnet sessions
ping  <ipaddr>                  Pings TCP/IP hosts
route help
      add <ipaddr|default>      Adds IP address and netmask to route table
          <gwaddr> <netmask>
      del <ipaddr>              Deletes IP address from route table
      list                      Lists route table IP addresses
socks                           Diplays network socket information
```

SNAP Radio Commands

```
hop   help
      length <hoplen>           Informs SNAP of radio hop dwell time
      sequence <75|25>          Informs SNAP of number of frequencies
radio [A|B]  help
             banner             Displays the banner of the specified radio
             network            Displays network number of specified radio
             cfg                Puts specified radio in configuration mode
remote       help
             list               Displays remotes currently registered
             send <hnd> <data>  Sends data to the specified remote
sync  help
      ether                     Sets sync mode to use Ethernet packets
      master                    Sets SNAP as sync master
      override                  Toggles master backup override
      settings                  Displays sync settings
      slave                     Sets SNAP as sync slave
      wire                      Sets sync mode to use RS-485 wire ports
```

Radio Commands

```
dx    [?|0-62]                      Sets range optimization in radio
ph    [?|0-fe] base only            Sets hop duration in 69.4s increments
pw    [?|0-35] base only            Sets Base Slot Size (35H=212 bytes=default)
wn    [?|0-63]                      Sets the network number (hopping pattern)
```

AP Mode Commands

```
sdp   help
      add <sdp> <ipaddr> <dstprt>   Adds an SDP entry
                <srcprt>
      cache <size>                  Sets the number of cached SDP output packets
      delete <sdp>                  Deletes an SDP entry
      list                          Lists SDP entries
      max <size>                    Sets SDP maximum packet size
```

PPP Mode Commands

```
ppp   help
      acct method [local|radius]    Sets accounting method to be used
      auth method [local|radius]    Sets authentication method to be used
      base <ipaddr>                 Sets base IP address for remotes
      count <1-62>                  Set to max number of remotes pararmeter of radio
      radius
          add [auth|acct]           Adds IP address of Radius server
            <ipaddr> [port]
          delete [auth|acct]        Deletes IP address of Radius server
            <ipaddr>
          port [auth|acct]
            <ipaddr> <pnumber>      Sets the port number for a Radius server
          secret [auth|acct]
           <ipaddr> <secret>        Sets the secret for a Radius server
          settings                  Displays Radius server settings
      status                        Displays status of registered users
      timeout                       Sets idle time timer in tenths of a second
      user  help
          add <usr>                 Adds a PPP username
          delete <usr>              Deletes a PPP username
          disable <usr>             Disables a PPP username
          enable <usr>              Enables a PPP username
          list <usr>                Lists current PPP users
          password <usr> <pwd>      Sets PPP user password
```

WIT2410 Command Summary

Serial Commands
```
sd[?|00..ff]          Set Data Rate Divisor
sp[?|00..14]          Set Protocol Mode
```

Network Commands
```
wb[?|0|1]             Set Transceiver Mode
wd[?|1..3f]           Set Default Handle
wn[?|00..3f]          Set Hopping Pattern
wg[?|0|1|2]           Enable Global Network Modes
wp[?|0|1]             Set Transmit Power
wr?                   Read Receive Signal Strength    (remote only)
dx[?|0..64]           Set Range Optimization          (base only)
```

Protocol Commands
```
pe[?|0..4]            Set Alternative Frequency Band
ph[?|00..fe]          Set Hop Duration                (base only)
pl?                   Get Maximum Data Length
pn[?|01..3e]          Set Maximum Number of Remotes   (base only)
pk[?|00..d4]          Set Minimum Data Length
pr[?|00..ff]          Set Packet Attempts Limit
pt[?|00..ff]          Set Data Transmit Delay         (remote only)
pv[?|0|1]             Set Slot Assignment Mode        (base only)
pw[?|00..35]          Set Base Slot Size              (base only)
px[?|0|1]             Set ARQ Mode
```

Status Commands
```
zb[?|0|1]             Banner Display Disable
zc[?|0..2]            Set Escape Sequence Mode
zh?                   Read Factory Serial Number High Byte
zm?                   Read Factory Serial Number Middle Byte
zl?                   Read Factory Serial Number Low Byte
zp[?|0..4]            Set Duty Cycle
zq[?|0|1]             Enable Low Power Acquisition     (remote only)
z>                    Exit Modem Control Mode
```

Memory Commands
```
m0                    Recall Factory Defaults
m<                    Recall Memory
m>                    Store Memory
```

SPECIFICATIONS

Radio Specifications

Model	SNAP2410	SNAP2420	SNAP2414
Data Throughput	230.4Kbps	460.8Kbps	230.4Kbps
Total over-the-air bandwidth	460.8Kbps	921.6Kbps	460.8Kbps
Network Interface	10BaseT		
SNAP Network Topologies	Point-to-Point or Multipoint		
Repeater	Use Digital Wireless HN-2010		
RF Output Power	100mW wiith included whip antenna, 400W EIRP with gain antenna		
RF Modulation	Frequency hopping, up to 64 user selectable hopping patterns		
Frequency Range	2400MHz to 2483.5MHz		
Operating Voltage Range	7VDC to 26VDC		
Enclosure	Ruggedized Aluminum		ABS Plastic
Dimensions	201 x 144 x 53 mm 7.9" x 5.7" x 2.1"		210x229x45 mm 8.25x9.0x1.75in
Operating Temperature	-30°C to +70°C 0 to 95% humidity, non-condensing		
Licensing	Type certified for Worldwide License-free operation under FCC Part 15.247 and ETS 300.328		

Connectors

Power	2-Pin DIN
Ethernet	RJ-45
Configuration Port	DB-9
Antenna	TNC Male
Hub (2414 only)	RJ-45

Indicators

Power
Ethernet Transmit Data
Ethernet Receive Data
Ethernet Link Status
Ethernet Collision

WARRANTY

Seller warrants solely to Buyer that the goods delivered hereunder shall be free from defects in materials and workmanship, when given normal, proper and intended usage, for twelve (12) months from the date of delivery to Buyer. Seller agrees to repair or replace at its option and without cost to Buyer all defective goods sold hereunder, provided that Buyer has given Seller written notice of such warranty claim within such warranty period. All goods returned to Seller for repair or replacement must be sent freight prepaid to Seller's plant, provided that Buyer first obtain from Seller a Return Goods Authorization before any such return. Seller shall have no obligation to make repairs or replacements which are required by normal wear and tear, or which result, in whole or in part, from catastrophe, fault or negligence of Buyer, or from improper or unauthorized use of the goods, or use of the goods in a manner for which they are not designed, or by causes external to the goods such as, but not limited to, power failure. No suit or action shall be brought against Seller more than twelve (12) months after the related cause of action has occurred. Buyer has not relied and shall not rely on any oral representation regarding the goods sold hereunder, and any oral representation shall not bind Seller and shall not be a part of any warranty.

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