



AN-30 System User Manual

Manual 70-00019-00 Rev. 3

Redline Communications AN-30 System User Manual

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2 - A Class A digital device is marketed for use in a commercial, industrial or business environment, exclusive of a device which is marketed for use by the general public or is intended to be used in the home.

3 - Intentional or unintentional changes or modifications not expressly approved by the party responsible for compliance must not be made. Any such modifications could void the user's authority to operate the equipment and will void the manufacturer's warranty.

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TABLE OF CONTENTS

1.	Getting Started	8
1.1.	How To Use This Manual	8
1.2.	AN-30 System Overview	8
1.3.	TDM over Wireless Theory of Operation	9
2.	Important Safety Information	10
3.	Important Service Information	12
4.	Unpacking the AN-30 System	13
5.	The AN-30 Terminal at a Glance.....	14
5.1.	The AN-30 System's T-58 Transceiver / Antenna at a Glance	18
6.	AN-30 System Installation	19
6.1.	General Site Survey	20
6.2.	Installing The Antenna.....	21
6.3.	Running The IF Cable	22
6.4.	Installing The Terminal	23
6.5.	Aligning The Antenna	25
7.	System Configuration and Operation Via The Console Port.....	27
8.	System Configuration and Operation Via Telnet.....	28
9.	AN-30 CLI (Command Line Interface) for Wireless and Ethernet	30
9.1.	CLI General Commands.....	30
9.2.	CLI System Configuration Commands	31
9.3.	CLI General Status Information Commands.....	35
9.4.	Upload Software.....	38
9.5.	System Password.....	39
9.6.	AN-30 Options.....	39
9.7.	System Logs.....	40
10.	AN-30 CLI (Command Line Interface) for the TDM card	43
10.1.	DS0 Bundles.....	43
10.2.	Command Line Interface	44
10.3.	Quick Setup	45
10.4.	Configuration	46
10.5.	Control commands	46
10.6.	General configuration commands.....	48
10.7.	Serial interface configuration commands	52
10.8.	DS0 Bundle configuration commands	53
10.9.	56
10.10.	Sample Setup Scripts	57
10.11.	Statistics commands.....	59
10.11.1.	Ethernet properties and statistics	59
10.11.2.	TDM properties and statistics	60
11.	Broadband Fixed Wireless Primer.....	62
11.1.	Who Can Benefit From The AN-30 System?.....	62
11.2.	The AN-30 Advantage	64
11.3.	Wireless Facts	66
11.3.1.	The Link Budget Tool	66
11.4.	Deployment Scenarios	72
11.4.1.	Co-located Deployments	72
11.4.2.	Adjacent Area Deployments	72
12.	Appendix	74

12.1.	Appendix 1 - Glossary Of Terms	74
12.2.	Appendix 2 – AN-30 Support For TDM explained	76
12.3.	Appendix 3 - AN-30 System Specifications	77

LIST OF TABLES

Table 1: FCC and Industry Canada Certified 5.8GHz Antennas.....	26
Table 2: Factory Defaults For Account Username and Password Values	28
Table 3: RF Channel Center Frequencies	33
Table 4: Max. Operational Power Per Channel (in dBm) vs. Modulation.....	33
Table 5: RF Status Error Codes.....	36
Table 6: E1 Framed Configuration Script.....	57
Table 7 : T1 Framed Configuration Script.....	58
Table 8: Modulation Scheme vs. Data Rate.....	67
Table 9: Availability Versus Outage Time	69
Table 10: Radar Horizon Ranges For Different Terminal Heights (H ₁ and H ₂)	71

LIST OF FIGURES

Figure 1: The AN-30 System Out Of The Box.....	13
Figure 2: Front Panel – System	14
Figure 3: Front Panel - Wireless	15
Figure 4: Front Panel – Ethernet.....	15
Figure 5: LAN Interface	16
Figure 6: AN-30 Radio With Vertical Mount	18
Figure 7: AN-30 System Installation.....	19
Figure 8: Radio Deployment Options	21
Figure 9: IF Cable	22
Figure 10: AN-30 Terminal Connected To Switch / Router / Hub	24
Figure 11: AN-30 Terminal Connected To Host Computer	24
Figure 12: AN-30 Terminal LAN Ethernet Port Pinout	25
Figure 13: Aligning The Antenna - Vertical Mount	25
Figure 14: System Logs Screen.....	40
Figure 15 Typical PTP ‘single hop’ configuration.....	43
Figure 16 Typical PTP ‘multi-hop’ configuration.....	44
Figure 17: Wireless Extension for Carriers	62
Figure 18: Wireless Solution For ISPs	63
Figure 19: Wireless Solution For Enterprise	64
Figure 20: Fresnel Zone Obstruction	68
Figure 21: Fresnel Zone Radius Calculation.....	68
Figure 22: Link Budget For 64 QAM $\frac{3}{4}$ Code Rate	70
Figure 23: Fade Margin Graphs For LOS, OLOS and NLOS.....	71
Figure 24: Adjacent Channel Interference.	72
Figure 25: Deployment Scenarios.....	73

1. Getting Started

1.1. How To Use This Manual

This User Manual is designed to get you started using the Redline Communications Access Node-30 (AN-30) Broadband Fixed Wireless (BFW) system by guiding you through the step-by-step process of setting up the system for the first time.

To that end, the following principal steps will need to be followed in the order presented:

- Review the safety and service information (Sections 2 and 3 of this manual)
- Unpack the AN-30 system (Section 4)
- Install the outdoor radio (transceiver plus antenna) (Section 6)
- Install the indoor terminal (Section 6)
- Configure the system via a host computer and (CLI) interface (Section 8)
- Ensure the encryption key has been properly configured (see Section 0)
- Install the 16/64 QAM license key to activate high speed Ethernet access (see Section 8.6 on page 39)

This User Manual will also help with the following:

- Understanding Fixed Wireless Systems
- Referencing AN-30 System Specifications
- Troubleshooting the System

1.2. AN-30 System Overview

The AN-30 is a wireless transport system providing simultaneous interfacing for legacy TDM and data traffic. Its architecture makes it an ideal platform to facilitate the migration from a TDM based telecom infrastructure to a fully packet based VoIP Next generation network.

The AN-30 can simultaneously support the transport of up to four (4) full or two (2) fractional rate T1/E1 lines along with high speed Ethernet access, available through optional license keys.

The AN-30 system operates in the licensed exempt band of 5.8 GHz and includes advanced technologies to address any potential inter-cell interference issues. The system supports modulation schemes, including BPSK, QPSK, 16 and 64 QAM to maximize data rate, and hence spectral efficiency. The system also features selective coding to ensure maximum robustness, and hence error free performance in the presence of hostile propagation conditions.

The AN-30 can be equipped with a narrow beam antenna to provide high directivity for long-range operations up to 30 miles (50 km) under line of sight (LOS) conditions, and up to 6.2 miles (10 km) under non line of sight (NLOS) conditions.

The AN-30 system is a Class A digital device for use in a commercial, industrial or business environment.

1.3. TDM over Wireless Theory of Operation

TDM transport is achieved through a form of circuit emulation, which has been specifically optimized for wireless operation.

TDM traffic, digitized voice or chanelized data, is received by the AN-30 at the RJ48 / BNC interfaces, interpreted and encapsulated within an Ethernet frame structure. The Ethernet encapsulated traffic is then transported over the wireless link to a remote end AN-30, where the TDM traffic is reconstructed by reversing the encapsulation process and re-clocking the TDM traffic.

Variable delay is commonly associated with packet based networks and can be introduced by the AN-30 during packet processing and transmission of simultaneous TDM and data traffic streams. In order to insure proper timing of the reconstructed traffic, the remote AN-30 employs a jitter buffer that is user defined between 5 and 300 msec. The jitter buffer is used to compensate for any delay variation that may occur during transport of the ethernet encapsulated traffic. For time sensitive applications, such as TDM voice, the buffer is typically set below 10 msec, while more data centric applications would employ a buffer that is closer to 300 msec to maximize packet efficiency.

Fractional nx64 services are also supported by allowing the user to specify which timeslot channels to transport over the wireless link. Timeslots can be set from 1 to 24 for T1 and from 1 to 32 for E1.

The AN-30 supports IEEE 802.1p, 802.1Q and 802.3x. Using these standards for VLAN tagging prioritization and flow control the AN-30 is able to maintain the necessary QoS guarantees for TDM traffic while simultaneously transporting data applications using the excess bandwidth.

2. Important Safety Information



- 1** Read this User Manual and follow all operating and safety instructions.
- 2** Keep all product information for future reference.
- 3** This product is supplied with a grounding power plug. Do not defeat this important safety feature.
- 4** The power requirements are indicated on the product-marking label. Do not exceed the described limits.
- 5** Always replace the fuse with the correct type and current rating.
- 6** Position the power cord to avoid possible damage, and do not overload wall outlets.
- 7** Do not place this product on or near a direct heat source, and avoid placing objects on the terminal.
- 8** Do not operate this device near water or in a wet location.
- 9** Use only a damp cloth for cleaning. Do not use liquid or aerosol cleaners. Disconnect the power before cleaning.
- 10** Protect the unit by disconnecting the power if it is not used for long periods of time.
- 11** Locate the AN-30 terminal on a stable horizontal surface or mount it securely in a 19" Telco rack.
- 12** The T-58 Transceiver unit must not be located near power lines or other electrical power circuits.
- 13** The T-58 Transceiver must be properly grounded to protect against power surges and accumulated static electricity. It is the user's responsibility to install this device in accordance with Section 810 of the National Electrical Code, ANSI/NFPA No. 70-1984 or Section 54 of the Canadian Electrical Code. These codes describe correct installation procedures for grounding of the transceiver unit, mast, lead-in wire and discharge unit, location of discharge unit, size of grounding conductors and connection requirements for grounding electrodes. It is recommended that the installation of the transceiver be contracted to a professional installer.

The following symbols may be encountered during installation or troubleshooting. These warning symbols mean *danger*. Bodily injury may result if you are not aware of the safety hazards involved in working with electrical equipment and radio transmitters. Familiarize yourself with standard safety practices before continuing.



Electro-Magnetic Radiation



High Voltage

3. Important Service Information



1 Refer all repairs to qualified service personnel. Do not remove the covers or modify any part of this device, as this will void the warranty.

2 Disconnect the power to this product and return it for service if the following conditions apply:

- a) The unit does not function after following the operating instructions outlined in this manual.
- b) Liquid has been spilled, a foreign object is inside or the AN-30 terminal has been exposed to rain.
- c) The product has been dropped or the housing is damaged.

3 Locate the serial number of the AN-30 Terminal, Antenna, and T-58 Transceiver and record these on your registration card for future reference. Use the space below to affix serial number stickers. Also record the MAC address, located on the back of the AN-30 Terminal.

Product Information	
AN-30 Terminal SN: _____	AN-30 Terminal MAC Address: _____
T-58 Transceiver SN: _____	Model #: _____
Antenna Model No.: _____	Antenna SN: _____
Serial Number Stickers	

4. Unpacking the AN-30 System

The AN-30 system comes packaged with the following major items (refer to Figure 1 for a pictorial view):

- AN-30 terminal (indoor unit)
- AN-30 Radio (outdoor unit):
 - T-58 Transceiver
 - Antenna
 - Antenna Mounting Bracket
- Power Cord and outdoor IF Cable (100 ft. / 30.5 m)
- User Manual

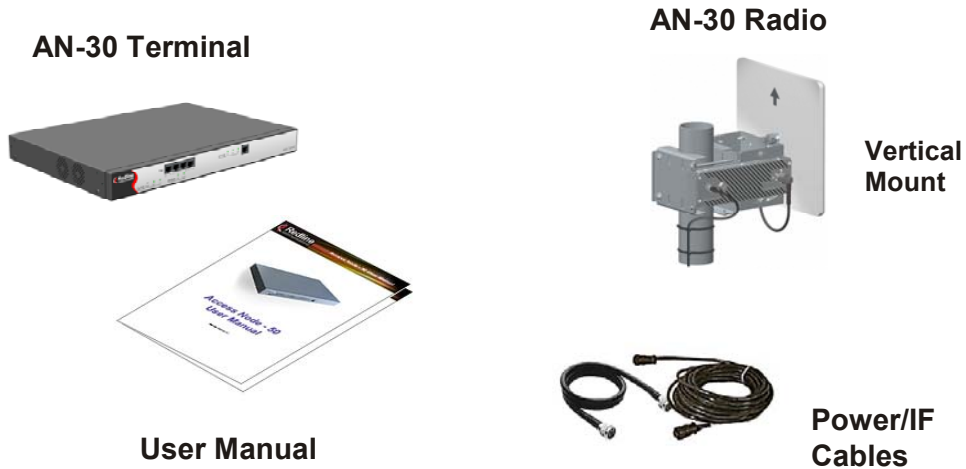


Figure 1: The AN-30 System Out Of The Box

A complete list of items included in the system is available on the packing list included with the system.

5. The AN-30 Terminal at a Glance

The front panel of the AN-30 terminal includes an RJ45 Ethernet interface, four (4) RJ48 / BNC E1/T1 interfaces and four (4) grouped status indicators; System, Wireless, TDM and Ethernet. The rear of the terminal includes the power cord connector and an F-Type female connector for the IF cable.

At power up, an LED power-up sequence occurs as follows:

All three Ethernet LEDs light for one second, then individual Ethernet LEDs blink twice in the following order: 100, FD, Link. The Fault LED lights for approximately four seconds, then turns off. The two Wireless LEDs remain off for approximately five seconds, then blink once and resume their normal state.

A) System Status Indicators

The System portion of the front panel features a recessed reset switch and two LEDs (Pwr and Fault), as shown in the figure below.



Figure 2: Front Panel – System

Reset – The system can be manually hard reset by depressing the “Reset” button recessed in the front panel. The reset button is used to reactivate the terminal in the event that it is functioning improperly or is in a state of suspension.

Pwr – The “Pwr” LED lights solid green when the AC power is properly applied to the terminal. In the event of internal power supply failure, if the cord is disconnected, or if the fuse is blown, the “Pwr” light will not illuminate.

Fault – The “Fault” LED lights solid red when a serious fault is detected within the system.

B) Wireless Status Indicators

The Wireless portion of the front panel features two LEDs; Link and Signal, as shown below.



Figure 3: Front Panel - Wireless

Link – The “Link” LED lights solid green when the radio link to the remote terminal is established. The LED will turn off if the link is lost.

Signal – The “Signal” LED lights solid green if the system is operating at the configured Uncoded Burst Rate. See section on for a detailed description.

C) Ethernet Status Indicators

The Ethernet status portion of the front panel display consists of three LEDs; Link, 100, FD, as shown below.



Figure 4: Front Panel – Ethernet

Link – The “Link” LED illuminates solid green when the Local Area Network (LAN) connection is established, and there is no traffic. The Link LED will flash when the Local Area Network (LAN) connection is established, and there is traffic.

100 – The “100” LED lights solid green when the Ethernet port is operating at 100 Mb/s. The LED will not illuminate if the port is operating in 10 Mb/s mode. The Ethernet port automatically selects the speed through auto-negotiation with either the host computer/server or router/switch.

FD – The “FD” LED is used to indicate if the Ethernet link is in full duplex and half duplex mode. It illuminates solid green for full duplex, and is set off to indicate half duplex mode. On a shared Ethernet networks, collisions are also indicated through the intermittent flashing of this LED. The system automatically selects the duplex mode through auto-negotiation with the host computer or switch.

D) The LAN Interface

The LAN interface is a 10/100 BaseT Ethernet port, which is used to connect the AN-30 terminal to either the core network or to a host computer. A router or switch is often used to complete the connection to the core network, as shown in the figure below. Note that different cables are required for connection to a hub/switch/router or host computer.

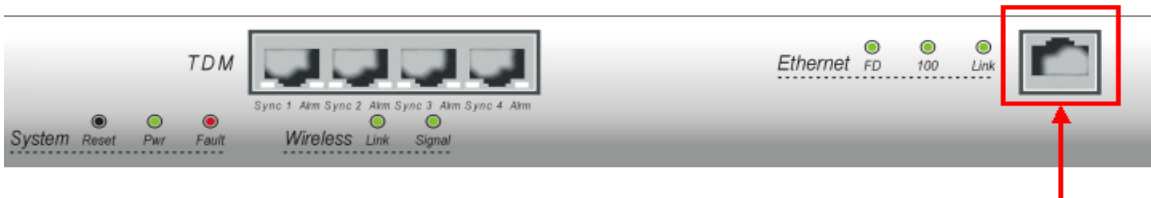


Figure 5: LAN Interface

All AN-30 base systems come equipped with basic Ethernet access (limited at under 2 Mbps). This feature is provided solely for the purpose of enabling remote in-band management. Optional license keys are available to activate access at higher speeds.

Warning

Exceeding the basic access rate of this port may impact the performance on the TDM interfaces.

E) The TDM Interface

The TDM interface includes four RJ48 / BNC E1/T1 ports, which are used to connect the AN-30 terminal to either a PBX or to another E1/T1 device. Note that different cables are required for connection to a third-party E1/T1 device.



Figure 6: TDM Interface

Each serial interface port has two LED indicators Alarm and Sync. LED indications are coded as follows for single alarm conditions

ALARM	Alarm LED (Amber)	Sync LED (Green)
LOS	On	Off
LFA	On	Blink
AIS	Off	Off
RAI	Flashes	Off
No Alarm	Off	On

The LEDs are able to report multiple alarm conditions as shown in the following table:

ALARM	Alarm LED (Amber)	Sync LED (Green)
AIS + LFA	Off	Blink
AIS + RAI	Flashes	Off
RAI + LFA	Flashes	Flashes

LOS = Loss of Signal

LFA = Loss of Frame Alignment

AIS = Alarm Indication Signal

RAI = Remote Alarm Indication

5.1. The AN-30 System's T-58 Transceiver / Antenna at a Glance

A vertical mount bracket (Figure 6) is provided with the system.

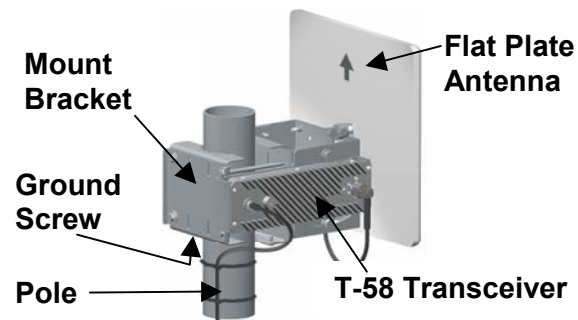


Figure 6: AN-30 Radio With Vertical Mount

The vertical mount bracket can accommodate 1 $\frac{3}{4}$ " to 4 $\frac{1}{2}$ " (4.45 cm – 11.45 cm) OD masts found on many commercial tower installations.



Before connecting the AN-30 system, it is important to review the safety tips provided at the beginning of this manual.

6. AN-30 System Installation

This section of the manual presents a basic overview of the steps required to install the AN-30 terminal, outdoor transceiver, antenna and associated equipment.

Figure 7 below illustrates the primary system components and cables. The power cord connects to a 110/220/240 VAC standard power outlet or to a 48 VDC, while the CAT 5/UTP cable (not included) connects the terminal to the data network via a standard 10/100BaseT Ethernet connection. The provided IF cable connects the terminal (located indoors) to the T-58 Transceiver (located outdoors), and carries the transmitted and received signal, DC power for the AN-30 radio, as well as control and reference signals. Note that the provided IF cable is meant for exterior use, and should be used for only minimal interior runs to connect to the terminal. Also note that the BNC connectors are for future use.

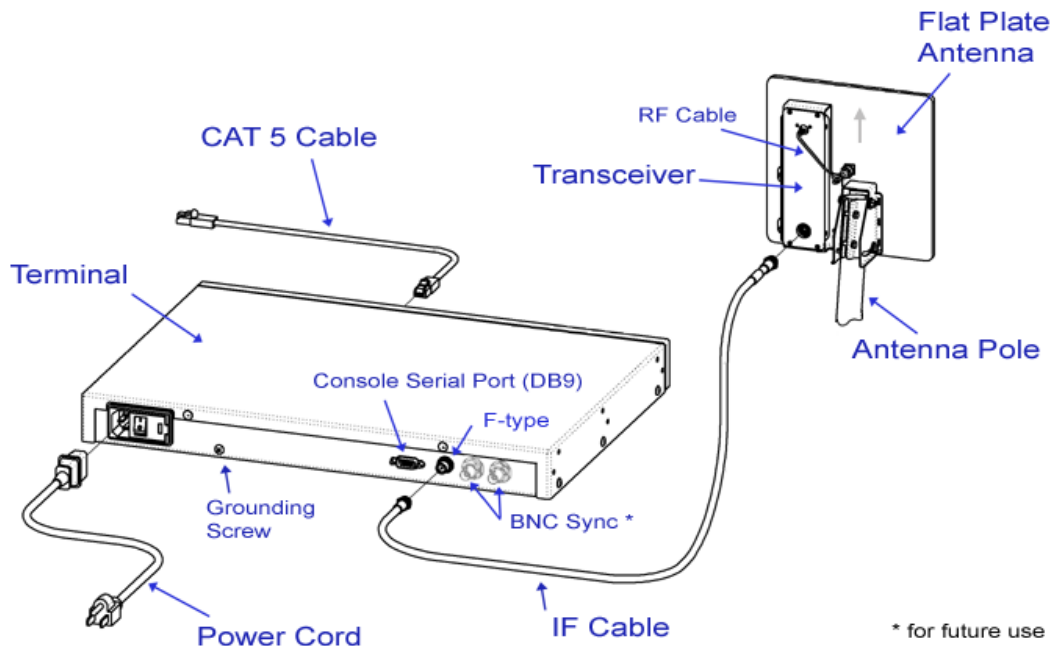


Figure 7: AN-30 System Installation

(AC shown)

The terminal is for indoor installation only, while the transceiver and antenna (together known as the AN-30 Radio) are mounted externally. The principal steps in installation are:

1. Conduct a general site survey
2. Install the antenna
3. Install the IF cable
4. Install the AN-30 terminal
5. Align the antenna

Each step is addressed in more detail below.

6.1. General Site Survey

The first step in installing the AN-30 system is to conduct a general site survey. Although the installation steps are relatively straightforward, they do involve some construction and electrical work, which is best performed by a professional installer.

The following site survey steps should be followed:

Determine the optimum location. The first key step in the deployment exercise is to determine and identify building candidates that can be used to support the link. A critical parameter to consider is the range at which the two terminals are required to operate. Range performance is determined by empirical formulas that consider a number of equipment and environmental factors described later in this manual. Ensure that the installation sites meet these range performance requirements before moving to the next step. You may use Redline's Link Budget Tool to determine the expected performance of the link. The Link Budget Tool can be obtained by contacting your Redline certified partner or system integrator. See Section 10.3.1 on page 66 for more information. **Verify the accuracy of any building drawings/blueprints that may be available.** The installation process may require penetrating the building to run the IF cable between the outdoor and indoor units. In this regard, it is imperative that the blueprints and/or drawings of the building are up to date and accurate. It may also be possible for the IF cable to be installed on the outside of the building leading to the antenna location on the roof of the building.

Identify the best path for the link. For maximum performance, it is recommended to mount the antenna in a location where there is line of sight to the remote terminal. If possible, the antenna should be positioned such that there is maximum clearance within the first Fresnel zone of the direct path. The best means of achieving Fresnel zone clearance is to mount the antennas as high as possible, on either a tall building or tower, as shown in Figure 8 (Vertical mount system is shown).

The AN-30 system is also designed to operate in non-line-of-sight (NLOS) conditions, as a result of the OFDM technology incorporated in the platform. Under NLOS conditions, the best method of obtaining a proper RF link is to evaluate different antenna orientations and choosing the one that results in the best Signal to Noise (SINADR) ratio and highest Received Signal Strength (RSSI) value. Often, this can be achieved by introducing an RF multipath condition by orienting the antennas towards a structure in sight of both the local and remote antennas. If the obstruction in the path is not exceptionally high, it may be possible to aim both antennas near the top of the obstruction. With the use of OFDM in the Redline system, any additional multipath signals introduced will provide additional opportunities for an improved link.

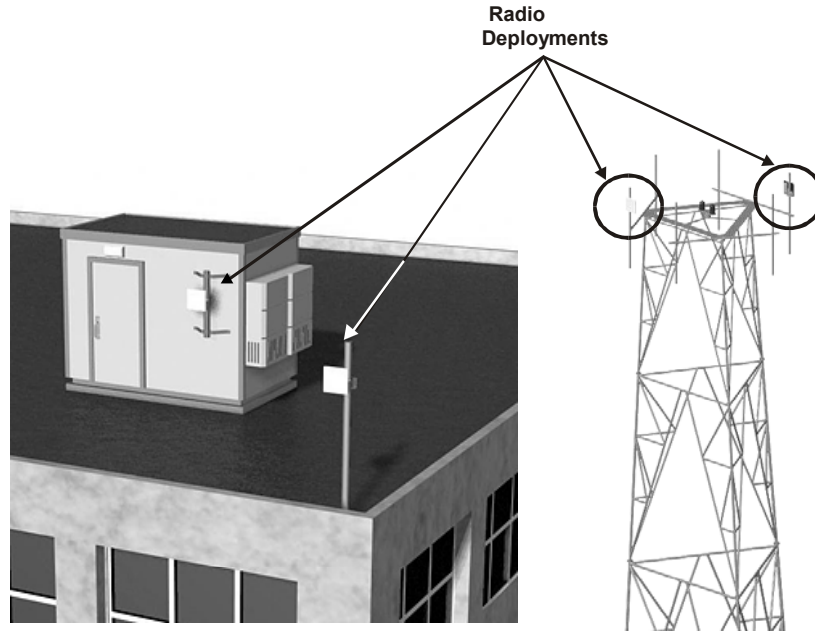


Figure 8: Radio Deployment Options

Identify potential sources of RF interference. Test for possible RF interference on the roof-top or tower by utilizing appropriate test equipment. RF interference arises from any other wireless system operating within the same frequency band as the AN-30. Note that the AN-30 system supports nine different overlapping channels within the 5.8 GHz band and has the ability to use up to five of these channels at any one cell site; there is, therefore, some flexibility in addressing or avoiding interference should other transmitters in relatively close proximity present problems.

6.2. Installing The Antenna

Once the site survey has been completed and the exact location for the antenna identified, the next step is to assemble and mount the radio onto either a building structure, pole or tower.

Note there is an arrow on the back of the antenna, which must point in the same direction for both the local and remote systems to ensure proper polarization when the antenna is deployed (see Figure 7 above). Ensure the proper polarization is used for the antenna before attaching the mounting bracket in the next step.

The vertical mount bracket is installed first. The antenna and mounting brackets have been designed to withstand strong winds; it is imperative that all hardware for the mounting brackets be securely fastened to avoid any movement which could introduce misalignment.

The T-58 Transceiver is then mounted to the mounting bracket. This assembly is in turn attached to the back of the antenna. Note the transceiver must be connected to the antenna via the short RF cable provided.

For building mounts, ensure the surface to which the mounting bracket will be attached is structurally sound, flat and vertical (use a level). Ensure that the installation can withstand wind loading.

6.3. Running The IF Cable

The system is shipped with a 100 foot (30.5 m) length of RG6 IF cable to connect the transceiver and indoor terminal. The IF cable carries the transmitted and received signal, DC power for the AN-30 radio, and control signals. One hundred feet is the mandatory minimum length; if a longer outdoor run is required, it is recommended that a single length of the appropriate cable be used; coupling the provided 100 foot cable to another length will result in increased attenuation. Refer to the cable requirements in the Specifications section at the end of this manual.

Note: If male F-type crimp connectors are used with custom cables, the cable's core conductor diameter must be no larger than 1mm (.042 inches) or longer than 1cm (0.38 inches) to avoid damage to the T-58 and AN-30 connectors. If the core diameter exceeds 1mm, use soldered F-type connectors that do not exceed these dimensions.

The following steps define the cable installation process:

1. Run the cable alongside the antenna pole as shown. The IF cable is equipped with 75 ohm male F-type connectors at both ends. Ensure the cable is running downward as shown to prevent water from accumulating on the connector. The cable should be fastened to the pole to prevent movement or damage to the connector.



Figure 9: IF Cable

2. The RF cable should connect the antenna to the transceiver.
3. Connect the male IF cable connector to the female F-type connector on the transceiver. The connector should then be weatherproofed with a standard weatherproofing material for outdoor RF installations. Note that the provided IF cable is for exterior use. It is recommended that the cable terminate at the exterior wall using a grounding block, and that interior grade cable be used to connect the terminal to the grounding block according to local codes. For convenience, a grounding block is included with the AN-30 system. An optional lightning arrestor may be used to protect the terminal and other indoor equipment from sudden electrical surges. A suitable arrestor may be purchased through any of Redline's system integrators. Note that performance may be affected by the use of other arrestors.
4. Connect the IF cable to the F-type female connector located on the back of the terminal. The connector should be tightened finger-tight and then tightened an additional 1/8 of a turn.

6.4. Installing The Terminal

Once the AN-30 terminal and the radio are connected, the terminal is ready to be installed and configured. The Ethernet data port will automatically negotiate network speed (10/100 Mbps) based on the capability of the device to which it is interfacing with.

If the terminal is used for connection to a core network, the network device is likely to be a router, hub, or switch as shown in Figure 10. In this configuration, a cross-over Ethernet cable is required to connect between the terminal and the network device.

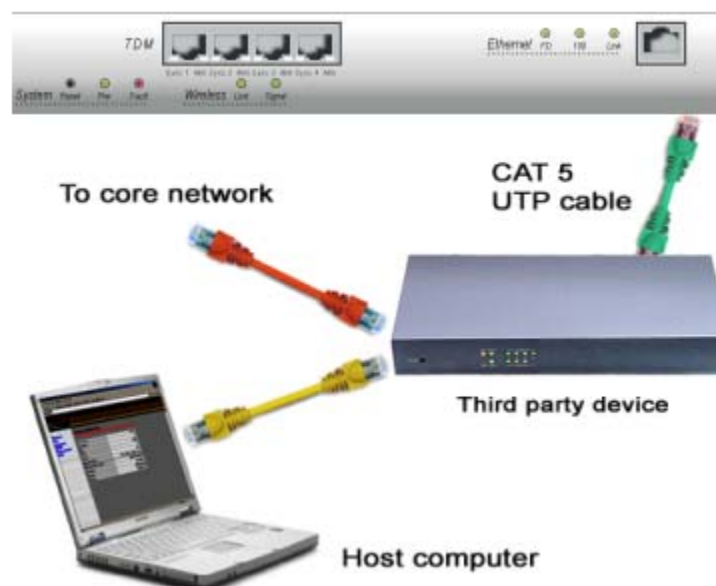


Figure 10: AN-30 Terminal Connected To Switch / Router / Hub

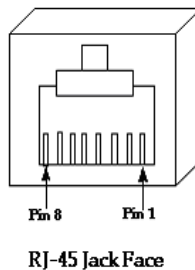
The AN-30 terminal may also be connected directly to the host computer, as shown in Figure 11. In this configuration, a straight-through CAT 5/UTP cable is required to complete the connection.



Figure 11: AN-30 Terminal Connected To Host Computer

To help you establish other implementations that are not addressed in this manual, Figure 12 provides an illustration of the pinout for the AN-30 terminal LAN interface.

Warning: do not connect a telephone cable to the AN-30 LAN interface, as this will damage the terminal.



Jack Pin	Function
1	Rx +
2	Rx -
3	Tx +
6	Tx -

Figure 12: AN-30 Terminal LAN Ethernet Port Pinout

Now connect the DC or AC cord to the AN-30 outlet and turn the terminal on using the toggle switch at the rear of the unit. The system “Pwr” LED should illuminate green to indicate power to the unit. The system is now ready to be configured. If the Pwr LED is not on and/or the “Fault” LED illuminates red, there is a problem with the terminal.

6.5. Aligning The Antenna

Once the antenna is mounted and the terminal is installed, the antenna must be aligned in both the azimuth and elevation planes. Elevation alignment is accomplished by loosening the two bolts attached to the mounting bracket, as shown in Figure 13 below, and angling the antenna so it is aligned towards the remote terminal. The azimuth alignment is accomplished by loosening the bolts on the antenna bracket and rotating the antenna until alignment is achieved. For basic tuning using actual signal strength, an alignment "buzzer" (intermittent tone sweep generator) is available on the T-58 Transceiver. Faster repetitions of the tone sweep indicate better alignment. The buzzer is enabled via the software interface described in section 0.

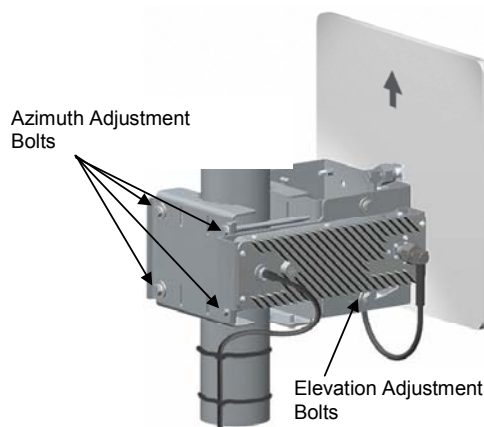


Figure 13: Aligning The Antenna - Vertical Mount

NOTICE

1 - The AN-30 System is used as a fixed wireless TDM and Ethernet bridge that requires professional installation with specified antennas and output power levels certified under the FCC Grant for AN-30 System for Point-to-Point or Point to Multipoint mode of operations.

2 - FCC RF Exposure Requirements - The antenna(s) used for this transmitter must be fixed-mounted on outdoor permanent structures with a separation distance of at least 3.0 meters (9.3 feet) from all persons and must not be co-located or operating in conjunction with any other antenna or transmitter.

3 - The AN-30 System is certified by the FCC and Industry Canada with 5.8 GHz directional antennas, listed below:

Table 1: FCC and Industry Canada Certified 5.8GHz Antennas

<i>Model Number</i>	<i>Antenna Gain, dBi</i>	<i>Antenna Type</i>	<i>Application</i>
486001	28.0	<i>Directional, planar array</i>	<i>PMP & PTP</i>
485002	23.0	<i>Directional, planar array</i>	<i>PMP & PTP</i>
485024	21.0	<i>Directional, flat panel</i>	<i>PMP & PTP</i>
484027	14.0	<i>Directional, flat panel</i>	<i>PMP & PTP</i>
484026	15.0	<i>Omni Directional, flat panel</i>	<i>PMP</i>
484025	14.0	<i>Omni Directional, flat panel</i>	<i>PMP</i>
SP4-5.2	34.8	<i>Directional, parabolic</i>	<i>PMP & PTP</i>
SP3-5.2	31.2	<i>Directional, parabolic</i>	<i>PMP & PTP</i>
SP2-5.2	29.0	<i>Directional, parabolic</i>	<i>PMP & PTP</i>
SP1-5.2	22.5	<i>Directional, parabolic</i>	<i>PMP & PTP</i>
SEC-55V-60-17	17.0	<i>Directional, sector</i>	<i>PMP & PTP</i>
SEC-55V-90-16	16.0	<i>Directional, sector</i>	<i>PMP & PTP</i>
MPR58031PTNF	31.0	<i>Directional, parabolic</i>	<i>PMP & PTP</i>
MPR58029PTNF	29.0	<i>Directional, parabolic</i>	<i>PMP & PTP</i>
TDJ-5818AM-60	18.0	<i>Directional, sector</i>	<i>PMP & PTP</i>
TDJ-5816AM-90	16.0	<i>Directional, sector</i>	<i>PMP & PTP</i>

Note: For the most current FCC / IC approved antenna list please visit our web site at www.redlinecommunications.com

4 - For fixed, point-to-point mode of operations, the transmitting antennas are specified in the above table; the use of omni-directional antenna is prohibited for point-to-point operation.

7. System Configuration and Operation Via The Console Port

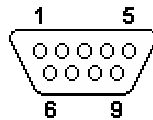
All operator communications with the AN-30 terminal may be made using a direct connection to the serial Console Port on the back of the terminal. This section describes the procedures for configuring and operating the AN-30 terminal via the Console Port using the command line interface (CLI).

Connect a PC/Terminal to the AN-30 terminal’s serial port DB9 connector using a cross-connect or null modem cable (DB9 female-female). Set the PC/Terminal to emulate a VT-52 or VT-100 terminal, using the following port settings:

Bits Per Second:9600; Data Bits:8; Parity: None; Stop Bits:1; Flow Control: Hardware

Hit the ‘Enter’ key – the AN-30 prompt will appear.

The diagram below shows the 9 PIN D-SUB male connector pinout at the AN-30 Terminal:



Pin	Name	RS232	V.24	Description
1	CD	CF	109	Carrier Detect
2	RXD	BB	104	Receive Data
3	TXD	BA	103	Transmit Data
4	DTR	CD	108.2	Data Terminal Ready
5	GND	AB	102	System Ground
6	DSR	CC	107	Data Set Ready
7	RTS	CA	105	Request to Send
8	CTS	CB	106	Clear to Send
9	RI	CE	125	Ring Indicator

Note: RS232 column is RS232 circuit name.

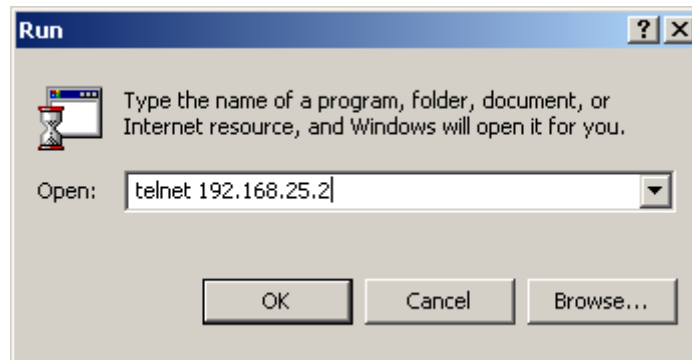
Note: V.24 column is ITU-TSS V.24 circuit name.

The terminal may now be configured and queried using a set of CLI. Type ‘help’ for a list of general commands.

8. System Configuration and Operation Via Telnet

All operator communications with the AN-30 terminal may be made using CLI over Telnet. This offers the advantage of allowing the operator to access and control the AN-30 terminal remotely from any geographical location, without the need for a web browser. This section describes the procedures for configuring and operating the AN-30 terminal via Telnet using the command line interface (CLI).

To connect to the terminal, Telnet to the IP address of the terminal (default address shown below).



When the command prompt screen appears, login using the Username: **admin** and Password: **admin**. The terminal may now be configured and queried using a set of CLI commands. Type ‘help’ for a list of general commands.

The AN-30 is factory set with two login accounts; “Administrator” and “User”. Logging in under the administrator account allows all privileges. Logging in under the user account restricts the privileges to executing show and get operations only. The factory set default values for each account’s username and password are given below:

Table 2: Factory Defaults For Account Username and Password Values

Account	Username	Password
Administrator	admin	admin
User	user	user

The administrator account’s default values, for both the username and password, are factory set to “**admin**”. The user account’s default values, for both the username and password are factory set to “**user**”.

Refer to the System Password screen to change the password for future sessions. If the password is changed, record it in a secure location for future reference. Note that the username cannot be changed for the Administrator account.

Wireless Configuration:

Max RF power: This parameter specifies the maximum power level of the system. Depending on RF channel, FCC regulations and/or local /regional regulations, the user must follow the table below when determining the power to be used.

<i>Model Number</i>	<i>Antenna Gain, dBi</i>	<i>Antenna Type</i>	<i>Application</i>	<i>Min conducted power (dBm)</i>	<i>Max conducted power ratings (dBm)</i>	<i>EIRP limit (dBm)</i>
486001	28.0	Directional, planar array	PMP	-5.4	8	36
485002	23.0	Directional, planar array	PMP	-5.4	13	36
485024	21.0	Directional, flat panel	PMP	-5.4	15	36
484027	14.0	Directional, flat panel	PMP	-5.4	22	36
484026	15.0	Directional, flat panel	PMP	-5.4	21	36
484025	14.0	Directional, flat panel	PMP	-5.4	22	36
SP4-5.2	34.8	Directional, parabolic	PMP	-5.4	1.2	36
SP3-5.2	31.2	Directional, parabolic	PMP	-5.4	4.8	36
SP2-5.2	29.0	Directional, parabolic	PMP	-5.4	7.0	36
SP1-5.2	22.5	Directional, parabolic	PMP	-5.4	13.5	36
SEC-55V-60-17	17.0	Directional, sector	PMP	-5.4	19.0	36
SEC-55V-90-16	16.0	Directional, sector	PMP	-5.4	20.0	36
MPR58031 PTNF	31.0	Directional, parabolic	PMP	-5.4	5.0	36
MPR58029 PTNF	29.0	Directional, parabolic	PMP	-5.4	7.0	36
TDJ-5818AM-60	18.0	Directional, sector	PMP	-5.4	18.0	36
TDJ-5816AM-90	16.0	Directional, sector	PMP	-5.4	20.0	36
486001	28.0	Directional, planar array	PTP	-5.4	25.3	No limit
485002	23.0	Directional, planar array	PTP	-5.4	25.3	No limit
485024	21.0	Directional, flat panel	PTP	-5.4	25.3	No limit
484027	14.0	Directional, flat panel	PTP	-5.4	25.3	No limit
SP4-5.2	34.8	Directional, parabolic	PTP	-5.4	25.3	No limit
SP3-5.2	31.2	Directional, parabolic	PTP	-5.4	25.3	No limit
SP2-5.2	29.0	Directional, parabolic	PTP	-5.4	25.3	No limit
SP1-5.2	22.5	Directional, planar array	PTP	-5.4	25.3	No limit
SEC-55V-60-17	17.0	Directional, parabolic	PTP	-5.4	25.3	No limit
SEC-55V-90-16	16.0	Directional, sector	PTP	-5.4	25.3	No limit
MPR58031 PTNF	31.0	Directional, sector	PTP	-5.4	25.3	No limit
MPR58029 PTNF	29.0	Directional, parabolic	PTP	-5.4	25.3	No limit

TDJ-5818AM-60	18.0	Directional, parabolic	PTP	-5.4	25.3	No limit
TDJ-5816AM-90	16.0	Directional, sector	PTP	-5.4	25.3	No limit

AN-30 CLI (Command Line Interface) for Wireless and Ethernet

The CLI (Command Line Interface) System Configuration commands provide a simple to use User Interface for the operator to input a complete set of system parameters for the Ethernet, TDM card and Wireless components of the AN-30 terminal. The CLI command format for Telnet and the RS-232 port is as follow:

<command> [parameter1] [parameter2] [parameter3]

8.1. CLI General Commands

chgver (Change Software Version): Swaps the operating and secondary software versions

get (Get parameter value): Get <parameter name> displays the value for a status parameter. For configuration parameters, use Set command.

login: Allows login under a different username and password

logout: Disconnects user from the terminal.

passwd (Change Password): passwd <username> <newpassword> Change password for user.

reboot: Reboot <time in seconds> Reboots the terminal.

resetstats (Reset Statistics): Resets all statistics

save config (Save Configuration): Permanently saves system configuration settings. This command is required to activate all Configuration settings set previously

save snmp (Save SNMP Configuration): Permanently saves SNMP configuration settings. This command is required to activate all SNMP settings set previously.

set (Set parameter value): Set one configuration parameter: <parameter name> [<value>]. Without <value>, 'set' returns the actual value for configuration parameters. For status parameters, use the Get command.

show config (List Configuration): Returns a list of all System Configuration parameters.

show log (List the log file): Returns a list of current system log entries.

show snmp (List SNMP Configuration): Returns a list of all SNMP communities and related parameters.

show stats (List System Status): Returns a list of all System Status parameters.

test config (Test System Configuration): Allows testing of configuration settings for 5 minutes, after which the system reverts to the previously saved settings. To make settings permanent use 'save' command.

upgrade (Software Upgrade): Begin a software upload.
upgrade <ipaddr> <filename>

8.2. CLI System Configuration Commands

To store the parameters into memory, the CLI Save Configuration command must be used. This operation is recorded in the System Logs.

sysname (System Name): An alphanumeric identifier for the local terminal, which can consist of any combination of letters and numbers up to 20 characters in length. The default name for the system from the factory is set to WEB01. The name remains with the system, even during power off states, until the operator re-types a new name using this menu field.

sysdetails (System Details): Specifies the location of the unit, telephone number and/or contact information of the network administrator. Can be up to 20 characters in length.

ipaddr (IP address): This field is used to provide an IP address for the local AN-30 terminal. The default address from the factory is 192.168.25.2. For the initial setup, the terminal should not be connected to the Internet, i.e., the host computer should be connected directly to the terminal Ethernet port, to avoid address conflicts with other devices on a public network. Once an IP address has been set, the terminal can be connected to the core network.

ipmask (IP Subnet Mask): This field is used to set the desired IP subnet mask. The mask value is set to "255.255.255.0" (Class C subnet).

gateway (Default Gateway Address): Specifies the IP address of the default router / gateway on the local Ethernet segment.

llmod (Link Length Mode): Specifies if the link length is calculated automatically or manually.

llmode <param>

where:

- **off:** the system is automatically calculating the link length
- **on:** the system expect the user to enter the link length

llmu (Link Length Measurements Units): Specifies the current measurements units used for the link length.

llmu <param>

where:

- **off:** the system defaults to miles
- **on:** the system will use kilometers

ll (Link Length): Specifies the actual length path that the wave need to travel.

ll <param>

where the parameter will represent the distance in miles or kilometers

flowctrl (Flow Control Enable): Flow control is a feature that Ethernet devices use to pause transmission of incoming packets. If a buffer on the Ethernet port is overrun, the port transmits a special packet (pause frame) that requests remote ports to delay sending packets for a period of time. For more information, see Appendix 2 – AN-30 Support For TDM explained.

telnet (Telnet Enable): Telnet is used to connect to remote devices, usually via Telnet port 23. Once a Telnet connection is established, it is possible to log in using the ‘admin’ or ‘user’ user id and set the parameters of the unit using the CLI

telnetport (Telnet Port): The default Telnet port is 23. The port can be changed to any other number between 23 and 65,000, excluding port 80.

set snmp (SNMP Enable / Disable): Specifies whether the Simple Network Management Protocol (SNMP) agent is enabled. When this item is enabled, a listing of the current SNMP communities and associated parameters can be viewed.

snmpcomm (Community Name): To add a new SNMP community:

snmpcomm add <community name> <access>

where <access> can be: "r", "w", "t" or any combination

To delete an SNMP community type: **snmpcomm del** <community name>

snmpaccess (Community Access): To modify access rights for a community type:

snmpaccess <community name> <access>

where <access> can be: "r", "w", "t" or any combination

- **r (Read):** use ‘Read’ to grant read access permission to members of this community

- **w (Write):** use ‘Write’ to grant write access permission to members of this community
- **t (Trap):** use “Trap” to grant read access permission to members of the trap community

snmptrap (Trap Enable /Disable and Destination): To add a trap destination for an SNMP community type:

```
snmptrap add <community name> <IP destination>
```

Or to delete a trap destination for an SNMP community:

```
snmptrap del <community name> <IP destination>
```

When the SNMP Agent in the AN-30 detects an error condition, a message known as a trap is sent. A Trap Host is an IP workstation/server that is set up to receive SNMP trap messages.

rfchannel (RF Channel): specifies the operating channel of the system, within the 100 MHz available in the 5.8 GHz band. The table below specifies the center frequencies of each permitted channel.

Table 3: RF Channel Center Frequencies

Channel	Frequency
1	5735 MHz
1A	5745 MHz
2	5755 MHz
2A	5765 MHz
3	5775 MHz
3A	5785 MHz
4	5795 MHz
4A	5805 MHz
5	5815 MHz

To avoid interference, two PTP links operating in the same physical location (co-located) or within close proximity must be separated by at least one channel, i.e., the gap between channels must be 20 MHz or more (e.g., channels 2 and 3). Refer to Section 10.4 for further information regarding deployment conventions.

txpower (Max Tx Power): this parameter specifies the maximum power level of the system. Depending on the RF channel and FCC regulations, the software will determine the actual power to be used, which will not exceed this user defined value. Refer to Table 4 below. The Actual Tx Power is displayed on the System Status page.

The Actual Tx Power is set by the software / firmware to the maximum power permitted for each channel according to the modulation scheme, as shown in the following table.

Table 4: Max. Operational Power Per Channel (in dBm) vs. Modulation *

	64QAM ³ / ₄ (54 Mb/s)	64QAM ² / ₃ (48 Mb/s)	16QAM ³ / ₄ (36 Mb/s)	16QAM ¹ / ₂ (24 Mb/s)	QPSK ³ / ₄ (18 Mb/s)	QPSK ¹ / ₂ (12 Mb/s)	BPSK ³ / ₄ (9 Mb/s)	BPSK ¹ / ₂ (6 Mb/s)
Max Tx Power	14	15	19	20	20	20	20	20

adaptmod (Adaptive Modulation): checking this box sets the system to operate in adaptive modulation mode. It is not recommended to keep the AN-30 in this mode as the system will automatically change the modulation schemes thus errors can be introduced to the TDM traffic. For systems that have upgraded with a high-speed data option, it is recommended that the user set the modulation up to two levels below the maximum achievable on the link. The user can define the desired modulation scheme by setting the Uncoded Burst Rate parameter (see next item). If the current Uncoded Burst Rate meets or exceeds this rate, the Wireless Signal LED on the front panel lights solid green. If packet errors exceed one in one million, the system will automatically step down the modulation scheme to maintain the link. The Wireless Signal LED will flash green if the current Uncoded Burst Rate is lower than the configured Uncoded Burst Rate. If errors continue when the system reaches the lowest order modulation scheme, the Signal and Link LEDs will turn off to indicate a failed RF link.

The dynamic modulation mode can be disabled by un-checking the Adaptive Modulation checkbox. In this manual mode, the user is required to set the Uncoded Burst Rate and the Modulation Reduction Level (see below). To operate in manual mode, first sample the link with Adaptive Modulation enabled, then switch to manual mode setting the modulation scheme up to 2 levels lower than that achieved using adaptive modulation.

**Note:*

In some countries outside of North America, the Maximum Operational Power Per Channel with a given antenna is limited in accordance to maximum allowable EIRP levels for the region

ubrate (Uncoded Burst Rate [Mb/s]): Defines the desired Uncoded Burst Rate for the link. Obtaining a 64 QAM license key (see section 8.6) raises the available Uncoded Burst Rate from the default 36 Mbps to 54 Mbps.

modreduct (Modulation Reduction Level): applies when Adaptive Modulation is disabled. Specifies how many levels the system must drop in modulation during re-transmission of erroneous wireless packets. The level can be set from 0-7, with 2 being the recommended value.

master (Master Mode): Sets the AN-30 system to serve as the master system, while the other AN-30 assumes a slave role. There are no consequences related to setting either unit to serve as the master or slave. One and only one unit must be set as the master.

chgver (Software Version): Specifies the current version of the system software. Note that software can be remotely downloaded into the AN-30 terminal. The system includes sufficient memory to hold two independent software loads. The operator can specify which software load is used in the system. See section 8.4 for additional details.

encrypt (Encryption Enable): Specifies whether over-the-air encryption is enabled. Note that if encryption is enabled, it must be enabled on both the local and remote units, otherwise no Ethernet packets can be transferred.

encryptkey (Encryption Key): Enter the MAC address of the remote terminal to enable over-the-air data encryption. Note, if encryption is enabled and the MAC address is not properly entered, no Ethernet packets can be transferred.

buzzer (Alignment Buzzer Enable): Enables the antenna alignment tone sweep generator located in the T-58 Transceiver for fine tuning using actual signal strength. Faster repetitions of the tone sweep indicate better alignment.

radio (Radio Enable): Specifies whether radio transmission is enabled.

save config (Save configuration): Saves the currently entered parameters.

test config (Test Configuration): Allows testing of the current settings for five minutes, after which the system reverts to the previously saved settings. To make settings permanent, click 'Save'.

reboot (System Reset): Resets all statistics and reboots the terminal.

8.3. CLI General Status Information Commands

The following is a brief description of each field of the CLI General Status Information

sysname (System Name): Identifies the local terminal. The factory default name for the system is "WEB01".

sysdetails (System Details): Specifies the location, telephone number and/or contact information.

ubrate (Uncoded Burst Rate [Mb/s]): Indicates the current uncoded burst rate of the system. With adaptive modulation, this data rate may change over time, depending on the prevailing propagation conditions.

master (Master Mode): Indicates if the system is serving as the master or slave.

swver (Software Version): Specifies the software version in use.

starttime (Time Since System Start): Specifies the time [dd/hh/mm/ss] since the system started.

macaddr (Ethernet MAC Address): Specifies the Ethernet MAC address used by the local terminal.

ipaddr (IP Address): Specifies the IP address used by the local terminal.

ipmask (IP Subnet Mask): Specifies the IP Subnet Mask used by the local terminal.

gateway (Default Gateway Address): Specifies the IP address of the default router / gateway on the local Ethernet segment.

ll (Link Length): Actual length of the path the wave travels

rflink (RF Link Established): "Yes" indicates the RF link with the remote terminal is established. "No" indicates there is no RF link to the remote terminal. This indicator is correlated to the Wireless Link LED.

rffreq (RF Channel Frequency): Specifies the center frequency of the channel in use.

Tx Power: Specifies the actual current transmit power level.

cableattn (Cable Attenuation): Indicates the attenuation of the signal over the IF cable.

rfstatus (RF Status [Error Code]): An error code from 0-31 indicating the condition of the RF components within the AN-30 terminal and T-58 Transceiver. See the RF Status Error Code table below for details.

Table 5: RF Status Error Codes

Error Code	AN-30 Terminal PLL Error	Communication Error Over IF Cable	Radio High Temp. Warning	Radio Power Supply Fault	Low DC Voltage At Radio Input
0 - NO ERRORS					
1					X
2				X	
3				X	X
4			X		
5			X		X
6			X	X	
7			X	X	X
8		X			
9		X			X
10		X		X	
11		X		X	X
12		X	X		
13		X	X		X
14		X	X	X	
15		X	X	X	X
16	X				
17	X				X
18	X			X	
19	X			X	X
20	X		X		
21	X		X		X
22	X		X	X	

23	X		X	X	X
24	X	X			
25	X	X			X
26	X	X		X	
27	X	X		X	X
28	X	X	X		
29	X	X	X		X
30	X	X	X	X	
31	X	X	X	X	X

Error Details:

AN-30 PLL Error: The PLL (Phase Locked Loop) section within the AN-30 terminal experienced an error. The System Fault LED may light. Try resetting the unit.

Communication Error Over IF Cable: Communication between the AN-30 terminal and the T-58 Transceiver failed. Check the IF cable and connectors.

Radio High Temp. Warning: The T-58 Transceiver’s internal temperature rose above 185F / 85C. The transceiver will shut down for 30 seconds to allow cooling time.

Radio Power Supply Fault: Indicates a fault in the transceiver’s power supply. This error could be due to a problem with the internal power supply, or with the power source from the AN-30 terminal. If the Low DC Voltage At Radio error is also indicated, (see below) check the IF cable and connectors. If the Low DC Voltage At Radio error is *not* indicated, the T-58 Transceiver will require servicing.

Low DC Voltage At Radio Input: The DC voltage at the transceiver (carried by the IF cable from the AN-30 terminal) is lower than the required 24VDC. Check the IF cable and connectors. The minimum required voltage for operation is 12VDC.

Ethernet LAN Statistics:

erxpkt (Rx packets): Counts the number of packets successfully received by the local system.

erxpkt (Rx packets – Discarded): Counts the number of packet errors received by the local system.

etxpkt (Tx Packets): Counts the number of Ethernet packets transmitted by the local system.

Wireless Statistics:

rssimin (Received Signal Strength – Min): Indicates the minimum received signal strength measured since the last screen refresh.

rssimean (Received Signal Strength – Mean): Indicates the average received signal strength, computed since the last screen refresh.

rssimax (Received Signal Strength – Max): Indicates the maximum received signal strength measured since the last screen refresh.

sinadr (SINADR): Indicates the average signal to interference, noise and distortion ratio measured since the last screen refresh. The ratio is based on the digital information provided from the output of the A/D converter, and includes the effects of the AGC.

wrxpkt (Rx Packets): Indicates the number of wireless packets received over the air from the remote terminal.

wrxpktr (Rx Packets – Retransmitted): Indicates the number of wireless packets retransmitted over the air from the remote terminal.

wrxpktd (Rx Packets – Discarded): Indicates the number of wireless packets originating from the remote terminal received over the air with errors due to degradation in the RF link.

wtxpkt (Tx Packets): Indicates the number of wireless packets (including Ethernet frames and error correction bytes) successfully transmitted over the air by the local terminal.

wtxpktr (Tx Packets – Retransmitted): Indicates the number of wireless packets retransmitted over the air by the local terminal. The retransmission scheme is based on the Automatic Repeat Request (ARQ) algorithm that detects when packets are lost, and makes a request to the MAC scheduler to repeat transmission of the lost packets.

wtxpktd (Tx Packets – Discarded): Indicates the total number of transmitted wireless packets discarded by the remote terminal, due to degradation in the RF link.

resetstats (Reset Statistics): Click this button to clear the data for the Wireless and Ethernet LAN Statistics on this page. You will be prompted for your password.

8.4. Upload Software

The CLI upload software command is used to upgrade the existing software load of the AN-30 terminal with new software stored in a binary file on the server or host computer. Note the AN-30 terminal contains two memory pages for storing two versions of the software / firmware. The user can select the operating software version using the CLI command. The upload will always overwrite the secondary (unselected) version; therefore it is important to select the desired operating version before beginning the upgrade process.

The upgrade process can be achieved remotely, using the Trivial File Transfer Protocol (TFTP) over the Internet. Two input fields must be filled in by the operator: TFTP Server

IP Address and File Name. The TFTP Server IP Address is the IP address of the host computer or server that contains the upgrade software in binary format, while File Name is the name of the actual binary file.

The CLI command for software upload is: **upgrade** <ipaddr> <filename>

After typing the TFTP Server IP Address and File Name, type enter to begin the file transfer. The upgrade file size is approximately 1.9 MB, and will take approximately two to four minutes to download from the server to the AN-30 terminal memory. To activate the new version, it is necessary to swap the operating and the secondary software version with the CLI command **chgver**.

Upon successful transfer of the file, the terminal will verify the integrity of the new software. If errors were introduced during the transfer process as a result of (for example) link degradation, the AN-30 terminal will reject the new software load and provide a warning that the upgrade was unsuccessful. In this case, the operator will need to repeat the upload process.

8.5. System Password

The factory default password for the system is "admin" for the administrator's ID, and "user" for the user's ID. To change the password, use the CLI command:

passwd <username> <newpassword>

using any alphanumeric combination for the password. Note the field is case sensitive and can be up to 16 characters in length.

For more information on password related issues, see section 8 on page 28.

Note: depressing the front panel Reset button for more that five (5) seconds will restore the factory default passwords.

8.6. AN-30 Options

Through the License Key (an optional purchase item) the following product features can be enabled:

- Add an additional one (1) or three (3) E1/T1 ports to the existing default single (1) port
- Add high speed data access to increase the throughput capacity beyond the basic Ethernet access provided by default on all systems.

Note:

Basic Ethernet access is provided solely for the purpose of managing the AN-30 system. Using this port for user data traffic requires installation of the high speed data option in order to avoid impacting TDM performance.

The key is personalized to each unit’s MAC address. Please ensure that the correct MAC address is provided when requesting a key from your local Redline representative, or register directly at <http://www.redlinecommunications.com/support/register>.

Use the following CLI command to enter the “Option Key”:

```
set optionskey <key_value>
```

Note, if the key_value is not correctly entered, it will not be saved and the options will not be selected. Please note that the option key is case sensitive.

8.7. System Logs

The System Logs page, shown in Figure 14, provides a list of the last forty messages recorded by the AN-30 terminal, describing either system activity or errors that have occurred.

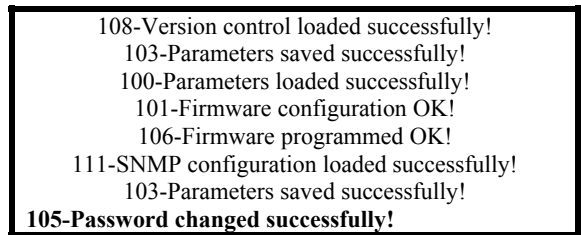


Figure 14: System Logs Screen

The **show log** CLI command can be use in order to display the log file.

The logs will also indicate if the following transactions were successfully completed:

- **Save Configuration** – Under the Configuration screen.
- **Upload** – Under the Upload Software screen.
- **Change Password** – Under the System Password screen.
- **Send Options Key**

The following table provides a brief description of the key messages recorded in the logs by the system:

Log Message	Description
100-Parameters loaded successfully!	All system parameters have been successfully downloaded.
101-Firmware configuration OK!	The onboard firmware configuration has been properly set up.
102-Ethernet port configured!	The Ethernet port has been properly configured and is operational.

103-Parameters saved successfully!	The latest configuration parameters have been successfully saved into the system memory.
104-Upgrade OK!	The software upgrade process completed successfully.
105-Password changed successfully!	The system password was successfully changed.
106-Firmware programmed OK!	The firmware was successfully programmed.
107-Statistics initialized!	Reset of statistics was successful.
108-Version control loaded successfully!	Software version control data was successfully loaded.
109-Options Key activated!	Product Options Key was accepted.
110-Options Key already used!	The Product Options Key was not accepted because it was already used once. Contact your local Redline representative.
111-SNMP configuration loaded successfully!	The SNMP configuration was successfully loaded.
201-EEPROM corrupted. Def. param. loaded!	The memory area containing the system configuration has been corrupted. Default parameters loaded.
202-Error while saving parameters!	The latest configuration parameters have not been successfully saved. In this case, repeat the save configuration process to try to resolve the problem.
203-Another upgrade in progress!	The system is already in upgrade mode, in the event the operator inadvertently invoked multiple simultaneous upgrades.
204-Invalid upgrade parameters!	The parameter entered is in error. If this message appears, check for typing errors.
205-Upgrade failed!	The software upgrade process completed unsuccessfully.
206-Password changed unsuccessfully!	The new password entered into the system was not successful. In this case, repeat the process.
207-Timeout on reading data packet!	The system has timeout looking for packets from the host computer or server. Check for obvious problems such as disconnected or faulty cable.
209-TFTP error received!	The Trivial File Transfer Protocol (TFTP) routine used to download the software to the AN-30 terminal during the Upgrade process failed. Likely cause is disconnected or faulty cable.
210-Error: TFTP unknown message!	The TFTP client received an unknown message. In this case, repeat the upgrade process.
211-Error: while writing flash!	While writing the new software into AN-30 terminal flash memory an unexpected error occurred. Try to repeat the process and if the error persist contact your local Redline representative.
212-Error firmware configuration!	An unexpected error occurred while writing the onboard firmware configuration. Try to repeat the process.
213-Firmware programming failed!	The firmware programming failed.
214-Error while loading version control!	Software version control data was not loaded successfully.
215-Log buffer full!	The log buffer overflowed.
216-Invalid Options Key!	User entered an invalid Product Options key.
217- PLL unlocked!	One or more RF synthesizers unlocked. The unit stopped RF transmissions and attempted to reprogram the synthesizers. If this message repeats or if the RF link is not back on, try to reset the terminal. If the problem persists, contact customer support.
218-Outdoor unit over temperature!	The T-58 Transceiver's internal temperature rose above 185F / 85C. The transceiver will shut down for 30 seconds to allow cooling.
219-Excessive DC loss on IF cable!	The DC voltage at the transceiver (carried by the IF cable from the AN-30 terminal) is lower than the required 24VDC. Check the IF cable and connectors.
220-Outdoor unit power supply fault!	Indicates a fault in the transceiver's power supply. This error could be due to a problem with the internal power supply, or with the power source from the AN-30 terminal. If the 'Excessive DC loss on IF cable' error is also indicated, check the IF cable and connectors. If not, the T-58 Transceiver will require servicing.
221-\public\ community can't be deleted!	The default 'Public' SNMP community cannot be deleted.
222-Max.community number already	No more communities may be defined, as the maximum number

defined!	has been reached
223-Community name already defined!	The name for the SNMP community has already been used. Choose another name.
224-MIB initialization error!	MIB construction process generated an error. Try to reset the terminal. If the problem persists, contact customer support.
225-Error while loading SNMP configuration!	EEPROM memory was corrupted and the SNMP configuration couldn't be loaded. Default SNMP configuration was loaded.
226-Error while saving SNMP configuration!	SNMP configuration saving process wasn't successfully. Try again. If the problem persists, contact customer support.

9. AN-30 CLI (Command Line Interface) for the TDM card

9.1. DS0 Bundles

The AN-30 supports distribution of the T1/E1 traffic across 4 sites in a cascaded PTP topology.

To uniquely identify traffic that is destined to a specific site, requires the definition of DS0 Bundles.

A DS0 bundle is a logical grouping of a specified number of timeslots. At least one bundle is required for each physical T1/E1 port. DS0 Bundles can be defined starting at any TS and running contiguously from 1 to a maximum of 24+1 timeslots (for T1 links) and a maximum of 32 timeslots (for E1 links). An AN-30 can support a maximum of 4 DS0 Bundles.

Figure 15 illustrates a typical single hop PTP configuration back hauling 2 full rate T1/E1 lines in a mobility application. All traffic is terminating at the same endpoints and therefore requires definition of one DS0 bundle for each T1/E1 line.

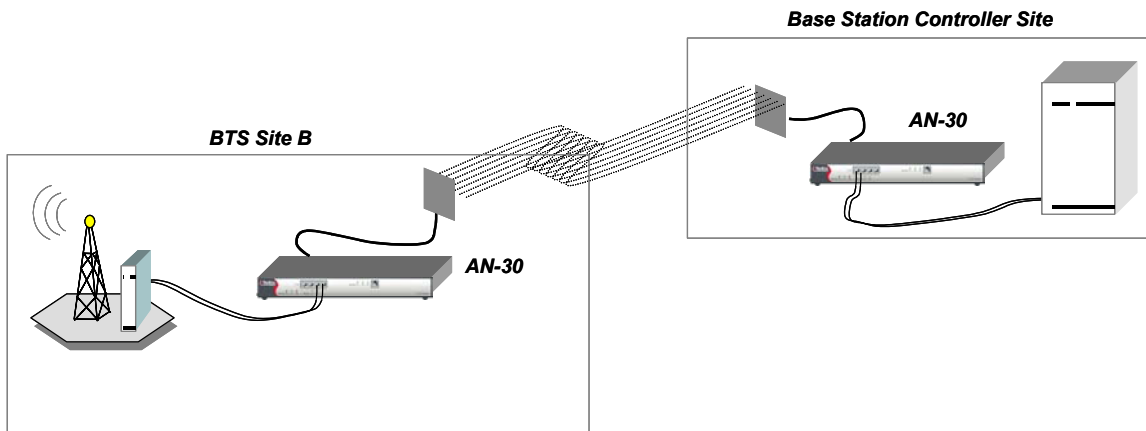


Figure 15 Typical PTP ‘single hop’ configuration.

Figure 16 illustrates a cascaded multi-hop configuration where 4 DS0 Bundles are required, one for each T1/E1 line.

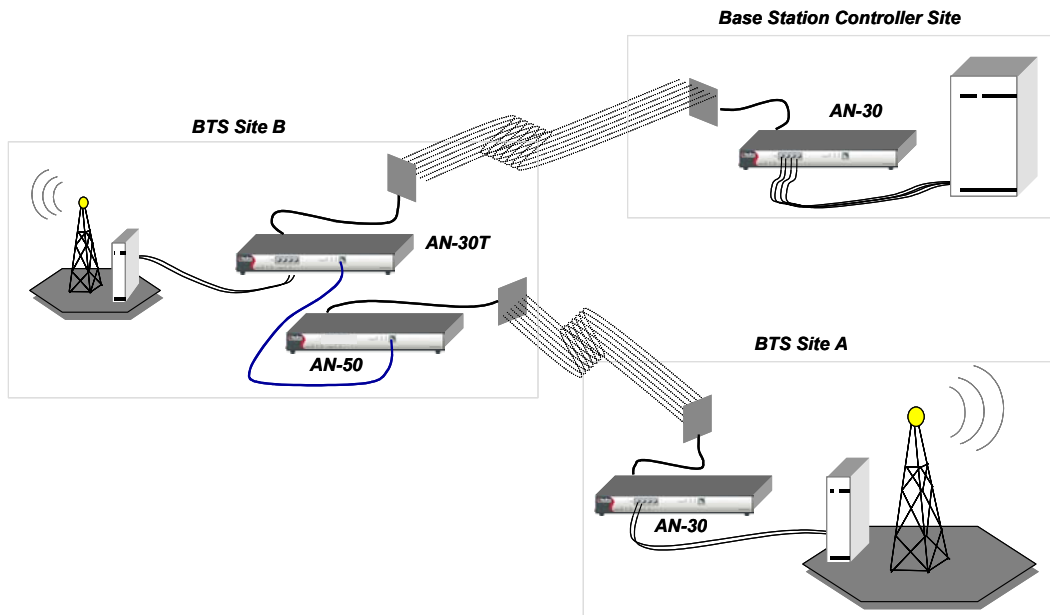


Figure 16 Typical PTP 'multi-hop' configuration

9.2. Command Line Interface

The command line interface is used to configure the T1/E1 capabilities via the AN-30's console port or through a telnet session. The command set is divided into 5 categories, *Control*, *General*, *Serial Interface*, *DS0 Bundle*, and *Statistics*. The General, Serial Interface and DS0 Bundle categories supports 3 distinct operations, a **get** operation, a **set** operation and a **show** operation.

The **tdm get** operation is used to retrieve the specified parameter value from a running configuration of an active system.

The **tdm set** operation is used to modify the specified parameter value in the temporary configuration.

The **tdm show<category>** operation is used to list all parameter values of the specified command category for either the running configuration or the startup configuration.

All commands conform to the following syntax:

<command operation> <command> <command target> <parameter value>

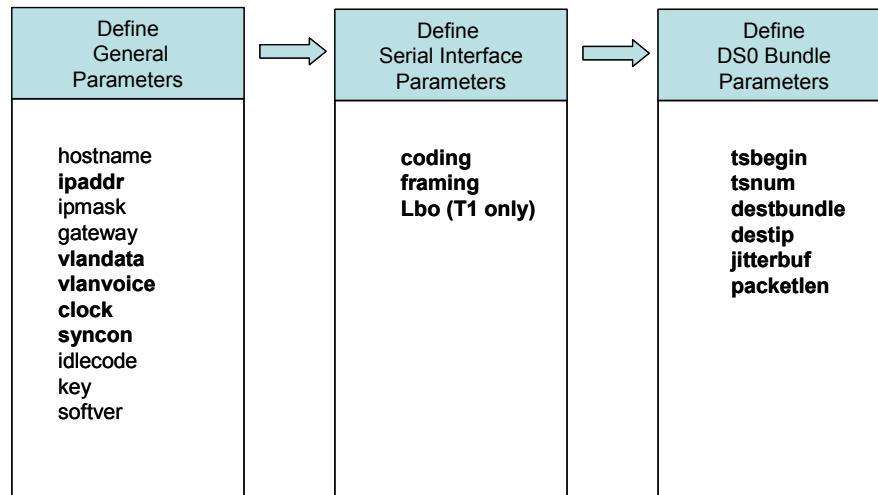
The <**command target**> field, is only used by the *Serial Interface* and *DS0 Bundle* category of commands:

The <**parameter value**> field is only required when issuing a **tdm set** operation.

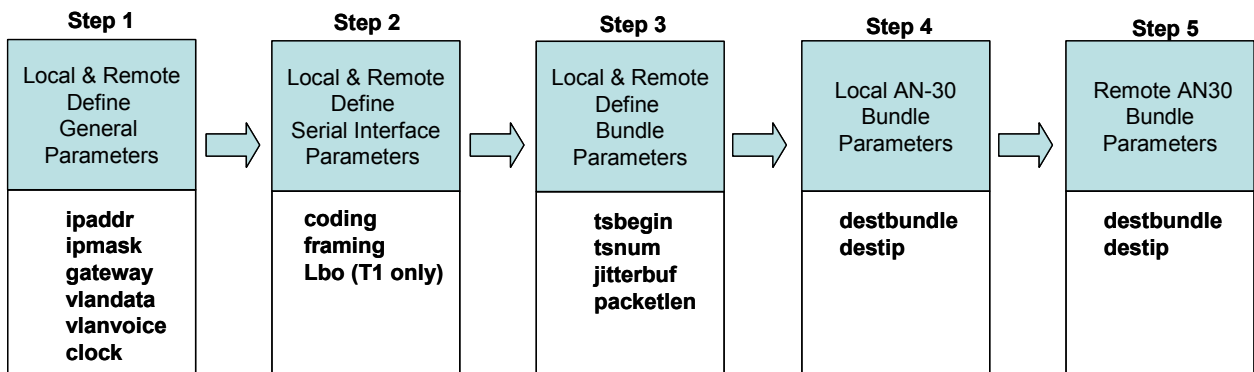
The **tdm get** operation requires only the **<command>** **<command target>** fields to be specified.

9.3. Quick Setup

The sequence of operations and the commands necessary to quickly configure the TDM portion of the AN-30 are indicated below. All commands in bold face text must be specified.



When setting up two AN-30s to form a wireless link the following steps must be completed in the sequence shown below:



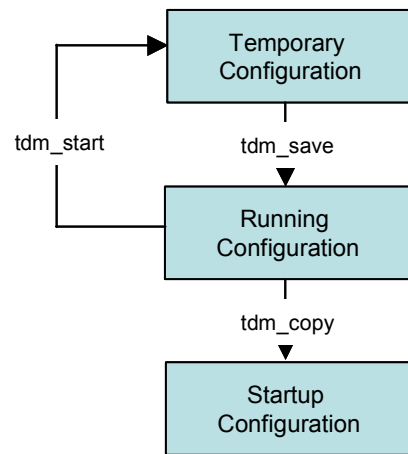
Subsequent sections discuss each of these commands in specific detail.

9.4. Configuration

The AN30 maintains 3 TDM configuration images,

- Temporary Configuration
- Running Configuration
- Startup Configuration

Through these distinct images the actions of modifying the temporary configuration, and activating a modified configuration are separated. The operator can therefore make all changes in advance of the actual cut over without impacting the unit's current operation.



The following sections describe the complete T1/E1 command set and their associated parameters.

9.5. Control commands

The control commands are used to manipulate the contents of each of the configuration images as well as to save and activate, a specific configuration. There are 4 control commands:

- **tdm start**
- **tdm exit**
- **tdm save**
- **tdm copy**

tdm start, no params.

This command synchronizes the temporary configuration with the running configuration. Before making any changes to the temporary configuration you must first issue the **tdm start** command to copy the running configuration into the temporary configuration image.

tdm exit, no params.

This command discards all changes made to the temporary configuration. Clearing the temporary configuration avoids the possibility of inadvertently loading a modified configuration in the event that a **tdm save** command being accidentally issued.

This command should always be issued to leave the temporary configuration image synchronized with the running configuration.

tdm save, no params

This command copies the temporary configuration image to the running configuration image.

Since all commands falling under general, serial interface, and DS0 bundle categories, modify only the temporary configuration image, the **tdm save** command is used to activate these changes, by copying them to the Running configuration image.

Warning:

This command will reset operation of a working AN-30 link disrupting all communications while the unit re-initializes to the new configuration. On a production network this command should only be issued during the off hours of a maintenance window.

The **tdm save** command triggers the following actions:

- The modified temporary configuration is checked.
- If valid, config is saved to running config and software is restarted.
- If configuration is not valid (i.e.: serial interface pointed by "syncon" is disabled), an error code is returned containing 3 fields: LEVEL + NUMBER + ERROR_ID and "save" command is ignored.

The meaning of the error code bytes is presented in the following:

Level	Definition
0	General Level
1	Serial Interface Level
2	Bundle Level

Level	Number	Definition
General	0	Always 0
Serial	1..4	the number of the misconfigured serial interface.
Bundle	1..128	the number of the misconfigured bundle.

Level	Error ID	Definition
General	0	GENERAL_SYNCON
	1	GENERAL_TOO_MANY_BUNDLES
	2	GENERAL_LINE_TYPE
Serial	0	SERIAL_BUNDLES_OVERLAP
	1	SERIAL_TOO_MANY_BUNDLES
	2	SERIAL_CODING
	3	SERIAL_FRAMING
Bundle	0	BUNDLE_TS0
	1	BUNDLE_MASK

Error codes are described in the following table:

Error Code	Description
0:0:1	Too many bundles: if user defines more than the internal bundle limit for the current software release
0:0:2	Line type (T1 or E1) is disabled in option key
0:0:3	Error at “syncon” parameter: if clocking is “loopback” and the serial interface selected for synchronization has no bundles defined, or if clocking is “adaptive” and there is no exactly one bundle defined
1:x:0	Bundles defined on the serial line “x” have timeslots overlapping, x=1...4
1:x:1	The serial line “x” is unframed and the user defined more than one bundle, x=1...4
1:x:2	Wrong line coding for the serial line “x”, x=1...4
1:x:3	Wrong line framing for the serial line “x”, x=1...4
2:y:0	The bundle “y” contains timeslot 0 and the corresponding serial line is framed, y=1...128
2:y:1	Too many timeslots selected for bundle “y”, y=1...128

tdm copy, no params

This command copies the current running configuration into the Startup configuration. A running configuration is stored in volatile memory and will be lost in the event of a system reset.

Therefore, once you are satisfied with a new configuration, the **tdm copy** command must be issued to store the new configuration into the Startup Image. This is the only way to permanently save an operating configuration. In order to insure the integrity of the saved image all real-time tasks are halted during execution of the **tdm_copy** command.

Warning:

This command will reset operation of a working AN-30 link disrupting all communications while the unit re-initializes to the new configuration. On a production network this command should only be issued during the off hours of a maintenance window.

Each time the unit is powered it will automatically load the last configuration that was copied to the Startup Image.

9.6. General configuration commands

General commands are the set of commands that do not require the **<command target>** field, and therefore are global in scope.

Set/Get Operations

The general set/get operations have the following syntax:

```
tdm set <command> <parameter value>  
tdm get <command>
```

The **get** operation returns values from running configuration, the **set** operation applies to the temporary configuration. The changes made by **set** operation become active only after the **tdm save** command is successfully executed.

The general command set is as follows:

```
hostname  
ipaddr  
ipmask  
gateway  
vlandata  
vlanvoice  
clock  
syncon  
idlecode  
key  
line  
softver  
fanstate
```

The parameter for each command is valid only if used with the **set** operation.

hostname, params: HOST

The hostname of the T1/E1 module.

ipaddr, params: IP address in format a.b.c.d

The IP address of the T1/E1 module.

The TDM module in the AN-30 is uniquely identified by its IP address. The IP address is used with the **destip** command to direct TDM traffic to a specific AN-30 end point.

By uniquely addressing the TDM module within the AN-30 it is possible to relay traffic through an intermediate set of AN-30s without terminating the TDM stream. The intermediate AN-30s can therefore act as a repeater while also providing Add Drop Multiplexing (ADM) functionality as shown in Figure 16.

ipmask, params: IP mask in format a.b.c.d

The network mask. Not implemented for **tdm_set** operation

gateway, params: IPGATEWAY in format a.b.c.d

The IP address of the default gateway. Not implemented for **tdm set** operation

vlandata, params: VID_DATA

The VLAN ID used to tag all ingress traffic at the data port of the AN-30.

The VID_DATA parameter should be a decimal number between 0 and 4095

vlanvoice, params: VID_VOICE

The VLAN ID used to tag all TDM traffic from the T1/E1 Serial Interface ports 1 to 4.

The VID_VOICE parameter should be a decimal number between 0 and 4095

clock, params: CLK_IND

The clocking information on the T1/E1 module.

Parameter CLK_IND has the following meaning:

CLK_IND	Definition
0	internal
1	loopback
2	adaptive

Internal clocking should be selected to set the AN-30 as the T1/E1 transmit clocking reference.

Loopback clocking (aka network clocking) should be selected to have the AN-30 extract it's T1/E1 transmit clock from the T1/E1 receive signal of a serial interface port.

Adaptive clocking should be selected, at the remote side of the wireless link, to have the AN-30 continuously adapt its T1/E1 transmit clock. In the case of adaptive clocking the AN-30 uses its internal clocking reference and adapts its transmit clock based on information extracted from the fill level of the jitter buffer for the serial interface port specified with the **syncon** command. On a typical link one AN-30 is always set to adaptive clocking, while the other end can be set for internal or loopback.

syncon, params: SYNC_ON

Parameter SYNC_ON must be specified if clocking is set to 'loopback' or 'adaptive'. SYNC_ON specifies the serial interface port to be used as clocking reference. In this case, the designated serial interface MUST have at least one active bundle at the time "**tdm save**" command is issued, otherwise "**tdm save**" will return non-ack. If clocking is 'internal', this command is ignored.

idlecode, params: IDLECODE

The idle code for unused timeslots on all of the serial interface ports.

If the idle code command is not specified, the default value 0xFF is used.

key, no params.

This is used **only** with a **get** operation: `tdm get key`
 This command will get the option key (permitted line types, number of lines, user data) on the T1/E1 module.

KEY fields				
Bit7..5	Bit4	Bit3	Bit2	Bit1..0
unused	1 - Enable User Port	1 - Enable T1 line type	1 - Enable E1 line type	00-1 line 01-2 lines 10-4 lines 11-reserved

line, params: LINE_TYPE

This command will set the line type on the T1/E1 module (if permitted by the option key).

LINE_TYPE	Definition
0	T1 line
1	E1 line

softver, no params

This command is used **only** with a **get** operation. Represents the coded software version.

fanstate, no params

This command will return 1 if the fan is ON (working) and return 0 if the fan is OFF (not working).

Show Operations

The **show** operation is:

- **tdm showgen**

tdm showgen, params: CONFIG

This command is used to get the general configuration parameters from running or startup config.

The default configuration selected is running config.

CFG	Definition
0	running config
1	startup config

- **tdm showactivebundles**

tdm showactivebundles, no params

This command is used to return the number of active bundles and list the Ids of those bundles

9.7. Serial interface configuration commands

Set/Get operations

The general set/get operation has the following syntax:

```
tdm set <command> <serial interface number> <parameter value>
tdm get <command> <serial interface number>
```

The **get** operation returns values from the running configuration. The **set** operation applies to the temporary configuration. The changes made by **set** operation become active only after the “tdm save” command is successfully executed.

In the following commands, the “serial interface number” (SN) parameter must be a valid serial interface number (i.e.: for 4 T1/E1 valid values are 1, 2, 3, and 4), otherwise the command will return non-ack.

The commands for serial interface configuration are:

- **coding**
- **framing**
- **lbo**

The second parameter for each command is valid only if used with the **set** operation, as indicated below.

coding, params: SN, COD_IND

Defines the line coding type for the current serial interface on T1/E1 module.

COD_IND	Definition
0	B8ZS
1	AMI
2	HDB3

framing, params: SN, FRM_IND

Defines the framing type of the current serial interface on T1/E1 module.

FRM_IND	Definition
0	ESF
1	D4

2	CRC4
3	FAS
4	unframed

lbo, params: SN, LBO_IND

Defines the LBO parameter of the current serial interface on T1/E1 module. This command has effect only on T1 modules.

LBO_IND	Definition
0	0dB
1	-7.5dB
2	-15dB
3	-22.5dB

Show operations

The **show** operation is:

- **tdm showserial**

tdm showserial, params: SN, CFG

This command is used to get the serial interface parameters pointed by SN from running or startup config.

If the CFG parameter is not specified the running config is selected by default.

CFG	Definition
0	running config
1	startup config

9.8. DS0 Bundle configuration commands

A DS0 bundle is a logical mapping of a number of timeslots from the same physical T1/E1 port.

The starting timeslot selected (**ts_begin**) is:

ts_begin = 0 if the line is unframed. In this case the number of selected ts must be 32 for E1 or 24+1 for T1.

$1 \leq \mathbf{ts_begin} \leq 31$ (24 for T1) and $\mathbf{tsnumber} \leq 32 - \mathbf{ts_begin}$ ($\leq 24 + 1 - \mathbf{ts_begin}$ for T1) for framed. In this case the number of selected ts must be less than or equal to 31 - **ts_begin** (24 - **ts_begin** for T1). If multiple DS0 bundles are defined for the same line, they must not overlap. So valid value will be:

for E1 **ts_begin**=1, **ts_num**=31

for T1 **ts_begin**=1, **ts_num**=24

for E1 **ts_begin**=1, **ts_num**=31

for T1 **ts_begin**=1, **ts_num**=24

The line that correspond to a DS0 bundle is selected based on the ID of the circuit group: 1-32 line 1, 33-64 line 2, 65-96 line3, 97-128 line 4.

Set/Get Operations

The general set/get operations have the following syntax:

```
tdm set <command> <bundle number> <parameter value>
tdm get <command> <bundle number>
```

The **get** operation returns values from the running configuration, while the **set** operation applies only to the temporary configuration. The changes made by **set** operations become active only after the “tdm save” command is successfully executed.

In the following commands, the value of BN (Bundle Number) is used to indirectly specify the Serial Interface to which it applies. The value of BN must be specified as 32*SN-31<=BN<=32*SN (Serial Interface Number) in order for the commands to execute successfully.

The following valid values for BN result:

Serial Interface Number	Minimum BN Value	Maximum BN Value
1	1	32
2	33	64
3	65	96
4	97	128

The bundle configuration commands are:

- tsbegin**
- tsnum**
- destbundle**
- destip**
- jitterbuf**
- packetlen**

Command Descriptions:

A bundle is automatically created through the definition of its associated parameters. The commands **tsbegin** and **tsnum** are used to define the range of timeslots that are mapped to specified bundle.

Valid values for TSB are 1 to 31 for E1 and 1 to 24 for T1 for framed and only value 0 for unframed. Valid values for BN are given in the table above.

The second parameter for each command is valid only if used with **set** operations

tsbegin, params: BN, TSB

This command defines the first active timeslot of the specified bundle BN.

Example:

```
tsbegin, 1, 1 (Creates the bundle 1 (corresponding to serial 1), beginning with timeslot 1 from serial interface 1)
```

tsnum, params: BN, TSN

This command defines the number active timeslots in the specified bundle BN.

Example:

tsnum, 0, 30 (assigns to bundle 1, 30 contiguous timeslots starting at timeslot 1 up to timeslot 30)

In this example assuming an E1 serial interface, the full channelized E1 line is mapped to a single bundle, 1.

destbundle, params: BN, DESTB

This command identifies the destination bundle, at the remote end, that maps to the specified bundle BN.

The DESTB parameter is used to map the channels assigned bundle BN to a specific bundle at the remote end. This allows the flexibility to remap the channels to different timeslots at the remote location, effectively performing a cross-connect function over the air.

destip, params: BN, DEST_IP in format a.b.c.d

This command identifies the destination IP address, of the remote end TDM module, that has defined on it, the destination bundle for the specified bundle BN.

The DEST_IP parameter is the IP address of the remote end TDM module. This is the IP address that was assigned to the TDM module using the general command **ipaddr**.

jitterbuf, params: BN, JBLEN

This command specifies the jitter buffer length in milliseconds for the specified bundle BN. Allowed values for JBLEN: 5..300ms.

The jitter buffer is used to compensate for any delay variation that may occur during transport of the ethernet encapsulated traffic. For delay sensitive applications, such as TDM voice, the buffer is typically set below 10 msec, while more data centric applications would employ a buffer that is closer to 300 msec. In order to minimize latency this parameter should be set to the lowest value possible, without triggering errors on the TDM interfaces.

Note:

For the lowest latency the Ethernet data port must be inactive with the AN-30 used exclusively for TDM transport. Utilizing the Ethernet port for either in-band management, or user data transport will require an increase in the jitter buffer setting, proportional with the Ethernet port's throughput.

packetlen, params: BN, PLEN

Defines the packet length to be used by the bundle BN.

Allowed values for PLEN: 64..1024 bytes.

Show operations

The **show** commands are:

- **tdm showbundle**

tdm SHOW_BUNDLE, params: BN, CFG,

This command is used to retrieve the bundle parameters for the specified BN from either the running or startup config.

The default configuration selected is running config.

CFG	Definition
0	running config
1	startup config

Other commands

Other commands are:

- **tdm delbundle**

tdm delbundle, params: BN

This command is used to delete the settings of bundle number BN.

9.9.

9.10. Sample Setup Scripts

Table 6: E1 Framed Configuration Script

Description	Local End AN-30	Remote End AN-30
General	<pre>tdm start tdm set ipaddr 192.168.100.192 tdm set ipmask 255.255.255.0 tdm set vldata 2 tdm set vlanvoice 3 tdm set clock 2 tdm set syncon 1 tdm set idlecode 255 tdm set line 1</pre>	<pre>tdm start tdm set ipaddr 192.168.100.199 tdm set ipmask 255.255.255.0 tdm set vldata 2 tdm set vlanvoice 3 tdm set clock 0 tdm set syncon 1 tdm set idlecode 255 tdm set line 1</pre>
Serial Interface	<pre>tdm set coding 1 2 tdm set framing 1 2 tdm set coding 2 2 tdm set framing 2 2 tdm set coding 3 2 tdm set framing 3 2 tdm set coding 4 2 tdm set framing 4 2</pre>	<pre>tdm set coding 1 2 tdm set framing 1 2 tdm set coding 2 2 tdm set framing 2 2 tdm set coding 3 2 tdm set framing 3 2 tdm set coding 4 2 tdm set framing 4 2</pre>
DS0 Bundle	<pre>tdm set tsbegin 1 1 tdm set tsnun 1 31 tdm set destbundle 1 1 tdm set destip 1 192.168.100.199 tdm set jitterbuf 1 60 tdm set packetlen 1 128 tdm set tsbegin 33 1 tdm set tsnun 33 31 tdm set destbundle 33 33 tdm set destip 33 192.168.100.199 tdm set jitterbuf 33 60 tdm set packetlen 33 128 tdm set tsbegin 65 1 tdm set tsnun 65 31 tdm set destbundle 65 65 tdm set destip 65 192.168.100.199 tdm set jitterbuf 65 60 tdm set packetlen 65 128</pre>	<pre>tdm set tsbegin 1 1 tdm set tsnun 1 31 tdm set destbundle 1 1 tdm set destip 1 192.168.100.192 tdm set jitterbuf 1 60 tdm set packetlen 1 128 tdm set tsbegin 33 1 tdm set tsnun 33 31 tdm set destbundle 33 33 tdm set destip 33 192.168.100.192 tdm set jitterbuf 33 60 tdm set packetlen 33 128 tdm set tsbegin 65 1 tdm set tsnun 65 31 tdm set destbundle 65 65 tdm set destip 65 192.168.100.192</pre>

	tdm set tsbegin 97 1 tdm set tsnun 97 31 tdm set destbundle 97 97 tdm set destip 97 192.168.100.199 tdm set jitterbuf 97 60 tdm set packetlen 97 128	tdm set jitterbuf 65 60 tdm set packetlen 65 128 tdm set tsbegin 97 1 tdm set tsnun 97 31 tdm set destbundle 97 97 tdm set destip 97 192.168.100.192 tdm set jitterbuf 97 60 tdm set packetlen 97 128
Control	tdm save	tdm save

Table 7 : T1 Framed Configuration Script

Description	Local End AN-30	Remote End AN-30
General	tdm start tdm set ipaddr 192.168.100.192 tdm set ipmask 255.255.255.0 tdm set vldata 2 tdm set vlanvoice 3 tdm set clock 2 tdm set syncon 1 tdm set idlecode 255 tdm set line 0	tdm start tdm set ipaddr 192.168.100.199 tdm set ipmask 255.255.255.0 tdm set vldata 2 tdm set vlanvoice 3 tdm set clock 0 tdm set syncon 1 tdm set idlecode 255 tdm set line 0
Serial Interface	tdm set coding 1 0 tdm set framing 1 0 tdm set coding 2 0 tdm set framing 2 0 tdm set coding 3 0 tdm set framing 3 0 tdm set coding 4 0 tdm set framing 4 0	tdm set coding 1 0 tdm set framing 1 0 tdm set coding 2 0 tdm set framing 2 0 tdm set coding 3 0 tdm set framing 3 0 tdm set coding 4 0 tdm set framing 4 0
DS0 Bundle	tdm set tsbegin 1 1 tdm set tsnun 1 24 tdm set destbundle 1 1 tdm set destip 1 192.168.100.199 tdm set jitterbuf 1 60 tdm set packetlen 1 128 tdm set tsbegin 33 1 tdm set tsnun 33 24	tdm set tsbegin 1 1 tdm set tsnun 1 24 tdm set destbundle 1 1 tdm set destip 1 192.168.100.192 tdm set jitterbuf 1 60 tdm set packetlen 1 128 tdm set tsbegin 33 1 tdm set tsnun 33 24

	tdm set destbundle 33 33 tdm set destip 33 192.168.100.199 tdm set jitterbuf 33 60 tdm set packetlen 33 128	tdm set destbundle 33 33 tdm set destip 33 192.168.100.192 tdm set jitterbuf 33 60 tdm set packetlen 33 128
	tdm set tsbegin 65 1 tdm set tsnun 65 24 tdm set destbundle 65 65 tdm set destip 65 192.168.100.199 tdm set jitterbuf 65 60 tdm set packetlen 65 128	tdm set tsbegin 65 1 tdm set tsnun 65 24 tdm set destbundle 65 65 tdm set destip 65 192.168.100.192 tdm set jitterbuf 65 60 tdm set packetlen 65 128
	tdm set tsbegin 97 1 tdm set tsnun 97 24 tdm set destbundle 97 97 tdm set destip 97 192.168.100.199 tdm set jitterbuf 97 60 tdm set packetlen 97 128	tdm set tsbegin 97 1 tdm set tsnun 97 24 tdm set destbundle 97 97 tdm set destip 97 192.168.100.192 tdm set jitterbuf 97 60 tdm set packetlen 97 128
Control	tdm save	tdm save

9.11. Statistics commands

9.11.1. Ethernet properties and statistics

tdm get ethprate, no params

Returns: rate

Rate	Definition
0	10 Mbps
1	100 Mbps

tdm get ethpmode, no params

Returns: mode

Mode	Definition
0	Half Duplex
1	Full Duplex

tdm get ethpstate, no params

Returns: state

State	Definition
0	not connected
1	connected (link up)

tdm get ethpmac, no params

Returns: MAC Address

tdm get ethsmfrok, no params

Returns: frames received ok

tdm get ethsbrok, no params

Returns: bytes received ok

tdm get ethsaerr, no params

Returns: align errors

tdm get ethscerr, no params

Returns: crc errors

tdm get ethsfrok, no params

Returns: frames transmitted ok

tdm get ethsbtok, no params

Returns: bytes transmitted ok

tdm get ethsscol, no params

Returns: single collisions

tdm ethsmcol, no params

Returns: multiple collisions

tdm get ethstdef, no params

Returns: transmission deffered

tdm get ethslcol, no params

Returns: late collisions

9.11.2. TDM properties and statistics

All commands return non-ack if the parameter SN is not valid (>4). A value of SN>4 is invalid.

tdm get tdmslos, params: SN

Returns: loss of signal

tdm get tdmslfa, params: SN

Returns: loss of framing alignment

tdm get tdmslomf, params: SN

Returns: loss of multi framing

tdm get tdmsrai, params: SN

Returns: remote alarm indication

tdm get tdmsais, params: SN

Returns: alarm indication signal

tdm get tdmses, params: SN

Returns: errored seconds

tdm get tdmsfec, params: SN

Returns: framing error counter

tdm get tdmsevc, params: SN

Returns: code violation counter

Show operations

These commands are:

- **tdm showstat**
- **tdm resetstat**

tdm showstat, params: STAT

This command requests the module specific statistics selected by STAT.
If STAT is not valid, the command will return non-ack.

STAT	Definition
0	reserved for all statistics (not yet implemented)
1..4	TDM statistics on serial interface 1..4
5..32	reserved for many serial interfaces
33	Ethernet Statistics
34	Ethernet Properties
35	Debug Statistics

tdm resetstat, params: STAT

This command resets the module specific statistics selected by STAT.
If STAT is not valid, the command will return non-ack.

STAT	Definition
0	reserved for all statistics (not yet implemented)
1..4	TDM statistics on serial interface 1..4
5..32	reserved for many serial interfaces
33	Ethernet Statistics
34	not applicable
35	Debug Statistics

10. Broadband Fixed Wireless Primer

This section provides an overview of the design and benefits of Broadband Fixed Wireless (BFW) network architecture based on the Redline AN-30 System.

10.1. Who Can Benefit From The AN-30 System?

The AN-30 system is an ideal solution for:

- Carriers
- Internet Service Providers (ISPs)
- Enterprises
- Educational Institutions and Campuses

A) Carriers

The AN-30 system will provide benefits to both Incumbent and Competitive Local Exchange Carriers (ILECs and CLECs, respectively). Although ILECs own and provide services over wireline infrastructures within a specific geographical area, they are faced with the challenges of reaching outlying regions suffering from poor to no service. The ILEC is usually compelled to provide an expensive solution using a series of PTP radio links, with low throughput (e.g., T1) and costly license fees and network interfaces including T1 multiplexers. The AN-30 system provides a cost-effective alternative, by connecting a remote site from the local CO, as shown in see Figure 17.

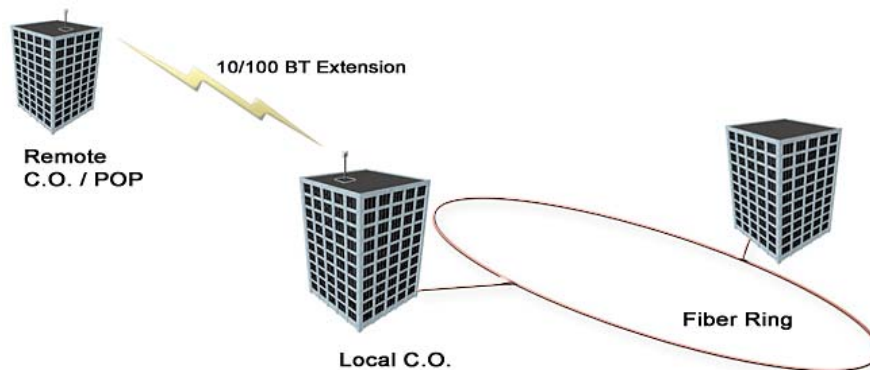


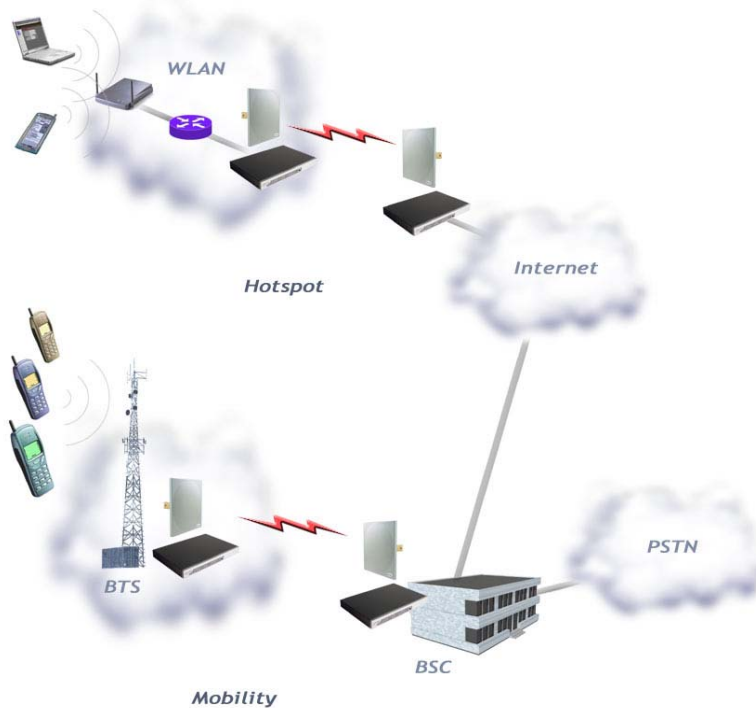
Figure 17: Wireless Extension for Carriers

The same challenges are faced by CLECs, who can use the AN-30 system to:

- Extend their existing fiber network, and
- Establish a remote Point of Presence (POP).

Mobility carriers will benefit from the AN-30 to provide a cost-effective alternative to landline T1/E1 carrier leased circuits. In most cases, equipment payback is achieved in 6-

12 months. In addition to backhauling voice, mobility carriers can support converged networks, backhauling voice with data, to derive incremental revenue from existing BTS infrastructures. An example is given in the figure below, where voice and data from hot-spots are backhauled from the same AN-30 node.



B) Internet Service Providers

The AN-30 system is perfect for ISPs looking to provide cost-effective broadband solutions to demanding business customers including Small Office Home Office (SOHO) and Small to Medium sized Enterprises (SME) located just outside of the downtown core, where there is a lack of infrastructure. High-speed leased lines are expensive and hard to obtain, especially from local telephone companies. Wireless access provides a reliable quality of service over longer distances, while avoiding Telco access fees.

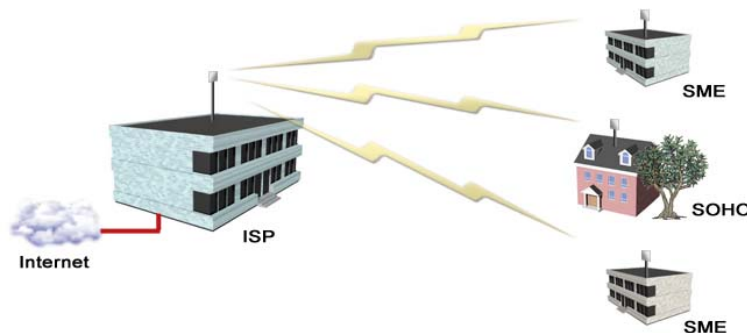


Figure 18: Wireless Solution For ISPs

C) Enterprises

Enterprises are particularly frustrated by the lack of broadband connectivity to branch offices, factories, or warehouses located just outside of the urban core. Establishing a LAN solution over several remote locations presents a significant inter-network challenge using conventional wireline solutions. The AN-30 system is well suited for addressing LAN extension requirements, offering superior data rates and PBX voice/ voice over IP (VoIP) connectivity in a secure format using encryption to protect sensitive information.

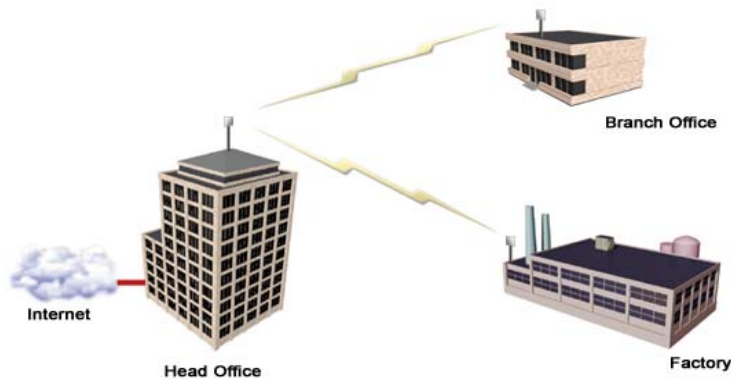


Figure 19: Wireless Solution For Enterprise

D) Educational Institutions and Campuses

The World Wide Web is a key element within the education system today, with BFW systems serving as an important enabler in bringing Internet content to the student body. Fixed wireless systems such as the AN-30 provide a cost effective means of creating a backbone for connecting existing and new campus buildings to the educational infrastructure to support distance learning and two-way interactive training.

10.2. The AN-30 Advantage

The Redline AN-30 system includes several key features to mitigate the effects of interference arising from other systems operating co-channel in the vicinity, as well as coping with propagation anomalies such as multipath. These features include:

Up to 64QAM Modulation

The modulation schemes supported are:

- Binary Phase Shift Keying (BPSK)
- Quadrature Phase Shift Keying (QPSK)
- 16 Quadrature Amplitude Modulation (QAM)

- 64 QAM

Refer to Table 8 for a summary of data rates for each modulation scheme.

Advanced Error Correction

In addition to conventional forward error correction techniques, the AN-30 terminal uses an Automatic Repeat Request (ARQ) scheme to dramatically reduce errors from interference and multipath

Orthogonal Frequency Division Multiplex (OFDM) Processing

The Redline OFDM technique offers tremendous robustness in the presence of harsh multipath interference.

Narrow Beam Width

Narrow antenna beams reduce considerably the probability of interference entering the system.

In addition to the anti-interference features described above, the AN-30 system also holds several other competitive advantages:

- High Data Rates
- High Bandwidth Efficiency
- Long Reach and Wide Coverage
- Higher Power Efficiency
- "Over-the-Air" Security

Support For TDM Applications

By supporting 802.1p and 802.3x protocols, the AN-30 can reliably maintain 4 T1/E1 native ports as well as up to eight T1/E1 lines using third party units. For more information regarding TDM application support, see Appendix 4 on page 76.

10.3. Wireless Facts

Wireless technology has existed for many years, proving itself to be a reliable communication medium, primarily for long haul point-to-point applications supporting critical links across the country for telephony and broadcast services. With the surge of broadband two-way internet use, fixed wireless systems are playing an even more important role in supporting network infrastructures.

The AN-30 system has been designed to operate in the band, which occupies the license exempt portion of the spectrum. This allows an operator to set up a wireless network without requiring formal consent from the regulatory agent. While this provides great advantages in terms of cost and time to market, the ease of access to the spectrum can bring with it undesirable effects, such as potential interference arising from other users exploiting the "free" band. By following the simple deployment guidelines in this manual, issues of this nature can be avoided.

This section provides additional background material to section 6 of this manual, including a description of the Link Budget tool, Fresnel zone considerations, height calculations, interference issues and radar horizon considerations.

10.3.1. The Link Budget Tool

Redline has developed a Link Budget Tool to help characterize the range performance of the AN-30 system for LOS, OLOS (optical line of sight) and NLOS conditions and various system parameters. The Link Budget Tool can be obtained by contacting your Redline certified partner or system integrator. Note the tool provides a first-order approximation, and does not consider the details of any specific terrain profile which may impact performance; rather, a generalized terrain is used in the calculations, based on empirical formulas approved by governing bodies such as the IEEE and ITU. Also, the tool does not consider system parameter variations arising from temperature fluctuations, cable loss tolerance, antenna alignment errors, etc.

The Link Budget Tool estimates the distance over which the system can operate at a desired error rate while achieving robust communication. A link is considered robust if the average error rate is less than 1 bit out of every 1000 million, expressed as 10^{-9} , for an availability of 99.99%. Availability is described in more detail below.

The table below describes the net data rate (after coding overhead) that can be obtained for each modulation type in an ideal propagation situation.

Table 8: Modulation Scheme vs. Data Rate

Modulation	Coding Rate	Over The Air Rate (Mbps)	Uncoded Burst Rate (Mbps)	Average Ethernet Rate (Mbps)
BPSK	1/2	12	6	5.82
BPSK	3/4	12	9	8.63
QPSK	1/2	24	12	11.38
QPSK	3/4	24	18	16.7
16 QAM	1/2	48	24	21.77
16 QAM	3/4	48	36	33.01
64 QAM	2/3	72	48	44.1
64 QAM	3/4	72	54	48.8

As indicated in the table above, higher order modulation schemes require greater S/N to maintain the same BER performance. The noise in this case is defined as the noise floor of the receiver, i.e., it assumes no interference from other sources (interference from other sources are addressed below). The main path calculation for determining range performance is given as:

$$RSL = P_{tx} + G_{tx} - FSL + G_{rx}$$

Where:

- P_{tx} is the transmit power level in dBm
- G_{tx} is the transmit antenna gain in dB
- FSL is the free space loss attenuation in dB, and
- G_{rx} is the receive antenna gain in dB

The FSL value is dependent on the range between the two terminals, the type of terrain over which the link is deployed, and whether or not the link is operating line of sight (LOS), optical line of sight (OLOS) or non-LOS (NLOS). The LOS FSL calculation is well understood and easy to calculate, and relies on the fact there is absolutely no obstacle near the direct path. The precise method for determining the amount of clearance required for LOS involves making use of a factor known as the Fresnel zone. A Fresnel zone is defined as a path difference of $\lambda/2$ away from the direct path, as shown in Figure 20. A "cleared LOS" link assumes there are no obstacles within 60% of the first Fresnel zone of the direct path. The diagram below illustrates OLOS conditions, where a treetop is within the first Fresnel zone, and a clear direct path exists between the antennas.

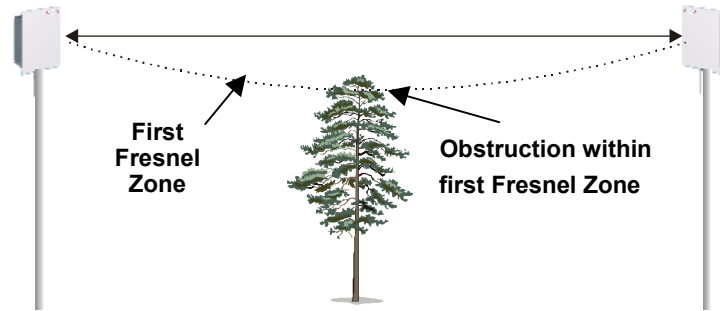


Figure 20: Fresnel Zone Obstruction

The formula for calculating the radius of the first Fresnel zone, as depicted in Figure 21, is given as:

$$R = 72.1 \sqrt{\frac{D1 * D2}{f * (D1 + D2)}} \text{ (ft)}$$

where,

- D1 and D2 are the distances from the terminals to the point of interest (in miles), and
 - *f* is the frequency (in GHz)
- (Note: multiply results by 0.3048 to obtain a solution in meters)

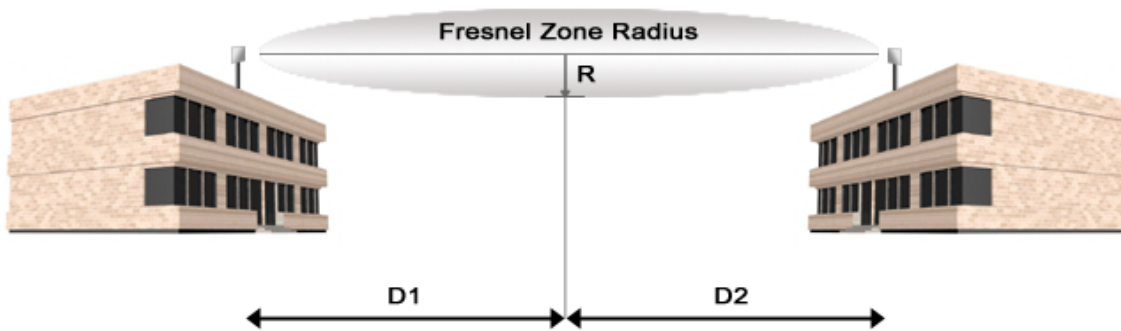


Figure 21: Fresnel Zone Radius Calculation

Specific FSL formulas are required to deal with this NLOS phenomenon. There are many NLOS calculations available from established institutions including the Institute of Electrical and Electronics Engineers (IEEE) and International Telecommunications Union (ITU), who are chartered with developing standardized calculations. The Redline Link Budget Tool is built upon these formulas; however, it is important to bear in mind that the calculations are an estimate only, with relatively large standard deviations (5-15 dB) depending on the exact deployment scenario and obstacle characteristics.

The last element to consider in the path calculation is the signal to noise (S/N) ratio, which is defined as:

$$S/N = RSL - S_{min}$$

where,

S_{min} is the receiver sensitivity expressed in dBm.

The S_{min} is determined by the thermal noise generated by the amplifier as well as the bandwidth of the filter used in the receiver front end. It defines the power level at which the receiver is sensitive enough to properly detect the signal. For the AN-30 operating in a channel spacing of 20 MHz, the S_{min} is approximately -96 dBm.

To ensure the link is sufficiently robust to deal with unexpected attenuation effects and seasonal fades, the S/N must be set higher than the S/N_{min} specific to each modulation level. The difference between these two levels is called the Fade Margin (FM). FM is similar to a "power reserve", in which extra power is designed into the link budget to deal with additional fades arising from such factors as climatic conditions (seasonal), multipath dispersions, and shadowing effects from natural (foliage) and man-made obstacles (buildings). The FM is determined by the availability one desires. Availability is defined as the amount of time (expressed in % per year) that a link properly detects the signal. "Properly" in this case is a BER that is less than 10^{-9} . The table below describes the outage period per year that corresponds to the different availability values.

Table 9: Availability Versus Outage Time

Availability (%)	Outage Period Per Year
99.9	8.8 hours
99.99	53 minutes
99.999	5.3 minutes
99.9999	32 seconds

It is recommended that the link be designed for an availability of greater than 99.99%. The tool automatically calculates the estimated required fade margin over distance to achieve this availability.

A key advantage of the AN-30 product is that it features a transmission correction scheme called Automatic Repeat Request (ARQ). The ARQ algorithm essentially detects when a packet(s) has been lost, due to fading, and makes a request to the remote system to re-transmit the lost packet(s). This feature provides an equivalent link budget gain of over 5 dB, which translates directly to an improved margin.

Another advantage of the AN-30 is its supports of multiple modulation schemes, i.e., BPSK, QPSK, 16QAM, and 64QAM. The system allows separate selection of the

modulation scheme for uplink and downlink. In this manner, the network can be balanced for the optimum spectral efficiency, no matter what propagation conditions prevail. Higher order modulation schemes (i.e., 64 QAM) are typically deployed at reduced ranges while lower order modulation schemes (i.e., BPSK) are implemented at long distances.

A sample link budget is shown in Figure 22 for the AN-30 system operating in 64 QAM, 3/4 code rating, providing a net burst throughput of 54 Megabits per second (Mbps). This provides an average throughput of 43 Mbps to the Ethernet port. The calculation is performed for LOS, however the graph (shown in Figure 23 below) also covers the OLOS and NLOS conditions.

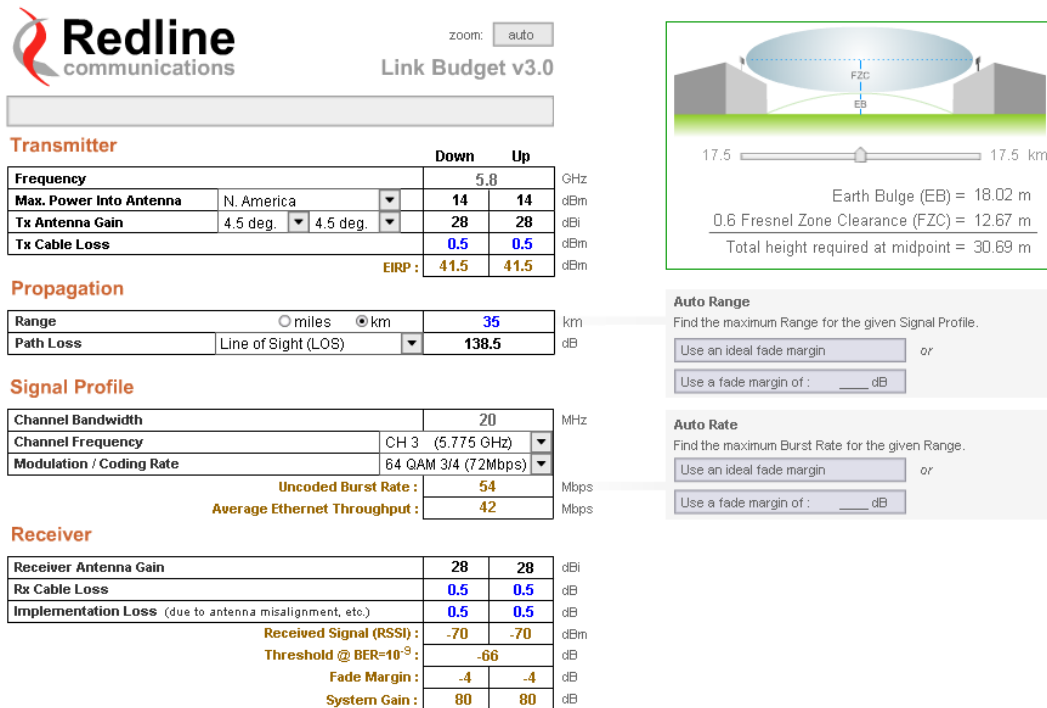
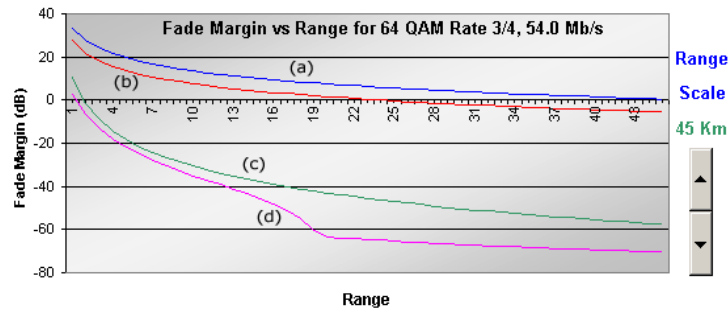


Figure 22: Link Budget For 64 QAM 3/4 Code Rate

A fade margin graph for this link budget is given in Figure 23 below for four conditions: LOS (a - blue line), OLOS with the first Fresnel zone obstructed (b - red line), NLOS scattered trees and buildings (c - green line) and heavily treed residential NLOS (d - magenta line).



- (a) LOS - Complete clearance, no first Fresnel zone obstacles.
- (b) Optical LOS - First Fresnel obstructed, giving rise to diffractive fading.
- (c) Erce g type C - Non line of sight, scattered trees and buildings, similar to business park scenario.
- (d) Residential, under the eave - Non line of sight, heavily treed, dense housing scenario.

Figure 23: Fade Margin Graphs For LOS, OLOS and NLOS

The graph assumes a fade margin of 3 dB. The effects of rain at bands are negligible, hence are not included in the link budget.

It is important to note the link calculation assumes that the Earth’s curvature is not blocking the propagation path. The equation for determining the distance at which the Earth will cause blockage is called the Radar Horizon, and is given as follows:

$$R_h = 4.1(\sqrt{h_1} + \sqrt{h_2}) \quad (\text{km})$$

where,

- h_1 is the height of terminal 1 (m)
- h_2 is the height of terminal 2 (m)

The table below specifies the horizon distance (km) that can be achieved for different terminal heights ranging from 10 to 70 m above mean terrain level.

Table 10: Radar Horizon Ranges For Different Terminal Heights (H_1 and H_2)

		H_2						
		10	20	30	40	50	60	70
H_1	10	25.9	31.3	35.4	38.9	42.0	44.7	47.3
	20	31.3	36.7	40.8	44.3	47.3	50.1	52.6
	30	35.4	40.8	44.9	48.4	51.4	54.2	56.8
	40	38.9	44.3	48.4	51.9	54.9	57.7	60.2
	50	42.0	47.3	51.4	54.9	58.0	60.7	63.3
	60	44.7	50.1	54.2	57.7	60.7	63.5	66.1
	70	47.3	52.6	56.8	60.2	63.3	66.1	68.6

10.4. Deployment Scenarios

This section examines two types of deployment scenarios: co-located (same rooftop), and adjacent area.

10.4.1. Co-located Deployments

It is possible to deploy more than one AN-30 system from the same rooftop to support multiple links, however, it is important to consider issues that may arise from co-channel and adjacent channel interference.

Co-channel interference results when two systems operate simultaneously in the same channel. This must be avoided by selecting different channels in the AN-30 **Configuration** screen. Adjacent channels are acceptable; however, it is important that the adjacent channel does not exceed the acceptable channel-to-interference (C/I) ratio for the system, as shown in Figure 24 (C is the desired channel, while I is the interferer).

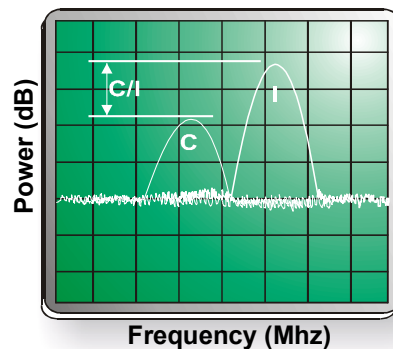


Figure 24: Adjacent Channel Interference.

10.4.2. Adjacent Area Deployments

During the installation process, it is important to ensure there is no potential for interference from other systems deployed in adjacent areas. Figure 25 presents a simple deployment configuration to illustrate the potential interference that may arise from adjacent area sources (Users 1 to 4 in Figure 25).

The desired communication link is between Terminals 1 and 2. The link between Users 1 and 2 must operate in an adjacent channel to avoid interference with the desired link. Users 3 and 4, on the other hand, can operate co-channel since they are outside the narrow beam width of both terminals. Narrow beam widths are one feature of the AN-30 to help address potential interference.

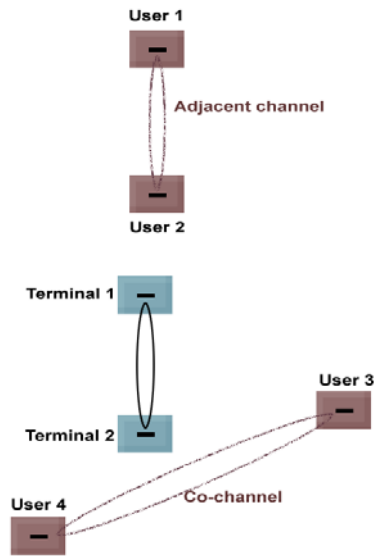


Figure 25: Deployment Scenarios

11. Appendix

11.1. Appendix 1 - Glossary Of Terms

AN-30	Redline Communications' Access Node-50 Broadband Fixed Wireless (BFW) system.
Antenna	A device for transmitting and/or receiving a radio frequency (RF). Antennas vary in design and frequencies supported.
Antenna Gain	The measure of antenna performance relative to a theoretical antenna called an isotropic antenna.
ARQ	Automatic Repeat Request. This is the protocol used over the air for error correction.
Beamwidth	The angle of signal coverage provided by an antenna.
BFW	Broadband Fixed Wireless
Bps (Bits Per Second)	A unit of measurement for the rate at which data is transmitted.
BPSK	Binary Phase Shift Keying.
Channel	A communications path wide enough to permit a single RF transmission.
dB	A ratio expressed in decibels.
dBi	A ratio, measured in decibels, of the effective gain of an antenna compared to an isotropic antenna.
dBm	Decibels above a milliwatt
DHCP	Dynamic Host Configuration Protocol. A DHCP server will automatically issue IP addresses within a specified range to devices on a network.
Directional Antenna	An antenna that concentrates transmission power into one direction.
Encryption	For the purposes of privacy, the transformation of data into an unreadable format until reformatted with a decryption key.
Ethernet	A LAN architecture using a bus or star topology
FD	Full Duplex. Refers to the transmission of data in two directions simultaneously (i.e. a telephone)
FWA	Fixed Wireless Access
Gain	The ratio of the output amplitude of a signal to the input amplitude of a signal. Typically expressed in decibels (dB).
Gateway	A network point that acts as an entrance to another network.
GHz	Gigahertz. 1,000,000,000 Hz, or 1,000 MHz
GUI	Graphical User Interface
Hertz (Hz)	The international unit for measuring frequency, equivalent to the number of cycles per second. One megahertz (MHz) is one million Hertz. One gigahertz (GHz) is one billion Hertz.
IF	Intermediate Frequency.
IP (Internet Protocol)	See TCP/IP.
Isotropic	A theoretic construct of an antenna that radiates its signal 360 degrees both vertically and horizontally—a perfect sphere. Generally used as a reference.
IXC (Inter-exchange Carrier)	A long-distance phone company.
LAN (Local Area Network)	A data communications network, typically within a building or campus linking computers, printers and other devices together.
LEC (Local Exchange Carriers)	The traditional local wired phone company.
LED	Light Emitting Diode
LOS	Line Of Sight. A clear direct path between two antennas, with no obstructions within the first Fresnel zone.
MAC (Media Access Control)	A unique number assigned to a network device. It corresponds to the

	ISO Network Model Layer 2 data link layer.
MHz	Megahertz. 1,000,000 Hz
Modem (MOdulator/DEModulator)	A hardware device which converts digital data into analog and vice versa.
Modulation	Any of several techniques for combining user information with a transmitter carrier signal.
Multipath	The radio echoes created as a radio signal bounces off of objects.
NLOS	Non Line Of Sight. Completely obstructed path between two antennas.
OFDM	Orthogonal Frequency Division Multiplexing. OFDM spreads data to be transmitted over a large number of orthogonal carriers.
OLOS	Optical Line Of Sight. A clear direct path between two antennas, with obstructions within the first Fresnel zone.
Packet	A bundle of data organized in a specific way for transmission. The three principal elements of a packet include the header, the text, and the trailer (error detection and correction bits).
PHY (Physical Layer)	Provides for the transmission of data through a communications channel by defining the electrical, mechanical, and procedural specifications.
PTP	Point to Point
QAM	Quadrature Amplitude Modulation
QPSK	Quadrature Phase Shift Keying
Receiver Sensitivity	A measurement of the weakest signal a receiver can receive and still correctly translate it into data.
RF	Radio Frequency
Rx	Receiver
S/N	Signal to Noise Ratio
SINADR	Signal to noise and distortion ratio.
TCP/IP (Transmission Control Protocol/Internet Protocol)	The standard set of protocols used by the Internet for transferring information between computers, handsets, and other devices.
TFTP	Trivial File Transfer Protocol
Tx	Transmitter

11.2. Appendix 2 – AN-30 Support For TDM explained

802.1p QoS

The AN-30 uses IEEE 802.1p to ensure QoS to TDM based applications such as mobility backhaul and enterprise PBX traffic. IEEE 802.1p allows traffic to be assigned into one of two (high or low priority) queues. Ethernet packets are queried to determine if they are priority tagged. Packets tagged with a priority value greater than or equal to four are automatically placed in the high priority queue. All other packets go into a default queue. The AN-30 always services the traffic in its high priority queue before the default, lower priority queue. A low priority packet will only be transmitted once the high priority queue is empty.

Flow Control

The AN-30 uses standard IEEE 802.3x flow control, for improved traffic handling.

IEEE 802.3x defines a control protocol between interfacing Ethernet port for the purpose of pausing transmission from an upstream device. Upon reception of a pause control frame, an Ethernet port will not transmit its next normal data frame until the timer specified in the pause control frame expires, or another pause control frame is received with its timer set to zero. During the flow controlled period, only flow control packets can be transmitted between across the Ethernet link.

The AN-30 uses this mechanism internally transmitting pause control frames as required based on the availability of its own internal resources, including buffers, transmit queues and receive queues.

Since Ethernet traffic typically runs at 100 Mbps it can easily exceed the maximum capacity of the wireless link. Left unchecked this situation will trigger indiscriminate packet discarding in the wireless transmit buffer. To avoid this condition the AN-30's wireless interface issues pause control frames to flow control upstream traffic. This effectively provides an automatic traffic shaping capability that automatically triggers in advance of a buffer overflow condition occurring. The system will therefore adjust itself to the available wireless throughput. If wireless throughput is decreased the system will automatically throttle-back (traffic shape) the lower priority traffic streams by first discarding the packets in its default queue.

Upon receiving additional packets, the system will issue pause control frames to halt upstream transmission until it can service its wireless transmit buffers.

Once wireless resources are again freed up, a new pause control frame is issued to resume transmission.

11.3. Appendix 3 - AN-30 System Specifications

AN-30 System Specifications										
System Capability	PTP mode, OFDM technology for robustness									
RF Band	5.725 - 5.825 GHz									
Channel Center Frequencies	Channel	1	1A	2	2A	3	3A	4	4A	5
	Freq.	5.735 GHz	5.745 GHz	5.755 MHz	5.765 GHz	5.775 GHz	5.785 GHz	5.795 GHz	5.805 GHz	5.815 GHz
Channel Size	20 MHz									
RF Dynamic Range	> 50 dB									
Modulation/Throughput	Modulation	Coding Rate		Over The Air Rate (Mbps)		Uncoded Burst Rate (Mbps)		Average TDM + Ethernet Rate (Mbps)		
	BPSK	1/2		12		6		5.82		
	BPSK	3/4		12		9		8.63		
	QPSK	1/2		24		12		11.38		
	QPSK	3/4		24		18		16.7		
	16 QAM	1/2		48		24		21.77		
	16 QAM	3/4		48		36		33.01		
	64 QAM	2/3		72		48		44.1		
64 QAM	3/4		72		54		48.8			
Maximum Tx Power	-20 to +20 dBm (channel dependent and region specific) *									
Rx Sensitivity	-86 dBm at 6 Mbps (based on BER of 1x10 ⁻⁹)									
IF Cable	<ul style="list-style-type: none"> Maximum length up to 250 ft (76m) using RG6U / 500 ft (152m) using high-grade RG11U Maximum allowable losses at 2.5 GHz: <ul style="list-style-type: none"> RG6: 10 dB/30m (100 feet) at 25°C RG11: 5 dB/30m (100 feet) at 25°C Multiplexed IF, DC power, control (Tx/Rx, AGC, APC) 									
Network Attributes	<ul style="list-style-type: none"> Transparent bridge DHCP passthrough VLAN passthrough 802.3x Ethernet flow control 802.1p Network traffic prioritization 									
Modulation	Modulation Options (bi-directional): • BPSK • QPSK • 16 QAM • 64 QAM									
Over The Air Encryption	Proprietary 64-bit encryption									
Coding Rates	1/2, 3/4 and 2/3									
MAC	<ul style="list-style-type: none"> Point to point Automatic Repeat Request (ARQ) error correction Concatenation 									
Range	<ul style="list-style-type: none"> Over 10 km / 6 miles for non-line-of-sight Over 80 km / 50 miles line-of-sight @ Tx 20 dBm 									
Network Services	Transparent to 802.3 services and applications									
Duplex Technique	Dynamic TDD (time division duplex)									
Wireless Transmission	OFDM (orthogonal frequency division multiplexing)									
Backhaul Connection	10/100 Ethernet (RJ45)									
System Configuration	<ul style="list-style-type: none"> SNMP CLI via Telnet and Local Console Port 									

* **Note:** In some countries outside of North America, the Max. Operational Power Per Channel with a given antenna is limited in accordance to maximum allowable EIRP levels for the region.

AN-30 System Specifications continued....

TDM Specifications		
Performance		
Jitter Buffering	5 to 300 msec	
Line Length	2000m using 22 AWG twisted pair cable	
Line Build-out	0dB, -7.5dB, -15dB, -22.5dB	
Diagnostics	Remote loop and local loop testing	
	Detects and Generates LOS (red), AIS (blue), RAI (yellow)	
Interface Ports	1 to 4 T1/E1 TDM Ports, Supports Fractional nx64 Services	
	1 RJ-45 (10/100BaseTX with Optional High Speed Data Upgrades)	
	E1 Specs	T1 Specs
Standards	ETS TBR 12/13, ITU-T Rec. G.703, G.704, G.706, G.732, G.821, G.823, G.826	AT&T TR-62411, ANSI T1.403, ITU-T Rec. G.703, G.704, G.733, G.821, G.824, G.826
Framing	Unframed, CRC4, FAS/MFAS	Unframed, D4 (SF), ESF
Data Rate	2.048 Mbps	1.544 Mbps
Line Code	HDB3, AMI	AMI, B8ZS
Connector	RJ-48c, BNC	Balanced RJ-48c, 8 pin
Line Impedance	Balanced: 120 Ohm (RJ-48c) Unbalanced: 75 Ohm (BNC)	Balanced 100 Ohm
Jitter	ITU-T G.823	Per AT&T TR-62411, ITU-T G.824
Clocking	Adaptive, Loopback, Internal	Adaptive, Loopback, Internal
Line Protection	ITU-T K-20, K-21	Bell Core GR 1089
AN-30 Physical Specifications		
Power Requirements	Single / Dual 110/220/240 VAC (auto-sensing) 50/60 Hz, 39W maximum Single / Dual 48 VDC, 39W maximum	
Operating Temperature Range	AN-50 Terminal Operating Conditions: 41F to 104F / 5C to 40C AN-50 Terminal Short-Term Conditions: 23F to 41F and 104F to 131F / -5C to 5C and 40C to 55C for up to 16 hours T-58 Operating Conditions: -40F to +140F / -40C to +60C	
Wind Loading	AN-30 Radio: 137 mph / 220 km/hr	
Physical Configuration	AN-30 terminal, AN-30 Radio	
AN-30 Dimensions	17" x 12" x 1.75" / 431.8 mm x 304.8 mm x 44.45 mm	
Component Weights	AN-50 Terminal 2.0 kg T-58 Transceiver 1.0 kg Vertical Mast Bracket Kit 3.0 kg Vertical Mast Bracket Hardware Kit 0.5 kg Cable, F Male/F Male, RG6, 100 ft 1.3 kg Antenna..... 1.0 to 16.0 kg	



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