

Cyclone 900 MHz User Manual

R 900.1

NOTICES

Federal Communications Commission (FCC) information:

This device complies with part 15 of the FCC Rules and Regulations. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) This device must accept any interference received, including interference that may cause undesired operation.

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio-frequency energy and, if not installed and used in accordance with these instructions, may cause harmful interference to radio communications.

If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment on and off, the user is encouraged to correct the interference by one or more of the following measures:

- Increase the separation between the affected equipment and the unit;
- Connect the affected equipment to a power outlet on a different circuit from that which the receiver is connected to;
- Consult the dealer and/or experienced radio/TV technician for help.

This device must be professionally installed.

Exposure Note

The antenna of a Cyclone 900 MHz module must be installed to provide a separation distance of at least 60 cm (approx 24 inches) from all persons. When so installed, the module's RF field is within Health Canada limits for the general population; consult Safety Code 6, obtainable from Health Canada's website <http://www.hc-sc.gc.ca/rpb>. Per Health Canada Safety Code 6, the installer of this radio equipment must ensure that the antenna is located or pointed such that it does not emit RF field in excess of Health Canada limits for the general population.

Certified Antennas

Antel BCD-HP7WD	Gain: 9.1 dBi*	Maximum Power of 26 dBm for a total of 36 dBm**
Til-Tek TA-926VH-8-120	Gain: 13.1 dBi*	Maximum Power of 22 dBm for a total of 36 dBm**
Til-Tek TA-926H-4-120	Gain: 11.1 dBi*	Maximum Power of 24 dBm for a total of 36 dBm**

* Reference: Addendums A, B, & C for specific Antenna specifications

** The regulatory power limit for the 900 MHz frequency band is 4 W (36 dBm).

The applicable power density exposure limit is 6 Watt/m², according to the FCC OET Bulletin 65, the ICNIRP guidelines, and the Health Canada Safety Code 6. The corresponding compliance distances referenced above have been determined by assuming worst- case scenarios. The peak power density (S) in the far-field of a radio-frequency source with rms transmit power *P* and antenna gain *G* at a distance *d* is

$$S = \frac{P \cdot G}{4 \pi d^2}$$

EXAMPLE: In the case of a 900 MHz Cyclone SM or AP with an antenna gain of 9.1 dBi (a factor of 9) and correctly entered in the user interface as a 9.1 dBi antenna, the peak power density equals the exposure limit at a distance of 18 cm. A power compliance margin of over 11 is artificially introduced by setting the distance to 60 cm.

The compliance distance is greatly overestimated in these cases because the far-field equation neglects the physical dimension of the antenna, which is modeled as a point-source.

FCC ID: QSX900ISM

Technical specifications were met.

Important Note:

Intentional or unintentional changes or modifications must not be made unless under the express consent of the party responsible for compliance. Any such modifications could void the user's authority to operate the equipment and will void the manufacturer's warranty.

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GETTING STARTED

WELCOME

Thank you for your purchase of a Cyclone access point. This new technology is the latest innovation in high speed wireless networking. Some of the Cyclone Plus system features are:

- Network speeds of 10/100 BaseT
- Small compact design
- No special set up on your PC.

INTENDED USE

This manual is intended to be used with Cyclone software release version 4.x or greater. The intended audience for this manual is system operators and equipment installers.

WARRANTY

Last Mile Gear offers a warranty covering a period of 1 year from the date of purchase by the customer. If a product is found defective during the warranty period, Last Mile Gear will repair or replace the product with the same or a similar model, which may be a reconditioned unit, without charge for parts or labor.

IN NO EVENT SHALL LAST MILE GEAR BE LIABLE TO YOU OR ANY OTHER PARTY FOR ANY DIRECT, INDIRECT, GENERAL, SPECIAL, INCIDENTAL, CONSEQUENTIAL, EXEMPLARY OR OTHER DAMAGE ARISING OUT OF THE USE OR INABILITY TO USE THE PRODUCT (INCLUDING, WITHOUT LIMITATION, DAMAGES FOR LOSS OF BUSINESS PROFITS, BUSINESS INTERRUPTION, LOSS OF BUSINESS INFORMATION OR ANY OTHER PECUNIARY LOSS, OR FROM ANY BREACH OF WARRANTY, EVEN IF LAST MILE GEAR HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES. (Some states do not allow the exclusion or limitation of incidental or consequential damages, so the above exclusion or limitation may not apply to you.) IN NO CASE SHALL LAST MILE GEAR LIABILITY EXCEED THE AMOUNT YOU PAID FOR THE PRODUCT.

BACKGROUND INFORMATION ON NETWORKING

Computers are assigned IP addresses by network operators, which have two methods available, static or dynamic IP addressing. The user of this document will need to understand how IP addressing is done at their particular location.

All Cyclone radio products (Access Point Modules, and Backhaul Modules)

have the default IP address of 169.254.1.1. For a computer to talk to Cyclone, as it comes from the factory, either of the following conditions must be met:

- If the computer is **not** configured for DHCP, then it has to have a static IP address on the 169.254 network (i.e. 169.254.1.5)
- If the computer is configured for DHCP, then it will automatically obtain an IP address on the 169.254 network after minute or two as long as it is not connected to the network.

SITE SELECTION CRITERIA

There are various issues that need to be taken into consideration when choosing a location for the network infrastructure. The following is a list of those considerations. There may be others as each site is unique.

- Height is essential when installing a Cyclone backhaul module. The Cyclone AP must be mounted higher than other objects located immediately around it such as trees, buildings, tower legs, etc.
- There should be no obstructions that will interfere with the unit's antenna. The area immediately in front of an access point module must be clear of all obstructions.
- Will the installation area change in the future? Will there be structures high enough to interfere with the signal? Will trees grow into the line-of-sight path?
- When possible, avoid high RF energy sites. Do not place Cyclone equipment in the same plane as other RF equipment.
- The means used by the installer to attach the backhaul module to the tower, rooftop, or pole should be rigid and should not move or flex due to wind or other vibrations.
- Tower availability...will a tower have to be erected?
- There must be grounding systems available for protection of the Cyclone equipment.
- Lighting arrestors are required in installation areas to transport lightning strikes away from equipment.

GENERAL CONSIDERATIONS

Fresnel Loss - The Fresnel Zone is a theoretical area around the line of sight of an antenna transmission that can affect the signal strength. Objects that penetrate the Fresnel Zone can cause fading of the transmitted signal. This fading is caused by the cancellation of the signal due to out-of-phase reflections. An unobstructed line of sight is important, but it is not the only determination of an adequate placement. Even though the path has a clear line of sight, if obstructions (such as terrain, vegetation, metal roofs, cars, etc.) penetrate the Fresnel zone, there will be signal loss.

Free Space Path Loss – As an RF signal travels through space, it is attenuated by the distance from the initial transmission point. The farther away from the transmission point, the weaker the RF signal.

Foliage Loss – Tree and plant foliage will cause additional signal loss. Seasonal density, moisture content of the foliage, and other factors such as wind may change the amount of loss. Caution should be used when a link may transmit through this type of environment.

Carrier to Interference – describes how much signal advantage must be engineered into the radio link to tolerate an interfering transmission.

CHANNEL PLANS

900 MHz Recommended Frequencies

The following are the 3 non-overlapping channels that are recommended:

- 906 MHz
- 915 MHz
- 924 MHz

NETWORKING INFORMATION

The Cyclone access point module will each utilize an IP address on the operator's network. It is recommended that the access point modules **never** be placed directly onto the Internet. IP addresses may be assigned sequentially clockwise around an access point cluster for easier manageability. The operator will also need to identify the appropriate subnet mask and network gateway each of the modules.

LIGHTNING PROTECTION

The Cyclone access point module, cluster management module, and GPS antenna must be mounted at least 2 feet below the highest point at the site for lightning strike mitigation. It is highly recommended that the site have a lightning protection system installed. Ensure the location is properly grounded for lightning protection according to all applicable national and local codes. To protect operator equipment from surges on the Ethernet cable that is connected to the Cyclone System, the Cyclone surge suppressor must be used.

ELECTRICAL REQUIREMENTS

Specifications for the voltages and distance can be found in the *Specification* section of this manual. Make certain the installation conforms to the National Electrical Code (NEC), country and local codes. If uncertain of code requirements, obtain the services of a licensed electrician.

DES ENCRYPTION

DES (Data Encryption Standard) is a secret key encryption scheme. The basics of DES are that it performs a series of bit permutations, substitutions, and recombination operations on blocks of data utilizing a secret key. On the Cyclone system, DES encryption of the over the air link is done on a per access point module or backhaul timing master module basis and does not affect the performance or throughput of the system. The Cyclone modules contain unique factory programmed secret keys to establish the encrypted link.

INSTALLATION

The following steps are required to install the Cyclone module:

1. Unpack the Cyclone products
2. Configuration of the modules
3. Installation of the modules
4. Alignment

UNPACK THE CYCLONE PRODUCTS

Upon receipt, carefully inspect all shipping boxes for signs of damage. If there is damage, immediately notify the transportation company. Unpack equipment, making sure that all ordered components have arrived. It is recommended that you save all the packing materials. They can be used for transportation of the equipment to and from installation sites.

CONFIGURATION OF THE AP

In all cases, when a configuration parameter is modified, the change must be saved and the module must be rebooted

NOTE: If the operator forgets either the password or the IP address for the module, a Cyclone default plug can be used to regain access. **See Configuration** for information on the default plug. There are two types of passwords that can be configured: display-only or full-access. The display only password allows the operator to view the module's current status. The full-access password allows the operator to view the module's current status and change its configuration. By viewing the red lettering to the right of the entry fields, the operator can discern that a password is set. The operator can enter in information about the Site Name, Location, and Contact. This is optional.

INSTALLATION OF THE EQUIPMENT

When power is applied to a Cyclone module or the unit reset via the web-based interface, the module will take approximately 25 seconds to boot up. During this boot up time, power on self tests and other diagnostics are being performed.

The following steps are needed to install the Cyclone equipment:

1. Remove the base cover from all Cyclone AP's to be installed.
2. Remove the GPS sync cable knockout from the base cover with needle-nose pliers.
3. Mount the backhaul modules:
4. The modules can be mounted in a variety of locations, choose the best location for your particular application. Mounting can be done by utilizing stainless steel hose clamps or another equivalent fastener.
5. Route the Ethernet cable from the backhaul module to the cluster management module.
6. The Ethernet cables use RJ-45 connectors (standard Ethernet) that connect to matching ports within the cluster management module.
7. A total of 8 ports are available on the cluster management module, to accommodate a combination of access point modules and backhaul timing master modules.
8. Route the GPS sync (serial) cable from the backhaul timing master module to the cluster management module.
9. The GPS sync cables use 6 conductor RJ-11 connectors that connect to matching ports within the cluster management module.
10. Replace the base cover on all of the backhaul modules.

THE INTERFACE SCREENS

The Cyclone backhaul module contains a series of web pages that are used to interface to the unit. The following is a quick reference to interface screens. Note: These screens are subject to change by subsequent software versions. To access the web based interface you first must be on a computer that is in some way connected to the access point module. This can be done either directly or through a network. Enter the IP address of the backhaul module (default is 169.254.1.1) into the address bar of your browser and hit enter on your keyboard.

THE TIMING MASTER

QUICK START

The Cyclone System consists of a family of highly flexible, fixed wireless access devices that can be put into service quickly and with a minimal configuration. The Quick Start is a wizard that walks the operator through that configuration. To place an access point module into operation, only three parameters need to be configured:

- RF Carrier Frequency
- Synchronization
- Network IP Address

Each of the pages in the Quick Start will explain a little about Cyclone and ask the operator for a choice that best addresses the network requirements. At the end, the operator will be given the opportunity to review the configuration selected and save it to non-volatile memory. None of the

changes made prior to saving the configuration will affect the system so experimentation with the interface is encouraged.

STATUS PAGE

The Status page contains information on the operation of the product. It is the default web page. The following parameters are displayed:

Device Type: displays the type of Cyclone module that is currently being viewed. This field will let the operator know the frequency band of the module, the protocol that it is utilizing, and the MAC address of the module.

Software Version: displays the version of the software that is currently loaded into the module. Please make note of this information when obtaining technical support.

FPGA Version: displays the version of the FPGA (field programmable gate array) that is currently loaded into the module. Please make note of this information when obtaining technical support.

Uptime: displays the length of time the module has been operating since power was applied.

System Time: displays the current time. If the access point module is connected to a Cluster Management Module (CMM) then the time will be Greenwich Mean Time (GMT). Any subscriber module that registers to the access point module will inherit the system time.

Ethernet Interface: displays the configuration of the Ethernet interface on the module.

Registered SM Count: This field displays the number of subscriber modules currently registered to the access point module.

GPS Sync Pulse Status: displays the current status of the type of synchronization the access point module is receiving. There are 3 values that could be displayed:

- *Generating sync:* If the module is set to generate its own sync pulse then this message will be displayed.
- *Receiving Sync:* If the module is set to receive a sync pulse from an outside source (not itself) and is actually receiving the pulse then this message will be displayed.
- *ERROR: No Sync Pulse:* If the module is set to receive a sync pulse from an outside source (not itself) and it is currently not receiving the pulse this message will be displayed.
- When this message is displayed the access point module will turn its transmitter off so as to not create any self-interference within the Cyclone System.

Radio Slicing Value: displays information to be used by Cyclone technical support.

Radio Transmit Gain Setting: displays information to be used by Cyclone technical support.

Site Name: displays information relating to the name of the physical module. This parameter can be set by the operator on the *Configuration* web page. This information is set into the *sysName* SNMP MIB-II object and can be polled via a SNMP management server.

Site Contact: displays contact information for the physical module. This parameter can be set by the operator on the *Configuration* web page. This information is set into the *sysContact* SNMP MIBII object and can be polled via a SNMP management server.

CONFIGURATION

The Configuration web page contains information and configurable parameters pertaining to the operation of the product. The first line of information on the Configuration screen is a repeat of the *Device Type* from the Status web page. The following are the parameters and their descriptions.

Sync Input: choose the type of synchronization that this access point module will utilize. If “Sync to Received Signal” is chosen, then it is assumed that:

- This access point module is connected to a Cluster Management Module and will be receiving a sync pulse via GPS
- This access point module is connected to another access point module that is generating its own sync pulse. If “Generate Sync Signal” is chosen then it is assumed that:
- This access point module is a stand-alone module with no other access point modules within a 5 mile radius.
- This access point module is generating the sync pulse for a cluster of access point modules and there are no other access point modules within a 5 mile radius.

Link Negotiation Speeds: choose the type of link speed desired for the Ethernet connection. The default for this parameter is for all the choices to be checked.

RF Frequency Carrier: choose the frequency that the module will transmit on. The default from the factory is to have this parameter set to none.

Downlink Data: choose the percentage of the aggregate throughput that is needed for the downlink (i.e. going from the access point module to the subscriber). For example, if the aggregate throughput on the access point module is 6 Mbps, then configuring this parameter for 75% will allocate 4.5 Mbps for the downlink and 1.5 Mbps for the uplink. If the access point module is in a cluster with other modules then this parameter on all units **must** be set exactly the same. The default for this parameter is 75%.

LAN 1 IP: enter in the IP address that will be associated with the Ethernet connection on this module. The default address is 169.254.1.1. If the IP address is forgotten, the operator will need physical access to the module and will need to create a Cyclone “default plug”. See steps at the end of this section for use of a default plug.

LAN1 Subnet Mask: enter in an appropriate subnet mask for the module to “talk” on the network. The default value for this parameter is 255.255.255.0

Default Gateway: enter in the appropriate gateway for the module to “talk” on the network. The default for this parameter is 169.254.1.1.

Private IP: the default for this parameter is 192.168.101.1. It is recommended that the operator not change this parameter. A flat, class C subnet is used to communicate with each of the subscriber modules that have registered. The access point utilizes a combination of the private IP and the logical unit ID (LUID) of the subscriber module.

For example, if there are two subscriber modules (LUID 2 and LUID 3) registered to an access point module, then the access point uses the following to communicate to each:

Unit LUID Private IP

Access point module 1 192.168.101.1

Subscriber module 1 2 192.168.101.2

Subscriber module 2 3 192.168.101.3

If the private IP address is changed then it must designate a Class C subnet that is not utilized for anything else and the address must be in the form of xxx.xxx.xxx.1, where 1 is the last octet of the address.

Color Code: enter in a value (0-254). The color code on the subscriber module and the access point module **must** match in order for registration to occur. Color code is not a security feature. It is a means for the Cyclone System operator to segregate an individual network or neighbor Cyclone networks. Also, color code can be used to force a subscriber module to only register to a specific access point module even though the subscriber module may be able to see multiple access point modules. The default value for this parameter is 0 on all Cyclone modules.

Sector ID: choose an ID number to give to this access point module. This parameter does not affect the operation of the module in any way. Its purpose is just another means to identify the access point module. When observing a subscriber module's *AP Eval Data* web page, the sector ID is one of the distinguishing fields present to help the operator understand what access point module is seen. It is recommended that when constructing an access point cluster (2-6 modules) that each sector be given a different ID and that the pattern be repeated throughout the entire Cyclone System for manageability.

Display-Only Access: enter the same password in both fields for verification. The display-only password, when used, will allow only view activities to the module. When the display-only password is set and not the full-access password, the display-only password will be tied to telnet and FTP sessions to the module. If the full-access password is also set then it has precedence on the telnet and FTP sessions. If the password is forgotten, the operator will need physical access to the module and will need to create a Cyclone "default plug" to override the unit. See steps at end of section for use and creation of a default plug.

Full Access: enter the same password in both fields for verification. The full-access password, when used, will allow view and change activities to the module. When the full-access password is set, the password will also be tied to telnet and FTP sessions to the module. When prompted for the password via the web-based interface, there is no username required; however when prompted for the password via a telnet or FTP session, the user that **MUST** be used is "root". If the password is forgotten, the operator will need physical access to the module and will need to create a Cyclone "default plug" to override the unit. See steps at end of this section for use of a default plug.

Webpage Auto Update: enter time period (in seconds) desired to have the web browser refresh the web-based interface. The default setting is 0, which will cause the web-based interface to never refresh.

Airlink Security: choose the type of air link security that is to be utilized on this access point module. There are two choices:

- *Normal:* If utilizing this mode there is no encryption on the air link. This is the default operation.
- *DES:* If utilizing this mode the air link is encrypted using single DES.

Bridge Entry Timeout: choose the appropriate bridge timeout for correct network operation with existing network infrastructure. It is important that this parameter be set for a longer time period than the ARP (address resolution protocol) cache timeout of the router being used to feed the network.

Note: Failure to properly configure this may lead to temporary loss of communication to specific end users.

AP Background BER Mode: choose to have this feature turned on or off. Bit Error Rate (BER) mode will allow an operator another means to verify the functionality of a link. When BER mode is turn on a bit error rate can be read on the subscriber side to determine the quality of a registered link. If the access point module is in a cluster with other modules then this parameter on all units **must** be set exactly the same. Continually, when this feature is on the aggregate available bandwidth will decrease by ~200 Kbps.

Community String: enter a string that will allow an SNMP management server accessibility to the SNMP information. There must not be any spaces in the community string. The default for this

parameter is "Cyclone".

Accessing Subnet: enter the network that will be allowed to access SNMP information from the Cyclone module. There are two pieces of information needed:

- The network in the form of xxx.xxx.xxx.xxx
- The CIDR (Classless Interdomain Routing) prefix length in the form of /xx

An example would be 198.32.0.0/16 where /16 is a subnet mask of 255.255.0.0. An Internet search on Classless Interdomain Routing will provide greater detail on this subject for the inexperienced network operator. The default is to allow all networks access.

Trap Address: enter in an IP address (xxx.xxx.xxx.xxx) of an SNMP management server where trap information can be sent. A trap is a way for the module to tell the monitoring system that something has happened. The following are scenarios where traps would be sent:

- after a reboot of the module
- if a SNMP management server tried to access agent information and supplied the wrong community string, wrong SNMP version number, or came from the wrong accessing subnet.

Site Name: enter information relating to a name given to the physical module. This parameter will set the supplied information into the *sysName* SNMP MIB-II object and can be polled by a SNMP management server. The buffer size for this field is 128 characters.

Site Contact: enter contact information relating to the module. This parameter will set the supplied information into the *sysContact* SNMP MIB-II object and can be polled by a SNMP management server. The buffer size for this field is 128 characters.

Site Location: enter information relating to the physical location of the module. This parameter will set the supplied information into the *sysLocation* SNMP MIB-II object and can be polled by a SNMP management server. The buffer size for this field is 128 characters.

Save Changes: by clicking on this button, any changes that have been made on the *Configuration* page will be committed to flash memory and will take effect after the next module reboot.

Undo Save Changes: by clicking on this button, any changes that have been made and **not** committed through a reboot of the module.

Set to Factory Defaults: depressing this button will change all of the configurable parameters (all of which are contained on the *Configuration* page) back to their factory settings.

Reboot: depressing this button will reboot the module.

Cyclone Default Plug

When inserted, the default plug brings the module up with a default configuration. This allows the operator to regain control of a module, which may be using an IP address and/or password that has been forgotten. The default plug will also override the passwords for access and change control and set the LAN1 IP address back to 169.254.1.1. This does not, by itself, change any configuration, rather, it allows the operator to attach to the module using the default configuration

so that they can read the actual non-default values and set them accordingly.

1. Obtain a RJ-11, 6-pin connector and a small length of CAT 5 cable.
2. Pin-out all 6-pins according the following diagram and then short (i.e. solder) together pins 4 and 6 on the other end. Remaining wires should not be connected to anything. Insert "default plug" in the GPS sync port of the module and apply power to the module via its Ethernet cable. When the module is booted up (power applied) it will be in default mode where the IP address will be 169.254.1.1 and the passwords will be blank. All other configurations will have been preserved.

EVENT LOG

This page contains information that is recorded from the subscriber module for troubleshooting purposes. Please make note of the information that is gathered here when calling for technical support.

Clear Event Log: this button will clear the event log.

LUID SELECT

This web page connects to a registered unit over the RF link, to view its internal web pages. The Sessions webpage determines which LUID corresponds to a specific unit. Enter the LUID in the field displayed and then click "Change LUID" to set the parameter. Click "View Current Subscriber Modem" to access the unit with that LUID.

LINK TEST

The Link Test is a test for measuring the throughput and efficiency of the RF link between two Cyclone modules. To perform a link test enter a number into the field labeled "*Duration*". The duration is the number of seconds the RF link will be tested. Start the link test by clicking the "*Start Test*" button. The test will now run for the set duration. If the web page is not set to automatically refresh, click the "*Refresh Display*" button to see the results. For a Cyclone System link to be considered acceptable it is necessary for the efficiencies of the link test to be greater than 90% in both the uplink and downlink direction. It is recommended that when a new link is installed that a link test be executed to ensure that the efficiencies are within recommended guidelines.

The key fields are:

- Downlink RATE, bits per second
- Uplink RATE, bits per second
- Downlink Efficiency, percent
- Uplink Efficiency, percent

TIME & DATE

This web page is utilized to set the time and date of the access point module when it is not connected to a Cluster Management Module (CMM). The time and date would need to be set every time there is a power cycle. The format for the entry is:

Time: *hh:mm:ss* Date: *mm/dd/yyyy*

- hh: two digit hour in military time
- mm: two digit minute
- ss: two digit second
- mm: two digit month
- dd: two digit day
- yyyy: four digit year

Enter in the appropriate information and click the *Set Time and Date* button.

SESSIONS

The Session web page contains information on each of the subscriber modules that has registered to the access point module. For each of the subscriber modules certain bits of information are shown on this web page. An example of such information is:

```
LUID: 002 : MAC: 0a-00-3e-00-02-2f State: IN SESSION
Software Version : CYCLONE 3.1 Aug 21 2002 13:52:12
FPGA Version : 08200207
Session Timeout: 7, AirDelay 5
Session Count: 2, Reg Count 2, Re-Reg Count 2
Average RSSI: 1842, Last RSSI: 1873
Average Jitter: 6, Last Jitter: 5
```

Description of parameters that are useful for managing and troubleshooting a Cyclone System are:

LUID: displays the logical unit ID of the subscriber module. As each subscriber module registers to the access point module it is assigned a LUID. The LUID range starts at 2. If a subscriber module were to lose its registration with the access point and then regain the registration it will retain the same LUID, as long power has not cycled on the access point module.

MAC: displays the MAC address (or electronic serial number) of the subscriber module.

State: displays the current status of the subscriber module. There are two states:

- *IN SESSION:* the subscriber module is currently registered to the access point module.
- *IDLE:* the subscriber module was registered to the access point module at one time, but is not currently.

Software Version: displays the version of software that is running on the subscriber module. If this parameter is not present, then a software version prior to release version 3.1 is on that module.

FPGA Version: displays the version of FPGA that is running on the subscriber module. If this parameter is not present, then a FPGA version prior to release version 082002 is on the module.

AirDelay: displays the distance of the subscriber module from the access point module. The number presented needs to be multiplied by 49 to convert the number to feet.

Session Count: displays the number of sessions that this subscriber module has had with the access point module. If this value is excessive large compared to other subscriber modules registered with this access point, there may be an issue with the installation of the subscriber.

Reg Count: displays the number of registration request messages the access point module has seen from the subscriber module. If this value is excessively large compared to other subscriber modules registered with this access point, there may be an issue with the installation of the subscriber.

Re-Reg Count: displays the number of registration request messages the access point module has seen from the subscriber module that is already in session. If this value is excessively large compared to other subscriber modules registered with this access point, there may be an issue with the installation of the subscriber.

Average RSSI: displays the average RSSI value for the subscriber module.

Last RSSI: displays the last RSSI value for the subscriber module.

Average Jitter: displays the average Jitter value for the subscriber module.

Last Jitter: displays the last Jitter value for the subscriber module.

GPS STATUS

The GPS Status web page displays information about latitude, longitude, height, satellites seen and tracked when the access point module is configured to sync to received signal and is connected to a Cluster Management Module.

ETHERNET STATS

The Packet Stats web page reports TCP throughput and error information for the Ethernet connection of the subscriber module. The following definitions are available:

inoctets count: displays the total number of octets received on the interface, including framing characters.

inucastpkts count: displays the total number of subnetwork-unicast packets delivered to a higher layer protocol

innucastpkts count: displays the total number of non-unicast (i.e. subnetwork-broadcast or subnetwork-multicast) packets delivered to a higher layer protocol.

indiscards count: displays the total number of inbound packets which were chosen to be discarded even though no errors had been detected to prevent their being deliverable to higher layer protocol. One possible reason to discard could be to free up buffer space.

inerrors count: displays the total number of inbound packets that contained errors preventing them from being delivered to a higher layer protocol.

inunknownprotos count: displays the total number of packets received via the interface which were discarded because of an unknown or unsupported protocol.

outoctets count: displays the total number of octets transmitted out of the interface, including framing characters.

outucastpkts count: displays the total number of packets that higher-level protocols requested be transmitted to a subnetwork-unicast address, including those that were discarded or not sent.

outnucastpkts count: displays the total number of packets that higher-level protocols requested be transmitted to a non-unicast (i.e. subnetwork-broadcast or subnetwork-multicast) address, including those that were discarded or not sent.

outdiscards count: displays the total number of outbound packets which were chosen to be discarded even though no errors had been detected to prevent their being transmitted. One possible reason for discarding such a packet could be to free up buffer space.

outerrors count: displays the total number of outbound packets that could not be transmitted because of errors.

RxBabErr: displays the total number of receiver babble errors.

EthBusErr: displays the total number of Ethernet bus errors on the Ethernet controller.

CRCError: displays the total number of CRC errors on the Ethernet controller.

RxOverrun: displays the total number of receiver-overflow errors on the Ethernet controller.

Late Collision: displays the total number of late collisions on the Ethernet controller. A normal collision occurs during the first 512 bits of the frame transmission. If a collision occurs after the 512 bit times, then it is considered a late collision. A late collision should be taken as a serious network problem, since it causes the frame being transmitted to be discarded. The most common cause of late collisions is a mismatch between duplex configurations at each end of a link segment.

RetransLimitExp: displays the total number of retransmit limit expirations.

TxUnderrun: displays the total number of transmission-under run errors on the Ethernet controller.

CarSenseLost: displays the total number of carrier sense lost errors occurred on the Ethernet controller.

EXPANDED STATS

Clicking on the *Expanded Stats* link will display a number of pages of statistics that are maintained by the Cyclone module. Cyclone Technical Support may ask the operator for specific information in this section when troubleshooting an issue.

THE TIMING SLAVE

STATUS

The Status page contains information on the operation of the product. It is the default web page. The following parameters are displayed:

Device Type: displays the type of Cyclone module that is currently being viewed. This field will let the operator know the frequency band of the module, the protocol that it is utilizing, and the MAC address of the module. The frequency band can either be in the 900, 2.4 GHz, 5.2 GHz, or 5.7 GHz band. The protocol for a subscriber module must be *multipoint*. The MAC address will be in the following format, 0a-00-3e-xx-xx-xx.

Software Version: displays the version of the software that is currently loaded into the module. Please make note of this information when obtaining technical support.

FPGA Version: displays the version of the FPGA (field programmable gate array) that is currently loaded into the module. Please make note of this information when obtaining technical support.

Uptime: displays the length of time the module has been operating since power was applied.

System Time: displays the current time, which is inherited from the Cyclone System via the registration to an access point module. When the module is registered to a Cyclone System where a Cluster Management Module (CMM) is being utilized the time is displayed in Greenwich Mean Time (GMT).

Ethernet Interface: displays the configuration of the Ethernet interface on the module.

Session Status: displays the current session state the module is in. There are four (4) options

that will be displayed in this field, *scanning, syncing, registering, registered, and alignment*

Scanning – module is cycling through the RF frequencies that it is configured to scan and looking for an access point module.

Syncing – module is attempting to synchronize timing to a single access point module.

Registering – module sent a request for registration and is awaiting a response.

Registered – module is locked on to a specific access point module and ready to transmit and receive data packets.

Alignment – module is in alignment mode.

RSSI: displays the current value for the Radio Signal Strength Indicator. This parameter will only display information when the module is registered to an access point module and the value is only updated by either refreshing the web browser screen or configuring the Cyclone module to auto refresh (see *Configuration* web page.) An acceptable RSSI value for a registered link is greater than 700; however it is important to view this value in conjunction with the *Jitter* value.

Jitter: displays the current value for the quality of the received signal. This parameter will only display information when the module is registered to an access point module and the value is only updated by either refreshing the web browser screen or configuring the Cyclone module to auto refresh (see *Configuration* web page.) The value range for Jitter is 5-15, with the quality being better on the low end of the scale.

Jitter must be below 9 for a link to be of acceptable quality.

Air Delay: displays the distance from the subscriber module to the registered access point module. At close range, 0-200 feet, the distance will not report accurately.

Radio Slicing Value: displays information to be used by Cyclone technical support.

Radio Transmit Gain Setting: displays information to be used by Cyclone technical support.

Site Name: displays information relating to the name of the physical module. This parameter can be set by the operator on the *Configuration* web page. This information is set into the *sysName* SNMP MIB-II object and can be polled via a SNMP management server.

Site Contact: displays contact information for the physical module. This parameter can be set by the operator on the *Configuration* web page. This information is set into the *sysContact* SNMP MIB-II object and can be polled via a SNMP management server.

CONFIGURATION PAGE

The Configuration web page contains information and configurable parameters pertaining to the operation of the product. The first line of information on the Configuration screen is a repeat of the *Device Type* from the Status web page. The following are the parameters and their descriptions.

Timing Mode: choose whether this module will be a timing master or a timing slave. If the operator is changing this mode, change only this parameter, save the changes and reboot. Upon reboot different set of web based interface pages will present themselves and offer the operator different manageable as well as configurable features.

Link Negotiation Speeds: choose the type of link speed desired for the Ethernet connection. The default for this parameter is for all the choices to be checked.

Custom RF Frequency Scan Selection (SM) List: choose the frequencies that the subscriber module will scan when looking for access point modules. The default for this parameter is to scan all available frequencies.

LAN1 IP: enter in the IP address that will be associated with the Ethernet connection on this module. The default address is 169.254.1.1.

The radio buttons to the right of the IP address field offer the ability to make the LAN 1 IP either a local or publicly accessible address. If the address is designated a local address it will only be accessible via the host computer (network) that is connected to the module via the Ethernet

cable. If the address is designated a public address it will be accessible network-wide. The default for this feature is for the address to be local. If the IP address is forgotten, the operator will need physical access to the module and will need to create a Cyclone “default plug”.

LAN1 Subnet Mask: enter in an appropriate subnet mask for the module to “talk” on the network. The default value for this parameter is 255.255.255.0

Default Gateway: enter in an appropriate gateway address for the module. The default value for this parameter is 169.254.0.0.

Color Code: enter in a value (0-254). The color code on the subscriber module and the access point module *must* match in order for registration to occur. Color code is not a security feature. It is a means for the Cyclone System operator to segregate an individual network or neighbor Cyclone networks. Also, color code can be used to force a subscriber module to only register to a specific access point module even though the subscriber module may be able to see multiple access point modules. The default value for this parameter is 0 on all Cyclone modules.

Display-Only Password: enter the same password in both fields for verification. The display-only password, when used, will allow only view activities to the module. When the display-only password is set and not the full-access password, the display-only password will be tied to telnet and FTP sessions to the module. If the full-access password is also set then it has precedence on the telnet and FTP sessions. If the password is forgotten, the operator will need physical access to the module and will need to create a Cyclone “default plug” to override the unit. See steps to create and use a default plug in the section on the Timing Master.

Full-Access Password: enter the same password in both fields for verification. The full-access password, when used, will allow view and change activities to the module. When the full-access password is set, the password will also be tied to telnet and FTP sessions to the module. When prompted for the password via the web-based interface, there is no username required; however when prompted for the password via a telnet or FTP session, the user that **MUST** be used is “root”. If the password is forgotten, the operator will need physical access to the module and will need to create a Cyclone “default plug” to override the unit. See steps to create and use a default plug in the section on the Timing Master.

Webpage Auto Update: enter time period (in seconds) desired to have the web browser refresh the web-based interface. The default setting is 0, which will cause the web-based interface to never refresh.

SM Power Up Mode with No 802.3 Link: choose which mode the module will default to when there is no Ethernet connection sensed by the module. There are two modes available, the first is Alignment mode and the second is Operational mode. Operational mode is the default setting.

Bridge Timeout Entry: choose the appropriate bridge timeout for correct network operation with existing network infrastructure. It is important that this parameter be set for a longer time period than the ARP (address resolution protocol) cache timeout of the router being used to feed the network.

Authorization Key: each module ships with a unique, pre-programmed authorization key to be used when an operator configures the Cyclone System for DES encryption.

Site Name: enter information relating to a name given to the physical module. This parameter will set the supplied information into the *sysName* SNMP MIB-II object and can be polled by a SNMP management server. The buffer size for this field is 256 characters.

Site Contact: enter contact information relating to the module. This parameter will set the supplied information into the *sysContact* SNMP MIB-II object and can be polled by a SNMP management server. The buffer size for this field is 256 characters.

Site Location: enter information relating to the physical location of the module. This parameter will set the supplied information into the *sysLocation* SNMP MIB-II object and can be polled by a SNMP management server. The buffer size for this field is 256 characters.

Save Changes: by clicking on this button, any changes that have been made on the *Configuration* page will be committed to flash memory and will take effect after the next module reboot.

Undo Save Changes: by clicking on this button, any changes that have been made and **not** committed through a reboot of the module.

Set to Factory Defaults: depressing this button will change all of the configurable parameters (all of which are contained on the *Configuration* page) back to their factory settings.

Reboot: depressing this button will reboot the module.

An example of the information shown on this web page for each access point module:

```
Index: 0 Frequency: 0 MHz ESN: 0a-00-3e-00-01-d5
Jitter: 5 RSSI: 1295 Beacon Count: 37
Type: Multipoint Avail: 1 Age: 0 Lockout: 0 RegFail 0 Range: 245 feet TxBER: 1
Session Count: 3 No LUIDS: 0 Out of Range: 0 Rescan Req: 0
FrameNumber: 568 SectorID: 0 Color Code: 0 BeaconVersion: 1 SectorUserCount: 1
PercentDataDwn: 75 PercentDataUpHi: 0 NumDackSlots: 3 NumContSlots: 3 NumUAckSlots: 3
```

Descriptions of the parameters that can be useful for managing and troubleshooting a Cyclone System are:

Index: each access point module that a subscriber module can see is assigned an index value for purposes of this web page only. The index number starts with 0 and increases by 1. This index is used to tell the operator which access point module the subscriber is currently registered to. For example, the first line of text on the web page says “*Current entry index: 5*”, the operator would then scroll down the list of access point modules to the module with “*Index: 5*” to view information about the link.

Frequency: displays the transmit frequency of the access point module.

ESN: displays the electronic serial number (MAC address) of the access point module.

Jitter: displays the last jitter value captured between the subscriber and access point module.

Range: displays the distance (in feet) between the subscriber and access point module. This parameter will only be valid when observing the data for the access point module that the subscriber is currently registered to.

Session Count: displays the number of times the subscriber module has gone in and out of session with the access point. If this number is particularly large, it typically signifies that there is some sort of issue with the link (i.e. non line of sight, interferers, etc.)

Out of Range: displays a counter for the number of times the access point module has seen a subscriber module who has attempted to register and has been farther away than the *max range* parameter on the access point.

Sector ID: displays the sector ID of the access point module.

Color Code: displays the color code of the access point module.

Sector User Count: displays the numbers of registered subscriber modules on the access point.

Rescan APs: click on this button to force the subscriber module to redo the scanning process. The subscriber module will scan, through the frequencies checked on the *Configuration* web page, for all available access point modules and register to the one that provides the best results for RSSI, Jitter, and number of registered users.

Link Test

The Link Test is a test for measuring the throughput and efficiency of the RF link between two Cyclone modules. To perform a link test enter a number into the field labeled “*Duration*”. The duration is the number of seconds the RF link will be tested. Start the link test by clicking the “*Start Test*” button. The test will now run for the set duration. If the web page is not set to automatically refresh, click the “*Refresh Display*” button to see the results. For a Cyclone System link to be considered acceptable it is necessary for the efficiencies of the link test to be greater than 90% in both the uplink and downlink direction. It is recommended that when a new link is installed that a link test be executed to ensure that the efficiencies are within recommended guidelines. The key fields are:

- Downlink RATE, bits per second
- Uplink RATE, bits per second
- Downlink Efficiency, percent
- Uplink Efficiency, percent

Alignment

The Alignment web page contains tools to assist in the alignment of a subscriber module to an access point module. There are two modes that can be utilized when aligning a module: 1) RSSI only and 2) normal alignment mode. RSSI Only is a mode where the module will report the signal strength based on the amount of energy present at a selected frequency. The subscriber module does not have to be registered to an access point module for information on signal strength to be reported back. This can simplify the aiming process for long links. To utilize RSSI only mode:

- Choose the frequency to monitor from the pick list (this would be the same frequency that the backhaul timing master module is transmitting on)
- Click the radio button to highlight “*Enable*” on RSSI Only mode
- Click “*Enable Aiming Mode*”

The module will now report back the level of RF energy present at that specific frequency. To refresh the screen, click the *Enable Aiming Mode* button as appropriate or configure the web page auto-refresh option. The normal operation of alignment mode will report information as it relates to the RSSI level and Jitter value. To utilize normal alignment mode, ensure that the *Disabled* radio button is checked and then click *Enable Aiming Mode* button. As with the previous mode to refresh the mode either continue clicking the *Enable Aiming Mode* button or configure the auto-refresh option. Also, during normal alignment mode the LEDs on the outside of the Cyclone module will report back information on the performance of the link. There are 6 LEDs and when in alignment mode the LEDs are turned into a 6-position bar graph. The more LEDs that are lit, the better the RSSI and Jitter values the module is seeing. The colors of the LEDs have no particular meaning other than to assist in distinguishing one position from the next. The minimum values that are needed for an acceptable link are RSSI this above 700, Jitter that is between 5 and 9, and link efficiencies that are greater than 90% in both the up and down link. If any one of these criteria are not met the link may still be operational but may have issues time to time.

Note: If a Cyclone module is placed into Alignment Mode it will automatically drop into Operational Mode after 15 minutes.

BER Display

Bit Error Rate (BER) Display is utilized by the operator to measure the amount bit errors present in a link. BER Display will only work if the access point module is configured to send the BER stream.

*****IMPORTANT** If one access point module in a cluster is set to send a BER stream then all other access point modules in that cluster must be configured in the same fashion.***

The field, Measured Bit Error Rate, will display a value that corresponds to the BER at the moment of web browser refresh. An acceptable link will have a BER that is less than 10^{-4} . If the BER is greater than 10^{-4} then the operator needs to evaluate the subscriber and/or access point module installation for potential issues. To refresh the screen, click the *Refresh Display* button as appropriate or configure the web page auto-refresh option.

APPENDIX

There are two basic concepts that are needed for a basic understanding of networking, IP addresses and subnet masks. IP addresses are 32-bit binary numbers that have two corresponding parts or sub-addresses, the first part identifying the network and the second part identifying the hosts on the network. An imaginary boundary separates the first part from the second. This imaginary boundary is marked by way of the subnet mask. The subnet mask is another 32-bit binary number that acts like a filter on the IP address. When a subnet mask has a bit set to 1, the corresponding bit in the IP address is part of the network address. A subnet is classified as either a class A, class B, or class C network. The following table shows the common subnet mask classes:

Class Network Portion Host Portion

A 11111111 00000000 00000000 00000000

B 11111111 11111111 00000000 00000000

C 11111111 11111111 11111111 00000000

For example, if you have an IP address of 169.254.1.1 and a subnet mask of 255.255.0.0, then the first 16-bits of the 32-bit IP address identify the network.

10101001 11111110 00000001 00000001 *IP address*

11111111 11111111 00000000 00000000 *Subnet Mask*

There are 216 (65,536) addressable hosts in this example and 169.254 is the network. There is one last piece of information that is needed here. Subnet masks are not shipped around in the IP packet, the packet only contains the 32-bit IP address of the destination. So without this valuable piece of information devices have no idea what portion of the IP address is part of the network and which is part of the host address. How does data know where it is supposed to go? IP systems developed a unique form of logic to make this determination. Class A network addresses always have the first bit of their IP address set to 0. Class B network addresses always have their first bit set to 1 and their second bit set to 0. Class C network addresses always have their first two bits set to 1 and the third bit set to 0. By examining these first bits of the IP address a device can determine what subnet mask should be applied to the IP address and determine where to route the data.

The following is a synopsis of an Internet Draft (<http://www.ietf.org/internet-drafts/draft-ietf-zeroconf-ipv4-linklocal-05.txt>) that describes how Microsoft and Apple operating systems react when a DHCP server is not found on the network. In general, a computer needs certain configuration information to operate on a network. Those configurations are an IP address, a subnet mask, and possibly a gateway address. A DHCP server will automatically assign this configuration information to a computer on a network or an operator is required to manually input these configurable items. When a computer is brought online and a DHCP server

is not accessible (i.e. server is down or the computer is not plugged into the network) Microsoft and Apple operating systems will default to an IP address and subnet mask of 169.254.x.x and 255.255.0.0 (169.254/16).

SPECIFICATIONS

- Operating Frequency Range
- ISM 902 - 928 MHz
- Access Method TDD/TDMA
- Signaling Rate 10 Mbps
- Modulation Type High Index BFSK
- (Optimized for interference rejection)
- Carrier to Interference (C/I) also known as Jitter 3dB nominal
- Receiver Sensitivity -90dBm 10⁻⁴ BER
- Operating Range (All Weather)
- Transmitter Power Meets FCC ISM ERP Limit
- DC Power .3A @ 24 VDC (7.2 watts)
- Interface 10/100 BaseT, half/full duplex
- Rate auto negotiated (802.3 compliant)
- Protocols Used by Cyclone IPV4, UDP, TCP, ICMP, Telnet,
- HTTP, FTP, SNMP, DES
- Protocols Supported by Cyclone
- Switched Layer 2 Transport with support for all common Ethernet
- protocols including IPV6, NetBIOS, DHCP, IPX, etc.
- Software Upgrade Path Remotely downloaded into FLASH via RF link
- Network Management HTTP, TELNET, FTP, SNMP
- Temperature -40°C to +55°C (-40°F - +131°F)
- Dimensions 89" H x 4.5" W x 6" D