

MULTIHAUL™ TG

Wireless 60 GHz L2 SDN Mesh for Multi-Gigabit Ethernet

Installation, Operation and Maintenance Manual

MHTG-I&O-01, Rev.D5

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This document was originally written in English. Please refer to the English language version for a full and accurate description of all products and services described herein.



Table of Contents

1	Introduction	5
1.1	Scope	5
1.2	Applicable Products and Releases	5
1.3	Audience	5
1.4	Conventions	5
1.5	List of Abbreviations	6
2	Safety and Regulatory Notices	7
2.1	General	7
2.2	FCC Regulatory Statements	7
2.3	Canada Regulatory Statements	8
2.4	EU Regulatory Notes	8
3	MultiHaul™ TG Overview	10
3.1	N366 Node	11
3.2	T265 TU	11
3.3	T280 TU	11
4	Installing the MultiHaul™ TG Units, N366 and T265	13
4.1	Preparing the Site	13
4.2	MultiHaul™ TG Package Contents	15
4.3	Unpacking the MultiHaul™ TG Units	15
4.4	Required Tools	15
4.5	Mounting and Aligning the MultiHaul™ TG Node on a Pole	15
4.6	Mounting the MultiHaul™ TG Node on a Wall	18
4.7	Mounting and Aligning the MultiHaul™ TG TU on a Pole or Wall	19
4.8	Connecting Cables	20
4.9	LED indicators	25
4.10	Link Up Verification	26
4.11	Resetting the Unit	27
5	Installing the MultiHaul™ TG T280 Terminal Unit	28
5.1	Preparing the Site	28
5.2	MultiHaul™ TG T280 Package Contents	30
5.3	Optional Items for the T280	30
5.4	Unpacking the MultiHaul™ TG T280	30
5.5	Required Tools	30



5.6	Mounting and Aligning the MultiHaul™ TG T280 on a Pole	31
5.7	Connecting Cables	39
5.8	LED indicators	44
5.9	Link Up Verification	45
5.10	Resetting the Unit.....	45
6	Management Concepts	46
7	Setup Using the Command Line Interface.....	47
7.1	Connecting to the CLI.....	47
7.2	Configuring Management IP Address	48



1 Introduction

1.1 Scope

This document describes how to install, configure, operate and maintain the MultiHaul™ TG, Siklu's Wireless 60 GHz L2 SDN Mesh for Multi-Gigabit Ethernet.

1.2 Applicable Products and Releases

- MultiHaul™ TG NodeN366
- MultiHaul™ TG Terminal Unit (TU) T265
- MultiHaul™ TG Terminal Unit T280
- MultiHaul™ TG Software Release: MH-TG-R1.0.2 for all products except MH-TG-R1.0.3 for MH-T280 in PtP mode only

1.3 Audience

This document assumes a working knowledge of wireless connectivity platforms and their operating environments.

This document is intended for use by persons involved in planning, installing, configuring, and operating the MultiHaul™ TG units.

1.4 Conventions

The following conventions are used in this document in order to make locating, reading, and using information easier.



Note: Informs you of an optional activity that may be performed at this stage.



Caution: Informs you that if you do not proceed as instructed, damage to or destruction of equipment or a loss of functionality may result.



Warning: Warns you that if you do not proceed as instructed, personal injury or loss of life could result.



1.5 List of Abbreviations

Abbreviation	Description
CDRH	Center for Devices and Radiological Health, a branch of the United States Food and Drug Administration (FDA)
FOV	Field Of View
MTU	Maximum Transmission Unit
NVRAM	Non-Volatile Random Access Memory
OTA	Over The Air
PD	Powered Device
PHY	Physical layer
PoE	Power over Ethernet
PoP	Point of Presence
PSE	Power Sourcing Equipment
PtMP	Point to MultiPoint
RAM	Random Access Memory
SaaS	Software as a Service
SDN	Software-Defined Networking
SFF	Small Form Factor
SFP	Small Form-Factor Pluggable
TU	Terminal Unit
UV	Ultraviolet



2 Safety and Regulatory Notices

The following are mandatory notices for installation and operation of MultiHaul™ TG Wireless Backhaul System. Indications appearing here are required by the designated government and regulatory agencies for purposes of safety and compliance.

2.1 General



Do not install or operate the MultiHaul™ TG units in the presence of flammable gases or fumes. Operating any electrical instrument in such an environment is a safety hazard.

2.2 FCC Regulatory Statements

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in any installation scenario. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Outdoor units and antennas should be installed, serviced or replaced ONLY by trained and qualified professionals who are familiar with local building and safety codes and, wherever applicable, are licensed by the appropriate government regulatory authorities.

The units are sold to service providers or professional network operators. They may not be sold retail to the general public.



Outdoor units may only be installed and operated with their integrated antenna, or with detachable antennas designated by Siklu Communication Ltd (in section 5.1).

Failure to do so may void the product warranty and may expose the end user or the service provider to legal and financial liabilities. Siklu Communication Ltd and its resellers or distributors are not liable for injury, damage or violation of regulations associated with the installation of outdoor units or antennas.



Les unités extérieures et les antennes doivent être installées, entretenues ou remplacées **UNIQUEMENT** par des professionnels formés et qualifiés qui connaissent les codes locaux du bâtiment et de la sécurité et, le cas échéant, sont agréés par les autorités réglementaires gouvernementales appropriées.

Les unités sont vendues à des prestataires de services ou à des opérateurs de réseaux professionnels. Elles ne peuvent être vendues au détail au grand public.



Les unités extérieures ne peuvent être installées et exploitées qu'avec leur antenne intégrée, ou avec des antennes amovibles désignées par Siklu Communication Ltd (dans la section 5.1).

Le non-respect de ces consignes peut annuler la garantie du produit et exposer l'utilisateur final ou le fournisseur de services à des responsabilités juridiques et financières. Siklu Communication Ltd et ses revendeurs ou distributeurs ne sont pas responsables des blessures, des dommages ou de la violation des réglementations associées à l'installation d'unités extérieures ou d'antennes.



Changes or modifications to this equipment not expressly approved by the party responsible for compliance (Siklu Communication Ltd) could void the user's authority to operate the equipment.

2.3 Canada Regulatory Statements

This Class B digital apparatus complies with Canadian ICES-003.

Cet appareil numérique de la classe B est conforme à la norme NMB-003 du Canada.

This device complies with Innovation, Science and Economic Development Canada's license-exempt RSS standard (s). Operation is subject to two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference that may be received or that may cause undesired operation.

Le présent appareil est conforme aux CNR d'Innovation, Sciences et Développement économique Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

2.4 EU Regulatory Notes

N366, T265	This product meets the technical requirements of ECC REC 07-03 (7 June 2019), Table 3, bracket C2, with operation between 57 GHz and 66 GHz and radiated transmitted power (EIRP) under 40 dBm.
T280	TBD

In some EU countries, outdoor operation of these devices is not permitted. If in doubt, please enquire with your national telecommunications regulator.



Changes or modifications to this equipment not expressly approved by Siklu Communication Ltd. or the party responsible for compliance could void the user's authority to operate the equipment.



Outdoor units and antennas should be installed **ONLY** by experienced installation professionals who are familiar with local building and safety codes and, wherever applicable, are licensed by the appropriate government regulatory authorities. Failure to do so may void the product warranty and may expose the end user or the service provider to legal and financial liabilities. Siklu Communication Ltd and its resellers or distributors are not liable for injury, damage or violation of regulations associated with the installation of outdoor units or antennas.

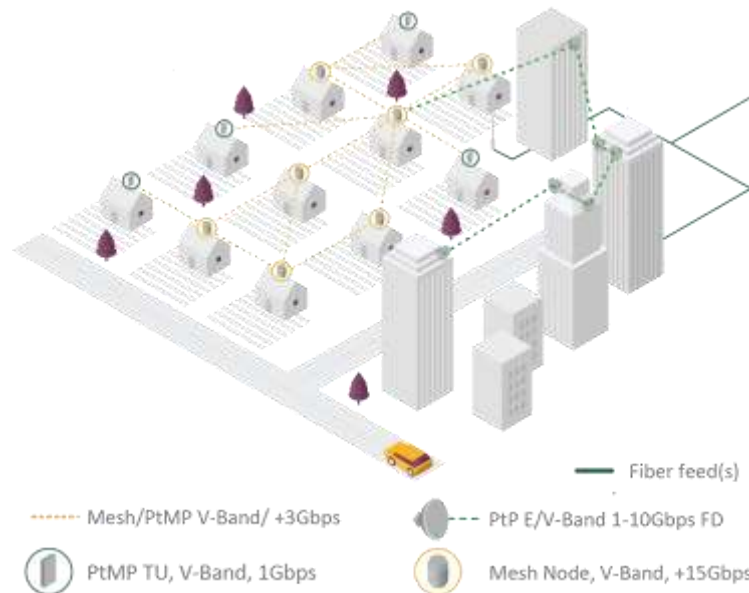


Les unités extérieures et les antennes doivent être installées par des professionnels expérimentés d'installation qui sont familiers avec les normes locales et les codes de sécurité et, si applicable, sont agréés par les autorités gouvernementales. Ne pas le faire peut annuler la garantie du produit et peut exposer l'utilisateur final ou le fournisseur de services à des obligations juridiques et financières. Les revendeurs ou distributeurs de ces équipements ne sont pas responsables des blessures, des dommages ou violations des règlements liés à l'installation des unités extérieures ou des antennes. L'installateur doit configurer le niveau de puissance de sortie des antennes conformément aux réglementations nationales et au type d'antenne.



3 MultiHaul™ TG Overview

The MultiHaul™ TG family is an advanced solution for fixed wireless delivery of multi-Gigabit services to homes, businesses and within smart cities Broadband IoT applications. It is complemented by additional Siklu solutions for network design and operation, the SmartHaul™ suite of SaaS applications and services, together with EtherHaul™, a series of very high capacity PtP wireless links.



MultiHaul™ TG is the culmination of innovation for L2 SDN mesh carrier-class systems operating in the uncongested, unlicensed V-band, delivering very high capacity over small to large neighborhoods for a wide range of applications. The plug and play units are designed for easy installation by a single technician, using a single cable for power and data.

This section provides a brief overview of the MultiHaul™ TG units. The MultiHaul™ TG family consists of the following units:

- MultiHaul™ TG N366 - a compact multi-sector unit deployed as a L2 SDN mesh node with built-in self-backhaul. Nodes can connect to additional N366 nodes to build a resilient wireless backbone across the served area, or to a network POP via either a fiber connection or a Siklu EtherHaul™ link with up to 10 Gbps FD.
- MultiHaul™ TG T265 - terminal units (TUs) deliver up to 1 GbE wirelessly to served locations. A smart beam-forming antenna provides for easy installation of a high capacity reliable wireless link by a single person, and serves one to three end-units per location.
- MultiHaul™ TG T280 - terminal units (TUs) deliver long-range, point-to-point and point-to-multipoint (future) connectivity, delivering 1 GbE full-duplex traffic (upgradeable to 5.5 Gbps aggregated with licenses and future software upgrade) over ranges of 1 kilometer or more.



3.1 N366 Node

Featuring 4 independent 90° sectors for a complete 360° coverage, a single node can be installed on a pole or roof to serve multiple locations. The node supports up to 15 TUs in each 90° sector when the sector does not self-backhaul to other nodes, up to a total of 60 TUs per N366. Each sector can also support 1 or 2 self-backhaul links, reducing the number of TUs that can be supported to 13 or 14 respectively (each backhaul link comes at the expense of a TU link).

The main features of the node include:

- 4 x 90° sectors.
- 4600 Mbps aggregate capacity OTA (over the air) per sector.
- > 3800 Mbps L2 traffic per sector, resulting in close to 16 Gbps capacity per node.
- 3 ports:
 - RJ-45 port with PoE-In, and capable of speeds from 1 Gbps to 2.5, 5 and 10 Gbps.
 - RJ-45 port with PoE-Out, and capable of speeds up to 1 Gbps.
 - SFP+ socket for SMF or MMF connections at speeds of up to 1 Gbps or 10 Gbps, depending on the inserted SFP device.
- On-board web GUI or CLI, for local or remote management and operations.
- Centralized management via SmartHaul™.

3.2 T265 TU

Featuring 90° scanning for easy installation, long distance and high performance, a TU can be installed on a pole or wall to serve between 1 - 3 connected devices with a copper or fiber interface. Additionally, the PSE/PoE-Out feature simplifies installation of the served devices by removing the need for additional power equipment.

The main features of the TU include:

- 90° horizontal scanning.
- 4600 Mbps aggregate capacity OTA (over the air).
- Up to 1 Gbps traffic.
- Up to 3 Ports, model dependent:
 - RJ-45 ports with PoE-In, and capable of 2.5 and 1Gbps speeds.
 - Optional RJ-45 port with PoE-Out.
 - Optional SFP+ socket for connection of SMF or MMF at speeds of up 10 Gbps.
- On-board Web EMS or CLI, for local or remotemanagement and operations.
- Centralized management via SmartHaul™ EMS.

3.3 T280 TU

The T280 Terminal Unit delivers long-range (over 1 kilometer), point-to-point connectivity (point-to-multipoint connectivity in the future, following a software upgrade). The T280 mounts easily on a pole, and offers up to 3 ports with both copper and fiber interfaces as well as a PoE out to power a collocated N366 or other 3rd party device.



A choice of 0.5ft, 1ft or 2ft antennas allows you to optimize your system in accordance with the required range, while allowing installation on roof tops, or on street furniture with the compact streamlined reflector antenna.

The main features of the T280 include:

- 4600 Mbps aggregate capacity OTA (over the air).
- 1 Gbps full duplex traffic, with upgrades up to 5500 Mbps with licenses and future software upgrades.
- 3 Ports:
 - RJ-45 ports with PoE-In, and capable of 1, 2.5, and 5 Gbps speeds.
 - RJ-45 port with PoE-Out.
 - SFP+ socket for connection of SMF or MMF at speeds of 1 or 10 Gbps.
- On-board Web EMS or CLI, for local or remotemanagement and operations.
- Centralized management via SmartHaul™ EMS.



4 Installing the MultiHaul™ TG Units, N366 and T265

This section describes how to install the MultiHaul™ TG nodes and TUs. For T280 installation guidelines, see [Chapter 5: Installing the MultiHaul™ TG T280 Terminal Unit](#)

4.1 Preparing the Site

Carefully select and prepare each site to make installation and configuration as simple and trouble-free as possible. During site selection and preparation, take into account local safety regulations and consider the long-term needs of both your network and your applications.

Installation and maintenance of the MultiHaul™ TG link should only be done by service personnel who are properly trained and certified to carry out such activities.

L'installation et l'entretien d'une unité MultiHaul™ TG ne doivent être effectués que par du personnel de service qui sont formés et accrédités pour mener à bien ces activités.



Minimum safe distance from antenna while radiating is 42 cm / 16.5 in (general public) or 19 cm / 7.5 in (occupational) according to calculation done based on "Environmental evaluation and exposure limit according to FCC CFR 47part 1, 1.1307, 1.1310; RSS-102, Safety Code6.

Distance de sécurité minimum de l'antenne tout en rayonnant est 42 cm selon le calcul fait sur la base de "l'évaluation environnementale et la limite d'exposition selon FCC CFR 47part 1, 1.1307, 1.1310, RSS-102, CODE6 sécurité.

4.1.1 Physical and Environmental Requirements

Each site should meet the following requirements:

- There must be a clear, unobstructed line-of-sight between the units.
- MultiHaul™ TG units should be mounted on a fixed, stable, permanent structure. Units can be mounted using the following methods:
- On reinforced steel mounting poles with the following diameters:
 - Node - 1.5" - 12"
 - TU (T265) - 1.5" - 4"



2" - 4" poles are recommended, in which case you can use the provided self-locking bands.

- Directly on a wall using the AX-MK-WM accessory, ordered separately from Siklu or your reseller.

4.1.2 Cabling Requirements

- Install the MultiHaul™ TG unit where network connections and optional power cabling are ready for operation and easily accessible.



Do not mount a MultiHaul™ TG unit on a structure that is temporary or easily moved. Doing so may result in poor service or equipment damage.

- All cabling connected to the MultiHaul™ TG unit should be outdoor grade, with UV protection.
- Use the following cables as per your type of connection:
 - 1 GbE - Cat5e (or higher) shielded outdoor cables terminated with metallic RJ45 connectors.
 - 10 GbE - Cat6 (or higher) shielded outdoor cables terminated with metallic RJ45 connectors.
- The MultiHaul™ TG unit is powered through the PoE input (ETH1). Take into account the power requirements of the MultiHaul™ TG unit (see [Section Error! Reference source not found.: Error! Reference source not found.](#)) and external PD(s) when planning Ethernet cabling and passive POE Midspan/Injectors.
- PSE Output (PoE Out) is available on MultiHaul™ TG units with more than a single Ethernet port.
- PSE port output voltage is nearly the same as PoE port input voltage. The total cable length from the PoE injector or PSE device to the last powered device (PD) should not exceed 100 meters (PSE to first unit + first unit to second unit).



PSE output is available only if the unit is powered directly by a power source such as 48VDC, or a PoE Injector/Midspan.

One MultiHaul™ TG unit will power a 2nd unit, however that 2nd unit cannot power a third unit. You must also consider proper power-in limitations to avoid damage to the first or second unit in the chain.

- In order to protect indoor equipment, you must install surge protection circuits on all copper cables on their entrance to the building.
- Install the MultiHaul™ TG unit in a location where proper electrical outdoor grounding is readily available. Typically, the grounding connection is attached directly to the mounting pole. If not already present, then suitable structure-to-earth grounding connections must be created before installation. Ground the unit using 16 AWG diameter (minimum) grounding cable or according to local electrical code.



Improper electrical grounding can result in excessive electromagnetic interference or electrical discharge.

Siklu will not be held responsible for any malfunction or damage if the unit is not properly grounded.

4.1.3 Node Orientation

The network has been carefully designed by your or Siklu's Planning Team to achieve the highest standards in availability and reliability, taking into account all potential lines of sight between the large quantity of units in your network. It is critical to implement the orientation of the multi-sector nodes as they are designed by the planners of the network. Sector 1 is the reference sector for node orientation. Make sure you obtain the azimuth for sector 1 from your or Siklu's Planning Team before installing, and align sector 1 along this planned azimuth, as described in [Section 4.5 - Mounting and Aligning the MultiHaul™ TG Node on a Pole](#), Step 7.



4.2 MultiHaul™ TG Package Contents

The MultiHaul™ TG N366 or T265 packages include the following components:

Description	N366	T265
MultiHaul™ TG unit	1	1
MultiHaul™ TG mounting bracket	1	1 (attached to the TU)
Unit grounding cable (90 cm / 35.4 in)	1	1
All-weather shells	2	2 (1 shell in case of 1 port)
Self-locking bands	2	2
PoE injector with AC cable	-	1

4.3 Unpacking the MultiHaul™ TG Units

Before installation, the MultiHaul™ TG package content should be examined carefully that all parts listed in the Quick Start Guide are present and there is no visible damage.



Unpack the MultiHaul™ TG components with care to avoid damaging or scratching the antenna radome.

4.4 Required Tools

The following tools are required for MultiHaul™ TG installation:

- Philips screwdriver, medium size head
- 7 mm hex socket driver
- Standard open-end wrench, 13 mm for the port caps
- Cutter
- Cable ties (for securing network and optional power cables)
- Cable labeling

4.5 Mounting and Aligning the MultiHaul™ TG Node on a Pole

To mount the node on a pole:

1. Insert self-locking bands in the mounting bracket.



The self-locking bands provided with the node are suitable for poles with a diameter of 1.5"-4". Poles with a diameter of 2"-4" are recommended.

2. Align the mounting bracket with the arrow pointing up and mount it on the pole.



Do NOT tighten the self-locking bands yet.

3. If all four sectors have a clear field of view and are not blocked by the pole, tighten the self-locking bands.
4. Ensure that the 4 mounting bracket screws are open.



5. Slide the node into the mounting bracket.



6. Tighten the four mounting bracket screws so that the node is securely fixed to the mounting bracket.

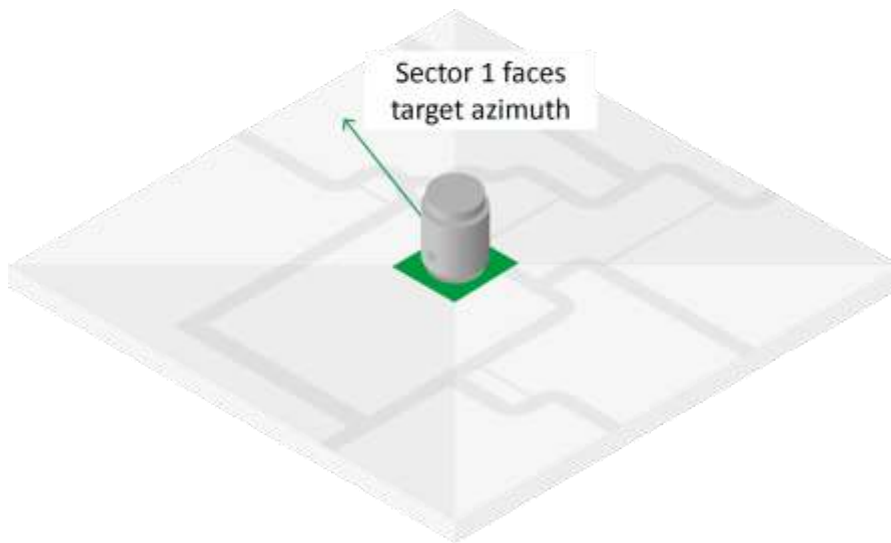


The node is now mounted on the pole.

7. Visually verify that the node's Sector 1 is aligned in accordance to the network design and instructions you received from your or Siklu's Planning Team (see [Section 4.1.3 - Node Orientation](#)). If required,



slightly release the self-locking bands and optimize the azimuth alignment by turning the mounting bracket.



Each sector is identified by the number that appears below the sector panel.



8. Once sector 1 faces the target azimuth, tighten the self-locking bands if required to secure the bracket to the mounting pole.

4.6 Mounting the MultiHaul™ TG Node on a Wall

The node can be mounted on a wall using the AX-MK-WM accessory and four wall-mount screws (not provided), as shown in the following figure:

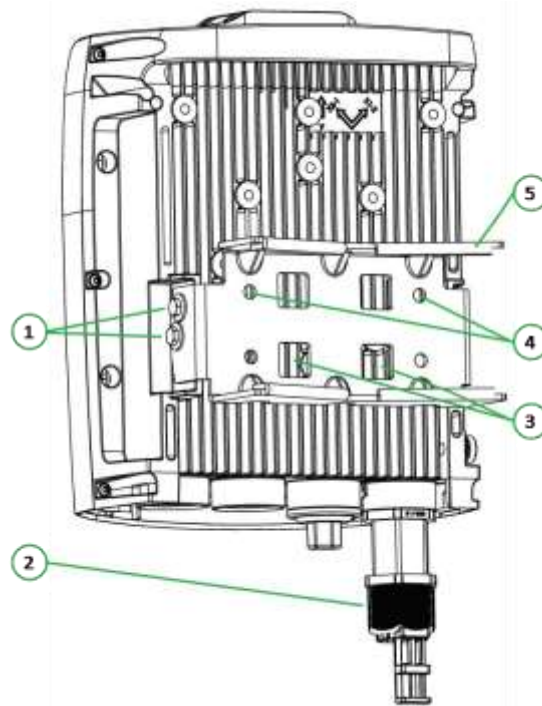


Order the AX-MK-WM accessory separately from Siklu or your reseller.



4.7 Mounting and Aligning the MultiHaul™ TG TU on a Pole or Wall

The TU is provided with a pre-attached mounting bracket suitable for mounting on a pole or wall.



1. Elevation lock bolts (2 x 7 mm on each side)
2. All-weather shells (1 or 3, depending on model)
3. Self-locking bands fixing points (for 2 x 130 mm bands provided)
4. Wall-mount fixing holes (4)
5. Mounting bracket

Field of View Considerations while Mounting



TUs should be pointed towards the node.

When mounting the TU using the attached mounting bracket, the FOV (field-of-view) of the TU is as follows:

- horizontal: $\pm 45^\circ$ electronically.
- vertical : $\pm 35^\circ$ (25° electronically and 10° mechanical adjustment, achieved through the elevation lock bolts).



- When mounting the TU on a pole: if additional vertical adjustment is required, use the EH-MK-SM mounting kit.



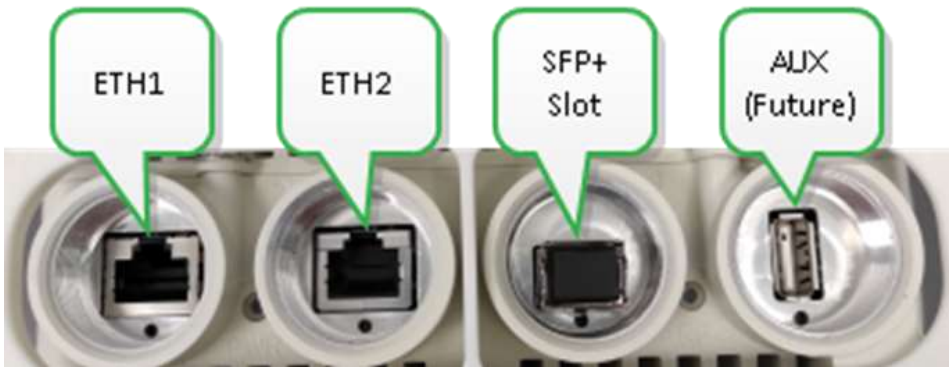
- When mounting the TU on a wall using the attached mounting bracket: if additional horizontal adjustment is required, use the AX-MK-WM accessory.
- When mounting the TU on a wall: if both additional horizontal and vertical adjustment are required, use the EH-MK-SM mounting kit and the AX-MK-WM accessory together.

•

4.8 Connecting Cables

4.8.1 Connecting the Cables to the MultiHaul™ TG Node

The MultiHaul™ TG node includes the following ports on the connector panel under the node, as shown and described below:

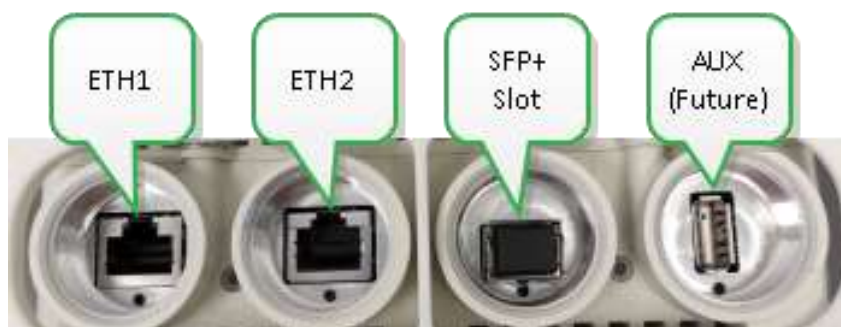


Description	Connector Type	Description
ETH1	RJ45	• 10 GbE (10/5/2.5/1 GbE) • PoE in
ETH2	RJ45	• 1 GbE • PoE out
ETH3	SFP+	• 10 GbE • 1 GbE
 Use only Class 1 Laser SFP/SFP+ devices with rated voltage of 3.3 VDC that are safety-approved in accordance with UL/EN/IEC 62368 / 60950-1. If deploying in the USA, the devices should be registered with the CDRH (Center for Devices and Radiological Health).		
AUX	USB	For future use



4.8.2 Connecting the Cables to the MultiHaul™ TG TU

The MultiHaul™ TG TU includes the following ports on the connector panel under the TU, as shown and described below:



Port	Connector Type	Description
ETH1	RJ45	2.5/1 GbE - PoE in
ETH2 (T265-CCP only)	RJ45	1 GbE - PoE out
ETH3 (T265-CCP only)	SFP+	10 GbE 1 GbE
		Use only Class 1 Laser SFP with rated voltage of 3.3 Vdc which is safety approved to UL/EN/IEC 60950-1 and which is CDRH registered.
AUX	USB	For future use



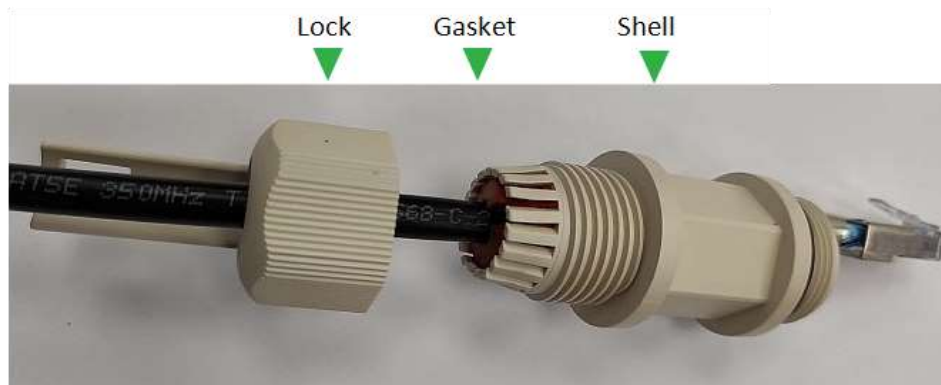
4.8.3 Weatherproofing the Cables

Before connecting a cable to a unit, you must first enclose the cable connector in a protective all-weather shell. Up to two sets of all-weather shells are provided with the unit. Additional all-weather shells can be purchased from Siklu or your reseller (P/N EH-AWS-SHORT).

The provided protective all-weather shells fit cables from 3.5 mm to 9.0 mm in diameter.

In some installations, the cables to the units are protected inside a 3/4" flexible conduit. Siklu provides an adapter to maintain the Ingress Protection (IP) rating of the installation by matching the all-weather shell termination to a Liquid Tight Adaptor (LTA) of your choice. The adapter can be purchased from Siklu or your reseller (P/N EH-AWS-ADAPT-CNDUIT)

To weatherproof the cables:



1. Thread the connectorized cable through the lock and shell, and plug it into the corresponding port.
2. Tighten the shell to the unit firmly by hand (do not use tools).
3. Pick a rubber gasket matching the cable diameter and insert the gasket snugly into the shell.
4. Secure the connector lock manually (do not use tools).
5. Attach the cable to the lock with two cable ties.



To avoid accidental damage to the connector, unlock the lock before removing the shell.



4.8.4 Grounding MultiHaul™ TG Units

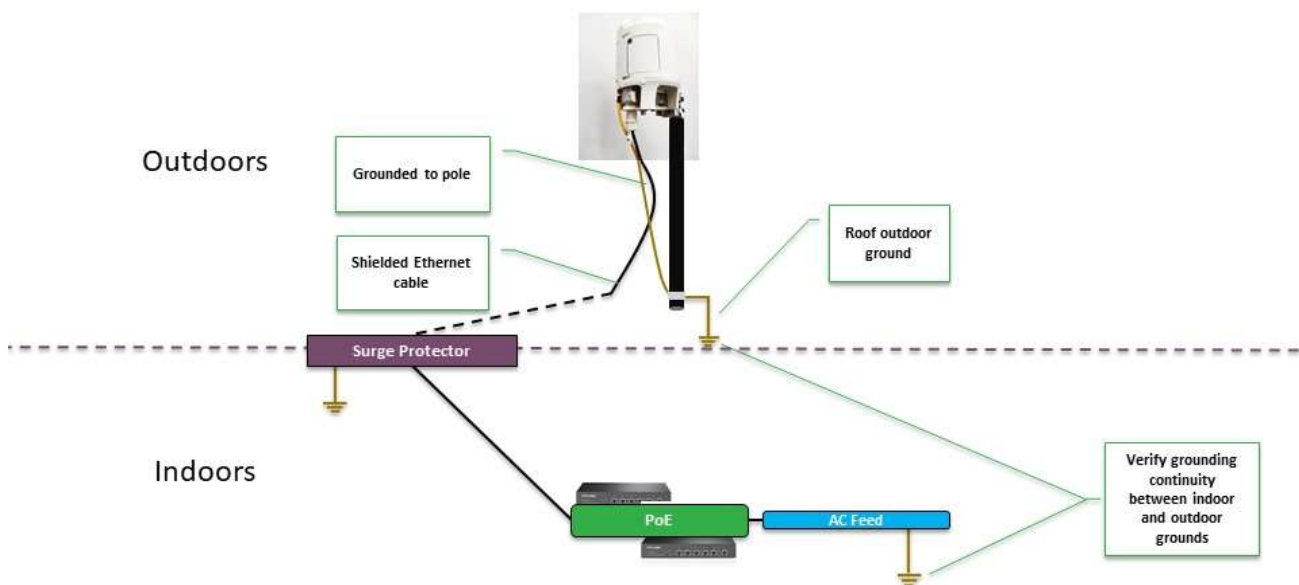
1. Connect one end of the grounding cable to the ground lug terminal. Secure the screw.



2. Connect the other end of the grounding cable to the ground connection. If the ground connection is out of reach of the grounding cable, install a longer cable using 16 AWG grounding cable minimum or according to local electrical code.

4.8.5 Installing Lightning Surge Protectors on Cables

A lightning surge protector should be installed on every ethernet cable to protect the indoor networking equipment. The lightning surge arrester should be installed next to the cable point-of-entry and must be properly grounded, as shown in the following figure.





4.8.6 Powering Units

You can power the unit using one of the following methods:

- PoE, active or passive, through the Ethernet cable connected to ETH1.
- Direct DC (input range: 36÷57 Vdc) by using an RJ45-DC adapter that can be purchased from Siklu or your reseller (P/N EH-PoE-DC-adaptor). In this case, port ETH1 will be used for power only.



Use a PoE power supply which is safety approved to UL/EN/IEC 62368 as a limited power source (LPS) with rated voltage of 42-57 Vdc and rated current of 2.5 A max, and approved for the altitude where it is deployed.

To power up the MultiHaul™ TG:

1. Connect the Ethernet cable with PoE or direct DC cable to port ETH1.

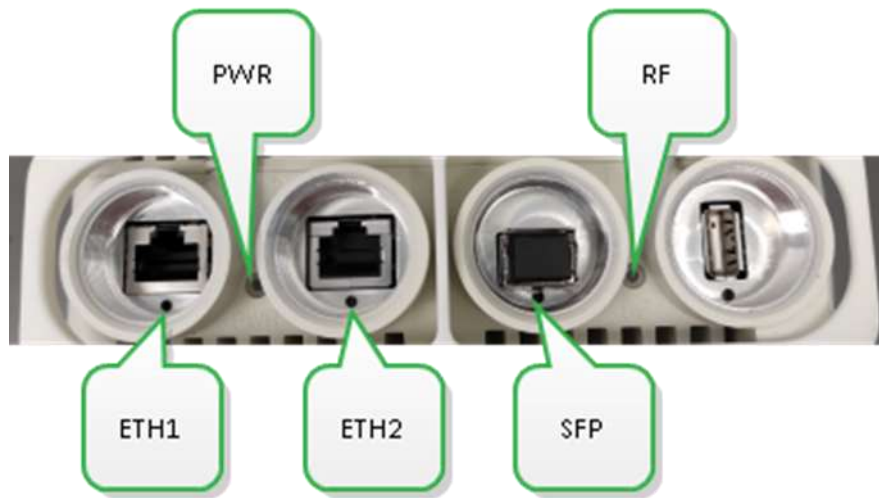
4.8.7 Connecting Other Network Cables

Connect any other network cables (ETH2, ETH3) as required by the deployment plan.



4.9 LED indicators

The MultiHaul™ TG unit includes the following LEDs on the connector panel under the unit, as shown and described below.



LED	Color	Description
PWR (Power)	Green	- On - power is on. - Blinking - booting up.
	Orange	On - booting up (boot failure if LED remains on for more than 2 seconds).
	Red	Blinking - when reset pushbutton is released.
	Off	No power.
RF	Green	- Node: on - at least one link connected (link can be to another node or a TU on any sector). - TU: on - connected to the node
	Off	No link.
ETH1	Green	- Node: on - 10 GbE link. - TU: on - 2.5 GbE link.
	Orange	- Node: on - 5/2.5/1 GbE, 10/100 Mbps link. - TU: on - 1 GbE, 10/100 Mbps link.
	Off	No link (carrier).
ETH2 (Node and T265-CCP only)	Green	On - 1 GbE link.
	Orange	On - 10/100 Mbps link.
	Off	No Link (carrier).
SFP (Node and T265-CCP only)	Green	On - 10 GbE link.
	Orange	On - 1 GbE link.
	Off	No Link (carrier).



4.10 Link Up Verification

4.10.1 Node Checks

Perform the following checks on each node:

1. Verify that node sector 1 is pointing to the azimuth specified for the site.
2. Verify the self-locking bands are tightened.
3. Verify that the unit has been properly grounded.
4. Verify that the PWR LED is green.

4.10.2 TU Checks

Perform the following checks on each TU:

1. Point the TU towards the serving node (see Section 4.7 - Mounting and Aligning the MultiHaul™ TG TU on a Pole or Wall).
2. Verify the self-locking bands and the elevation lock bolts are tightened.



If you mounted the TU using the EH-MK-SM mounting kit, verify the elevation and azimuth lock bolts on the mounting kit are tightened.

3. Verify that the PWR LED is green.
4. Verify that the RF LED is green, indicating correct association with the serving node (Link Up).

4.10.3 Configuring the System

The MultiHaul™ TG units can now pass management and traffic between the units over the radio link, to/from the ethernet ports.

You can use the GUI or CLI for advanced configuration of the units, monitoring their status and troubleshooting.



4.11 Resetting the Unit

Resetting the unit causes all user configurations to be lost.

The MultiHaul™ TG unit includes a pushbutton next to the USB port on the connector panel under the unit, as shown and described below:



Button	Description
Reset	10 second or more press - reset to factory default. See Section 4.9 - Unit LEDs



5 Installing the MultiHaul™ TG T280 Terminal Unit

This section describes how to install the MultiHaul™ TG T280 terminal unit.

5.1 Preparing the Site

Carefully select and prepare each site to make installation and configuration as simple and trouble-free as possible. During site selection and preparation, take into account local safety regulations and consider the long-term needs of both your network and your applications.

Installation and maintenance of the MultiHaul™ TG unit should only be done by service personnel who are properly trained and certified to carry out such activities.

L'installation et l'entretien d'une unité MultiHaul™ TG ne doivent être effectués que par du personnel de service qui sont formés et accrédités pour mener à bien ces activités.

Minimum safe distance from the antenna while radiating varies with the antenna type and is calculated in the table below in accordance with Environmental evaluation and exposure limit according to FCC CFR 47part 1, 1.1307, 1.1310 and ISED RSS-102, Safety Code 6.

La distance de sécurité minimale de l'antenne pendant le rayonnement varie selon le type d'antenne et est calculée dans le tableau ci-dessous conformément à Evaluation environnementale et limite d'exposition selon FCC CFR 47part 1, 1.1307, 1.1310 et ISED RSS-102, Code de sécurité 6.

	AX-ANT-0.5FT (16cm / 38dBi)	AX-ANT-0.1FT (30cm / 43dBi)	EH-ANT-2ft-60GHz (65cm / 48dBi)
General public / Grand public	2.1m	0m	0m
Professionals / Professionnels	0m	0m	0m

5.1.1 Physical and Environmental Requirements

Each site should meet the following requirements:

- There must be a clear, unobstructed line-of-sight between the units.
- MultiHaul™ TG units should be mounted on a fixed, stable, permanent structure. Units can be mounted using the following methods:
- On reinforced steel mounting poles with the following diameters:
 - T280: 1.5" - 4"



2" - 4" poles are recommended, in which case you can use the provided self-locking bands.

5.1.2 Cabling Requirements

- Install the MultiHaul™ TG unit where network connections and optional power cabling are ready for operation and easily accessible.



Do not mount a MultiHaul™ TG unit on a structure that is temporary or easily moved. Doing so may result in poor service or equipment damage.

- All cabling connected to the MultiHaul™ TG unit should be outdoor grade, with UV protection.
- Use the following cables as per your type of connection:
 - 1 GbE - Cat5e (or higher) shielded outdoor cables terminated with metallic RJ45 connectors.
 - 10 GbE - Cat6 (or higher) shielded outdoor cables terminated with metallic RJ45 connectors.
- The MultiHaul™ TG unit is powered through the PoE input (ETH1). Take into account the power requirements of the MultiHaul™ TG unit (see [Section Error! Reference source not found.: Error! Reference source not found.](#)) and external PD(s) when planning Ethernet cabling and passive POE Midspan/Injectors.
- PSE Output (PoE Out) is available on MultiHaul™ TG units with more than a single Ethernet port.
- PSE port output voltage is nearly the same as PoE port input voltage. The total cable length from the PoE injector or PSE device to the last powered device (PD) should not exceed 100 meters (PSE to first unit + first unit to second unit).



PSE output is available only if the unit is powered directly by a power source such as 48VDC, or a PoE Injector/Midspan.

One MultiHaul™ TG unit will power a 2nd unit, however that 2nd unit cannot power a third unit. You must also consider proper power-in limitations to avoid damage to the first or second unit in the chain.

- In order to protect indoor equipment, you must install surge protection circuits on all copper cables on their entrance to the building.
- Install the MultiHaul™ TG unit in a location where proper electrical outdoor grounding is readily available. Typically, the grounding connection is attached directly to the mounting pole. If not already present, then suitable structure-to-earth grounding connections must be created before installation. Ground the unit using 16 AWG diameter (minimum) grounding cable or according to local electrical code.



Improper electrical grounding can result in excessive electromagnetic interference or electrical discharge.

Siklu will not be held responsible for any malfunction or damage if the unit is not properly grounded.

5.1.3 T280 Orientation

The network has been carefully designed by your or Siklu's Planning Team to achieve the highest standards in availability and reliability, taking into account all potential lines of sight between the large quantity of units in your network. Make sure you obtain the azimuth for the T280 from your or Siklu's Planning Team before installing, and align the T280 along this planned azimuth, as described in [Section 5.6: Mounting and Aligning the MultiHaul™ TG T280 on a Pole](#), Step 7.



5.2 MultiHaul™ TG T280 Package Contents

The MultiHaul™ TG T280 package includes the following components:

Description	Quantity
MultiHaul™ TG unit	1
Unit grounding cable (90 cm / 35.4 in)	1
All-weather shells	1

5.3 Optional Items for the T280

The MultiHaul™ TG T280 requires some additional items, depending on your application:

Description	Quantity	Required / Optional
External antenna	1	Required
Mounting bracket for external antenna	1	Depends on the antenna size
Power, PoE injector	1	Depends on the use case and source of power

5.4 Unpacking the MultiHaul™ TG T280

Before installation, the MultiHaul™ TG package content should be examined carefully that all parts listed in the Quick Start Guide are present and there is no visible damage.



Unpack the MultiHaul™ TG components with care to avoid damaging or scratching the antenna port.

5.5 Required Tools

The following tools are required for MultiHaul™ TG installation:

- Standard handheld digital voltage meter (DVM) with probes
- Philips screwdriver, medium size head
- 7 mm or 8mm hex socket driver
- Standard open-end wrench, 7-millimeter or 8mm, for tightening the radio on the MK
- Standard open-end wrench, 13 mm for the port caps
- 8mm Allen key for ODU installation with 2ft antenna
- Standard open-end wrench, 16-millimeter (or equivalent Hex socket) installation with 2ft antenna
- Cutter
- Cable ties (for securing network and optional power cables)
- Cable labeling



5.6 Mounting and Aligning the MultiHaul™ TG T280 on a Pole

The mounting and alignment of the T280 should be performed in the following stages:

1. [Connecting of the antenna to the radio unit in a staging area](#)
2. [Pre-establishment of a radio link in a staging area](#)
3. [Mounting and coarse alignment on site](#)
4. [Fine alignment](#)

5.6.1 Connecting the Antenna to the Radio Unit

To connect the antenna to the radio unit:

1. To connect the antenna to the radio unit, align them so that the interface in the center will overlap when attached.





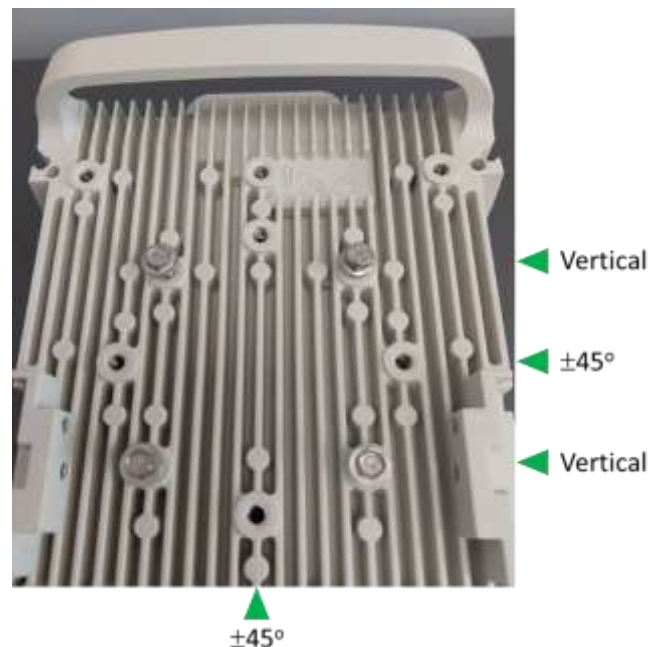
2. Attach the antenna to the radio unit by tightening the 4 pre-attached screws with xxx tool.



3. Insert the 4 bracket-mounting screws in the rear of the radio unit in accordance with polarity requirements, and screw them in half-way. These screws will be used to mount the radio unit on the bracket.



MultiHaul TG radio links are usually configured for either vertical or ± 45 degree polarity. The establishment of multiple links, each with a different polarity, effectively multiplies the bandwidth that is available in a given physical space, using the same frequency.

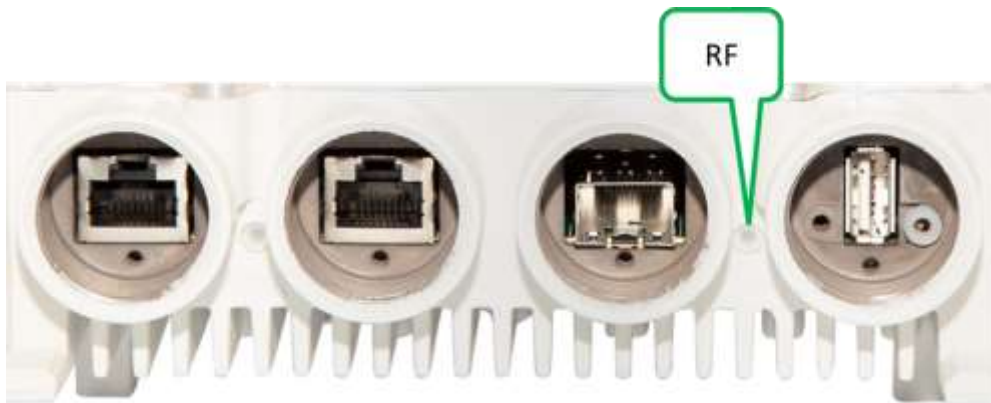




5.6.2 Pre-Establishing a Radio Link in a Staging Area

To establish and verify a link in the staging phase:

1. Position two T280 terminal units in the staging area so that a link can be established between them.
2. Power on the terminal units.
3. Use the CLI to configure the link. See [Chapter 17: Setup Using the Command Line Interface](#).
4. Check that the RF LED is green, confirming that the link has been established.



5. Use the following CLI command to set the transmit power to maximum:

```
set radio-common node-config tx-power-control max
```

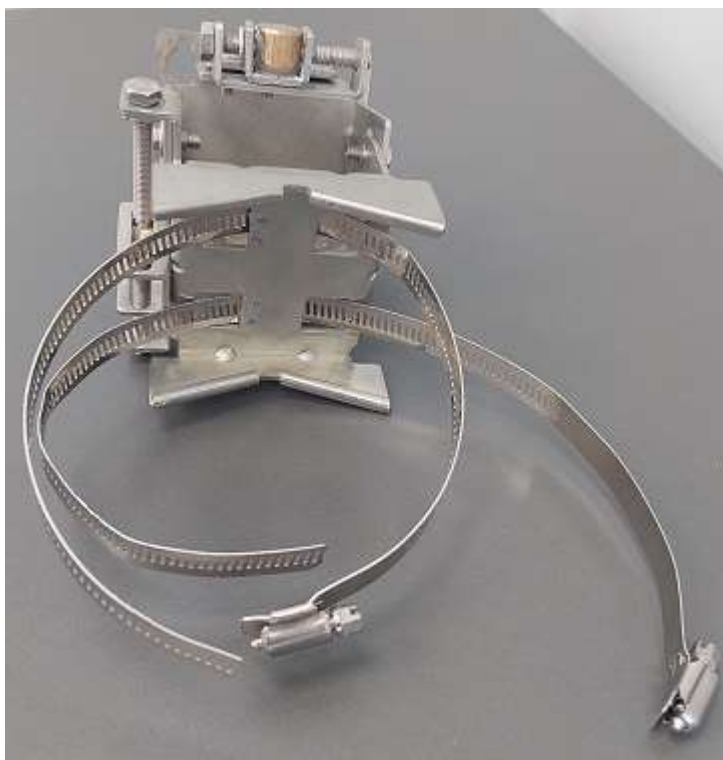
6. Power off the units and deploy them to the field.



5.6.3 Mounting the T280 on a Pole / Coarse Alignment

To mount the T280 on a pole and perform a coarse alignment:

1. Insert self-locking bands in the mounting bracket.



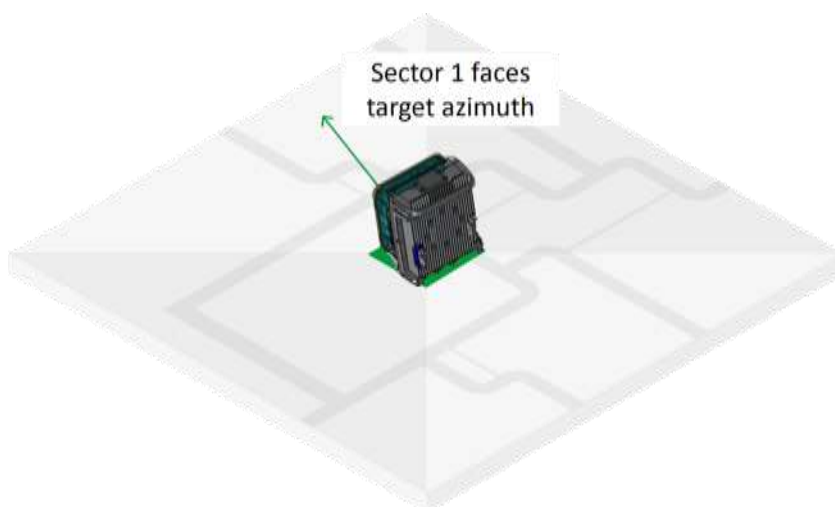
The self-locking bands provided with the node are suitable for poles with a diameter of 1.5"-4". Poles with a diameter of 2"-4" are recommended.



2. Mount the bracket on the pole as shown in the figure below, and tighten the bands.

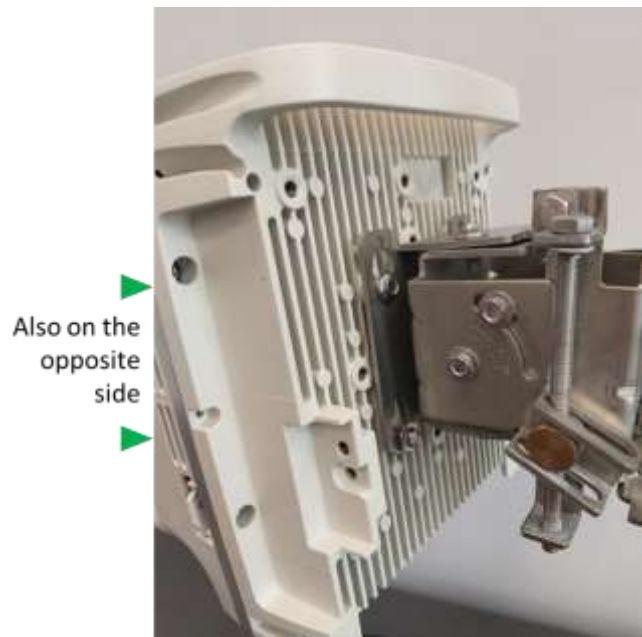


3. Visually verify that the T-280's antenna is aligned in accordance to the network design and instructions you received from your or Siklu's Planning Team (see [Section 5.1.3: Node Orientation](#)).





4. Insert the bracket-mounting screws into the corresponding openings in the bracket, and hang the radio unit on the bracket.



5. Tighten the four mounting bracket screws with a flathead screwdriver so that the radio unit is securely fixed to the mounting bracket.
6. To perform a coarse alignment, insert the viewfinder (which can be found in the box containing the antenna) in the T280 as shown in the figure below, and align it with the remote unit by rotating the complete unit and bracket on the pole to achieve the proper azimuth. Following the coarse alignment, tighten the bands.



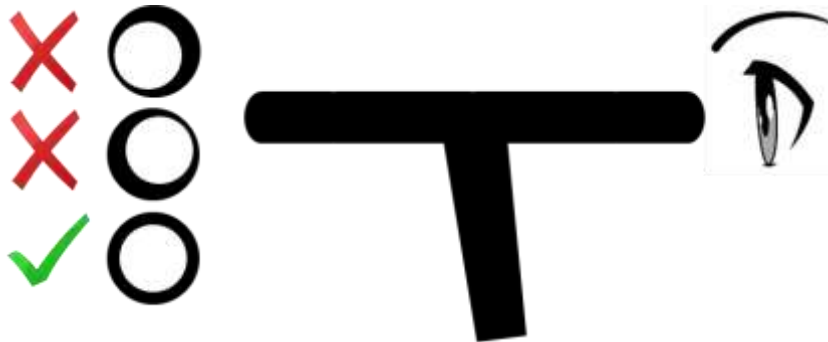
The viewfinder can be mounted on the right side of the radio unit if the left side is not accessible.



7. To optimize the alignment of the T280 with the remote unit, loosen the lock bolts screws on both sides and the top of the bracket (see the figure below), and adjust the antenna's elevation and azimuth.



8. Make sure that the remote terminal unit appears in the center of the viewfinder.



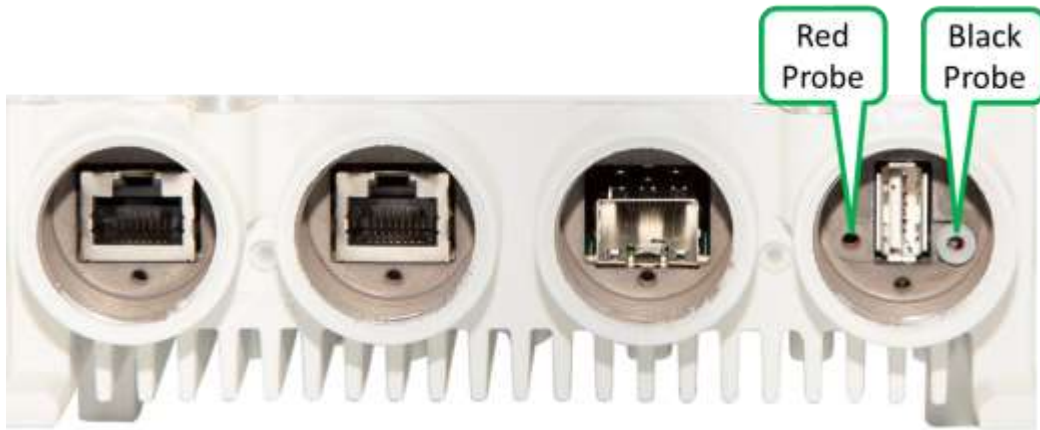
9. If required, tighten the self-locking bands to secure the bracket to the mounting pole.



5.6.4 Performing a Fine Alignment

To perform a fine alignment:

1. Power on the terminal units
2. Connect a digital volt meter (DVM) to the radio by inserting both the red and the black probes into their appropriate positions in the AUX port, as shown in the figure below.



Throughout the alignment procedure, you should compare the actual receive signal strength indication (RSSI) to the expected RSSI that was calculated during network link budget preparation. For best performance, measured RSSI should be within ± 4 dB of the calculated value.

Read the receive level (RSSI) using the DVM. The voltage reading will be between 0 to 1 Volt, indicating the RSSI in units of dBm. For example, a DVM reading of 0.45V is equivalent to -45 dBm.



When performing a fine alignment on an antenna, the antenna in the remote node must remain stationary. Perform a fine alignment first on the local antenna, and only afterwards on the remote antenna.

3. Perform a fine azimuth alignment on the local radio. Use the hexagonal wrench to adjust the azimuth fine adjustment screw. Be sure to sweep the complete range of the azimuth in order to determine the maximum received signal strength position. When the optimum alignment is achieved, tighten both azimuth adjustment lock bolts.
4. Perform a fine elevation alignment. Use the hexagonal wrench to adjust the elevation fine adjustment screw. Be sure to sweep the complete range of the elevation in order to determine the maximum received signal strength position. When the optimum alignment is achieved, tighten both elevation adjustment lock bolts.
5. Perform steps 3 and 4 on the remote radio.
6. Repeat steps 3 and 4 on the local radio and so on until optimum alignment is achieved.
7. Once the optimum alignment has been achieved for the link, tighten the azimuth adjustment lock bolts on the local radio (using a torque of 8 Nm), being very careful not to move the radio while tightening.



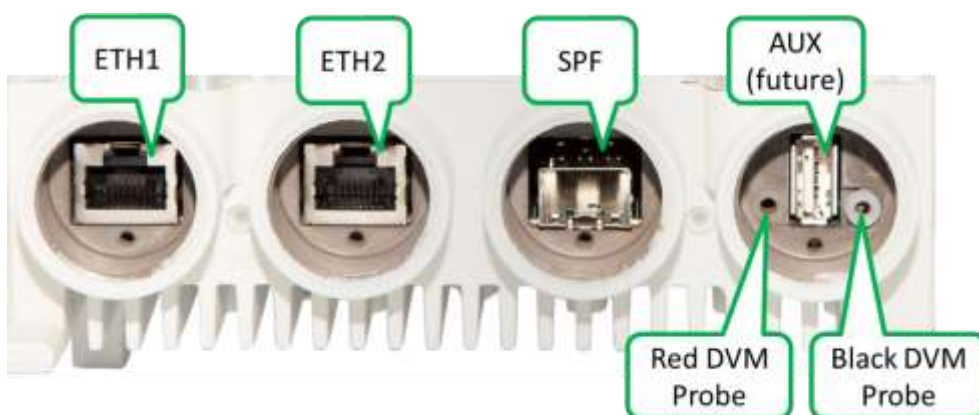
8. Tightening the azimuth adjustment lock bolts will tilt the radio, so realign the elevation as necessary. Once the optimum alignment has been achieved for the radio pair, tighten the elevation adjustment lock bolts on the local radio (using a torque of 8 Nm), being very careful not to move the radio when tightening.
9. Repeat steps 7 and 8 for the second radio.
10. Use the DVM to verify that the received signal strength has not changed on either the local or the remote radio after final tightening of the lock bolts. Antenna alignment is now complete.
11. Use the following CLI command to set the transmit power to automatic:

```
set radio-common node-config tx-power-control auto
```

5.7 Connecting Cables

5.7.1 Connecting the Cables to the MultiHaul™ TG T280

The MultiHaul™ TG T280 includes the following ports on the connector panel under the TU, as shown and described below:



Port	Connector Type	Description
ETH1	RJ45	5/2.5/1 GbE / 100MbE - PoE in
ETH2	RJ45	1 GbE - PoE out
ETH3	SFP+	10 GbE 1 GbE
		Use only Class 1 Laser SFP with rated voltage of 3.3 Vdc which is safety approved to UL/EN/IEC 60950-1 and which is CDRH registered.
DVM Probe Interface	2 prongs	Receive signal level, in dBm
AUX	USB	For future use





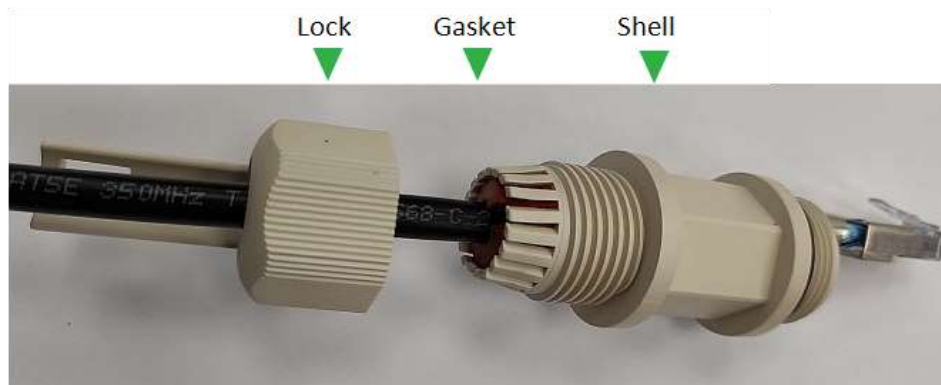
5.7.2 Weatherproofing the Cables

Before connecting a cable to a unit, you must first enclose the cable connector in a protective all-weather shell. Up to two sets of all-weather shells are provided with the unit. Additional all-weather shells can be purchased from Siklu or your reseller (P/N EH-AWS-SHORT).

The provided protective all-weather shells fit cables from 3.5 mm to 9.0 mm in diameter.

In some installations, the cables to the units are protected inside a 3/4" flexible conduit. Siklu provides an adapter to maintain the Ingress Protection (IP) rating of the installation by matching the all-weather shell termination to a Liquid Tight Adaptor (LTA) of your choice. The adapter can be purchased from Siklu or your reseller (P/N EH-AWS-ADAPT-CNDUIT)

To weatherproof the cables:



1. Thread the connectorized cable through the lock and shell, and plug it into the corresponding port.
2. Tighten the shell to the unit firmly by hand (do not use tools).
3. Pick a rubber gasket matching the cable diameter and insert the gasket snugly into the shell.
4. Secure the connector lock manually (do not use tools).
5. Attach the cable to the lock with two cable ties.



To avoid accidental damage to the connector, unlock the lock before removing the shell.



5.7.3 Grounding the MultiHaul™ TG T280

1. Connect one end of the grounding cable to the ground lug terminal. Secure the screw using a Phillips screwdriver.

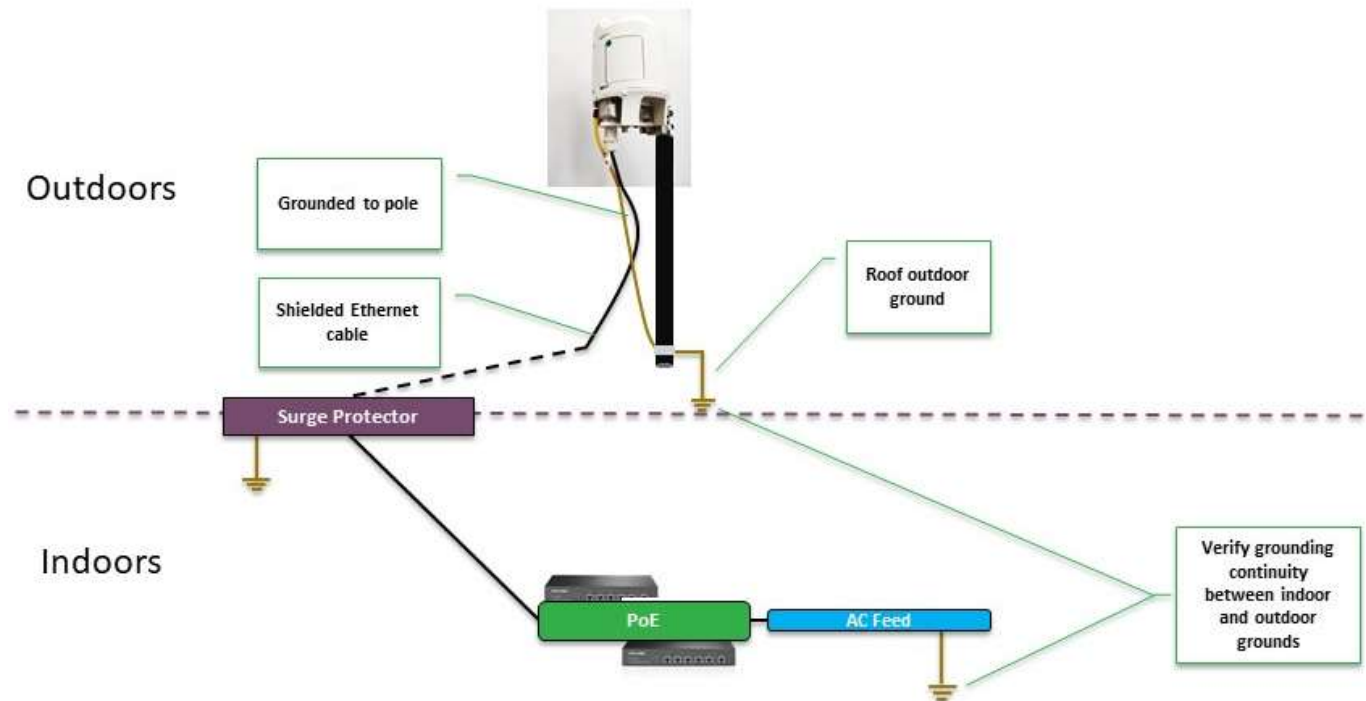


2. Connect the other end of the grounding cable to the ground connection. If the ground connection is out of reach of the grounding cable, install a longer cable using 16 AWG grounding cable minimum or according to local electrical code.



5.7.4 Installing Lightning Surge Protectors on Cables

A lightning surge protector should be installed on every Ethernet cable to protect the indoor networking equipment. The lightning surge arrester should be installed next to the cable point-of-entry and must be properly grounded, as shown in the following figure.



5.7.5 Powering Units

You can power the unit using one of the following methods:

- PoE, active or passive, through the Ethernet cable connected to ETH1.
- Direct DC (input range: 36÷57 Vdc) by using an RJ45-DC adapter that can be purchased from Siklu or your reseller (P/N EH-PoE-DC-adaptor). In this case, port ETH1 will be used for power only.



Use a PoE power supply which is safety approved to UL/EN/IEC 62368 as a limited power source (LPS) with rated voltage of 42-57 Vdc and rated current of 2.5 A max, and approved for the altitude where it is deployed.

To power up the MultiHaul™ TG:

1. Connect the Ethernet cable with PoE or direct DC cable to port ETH1.

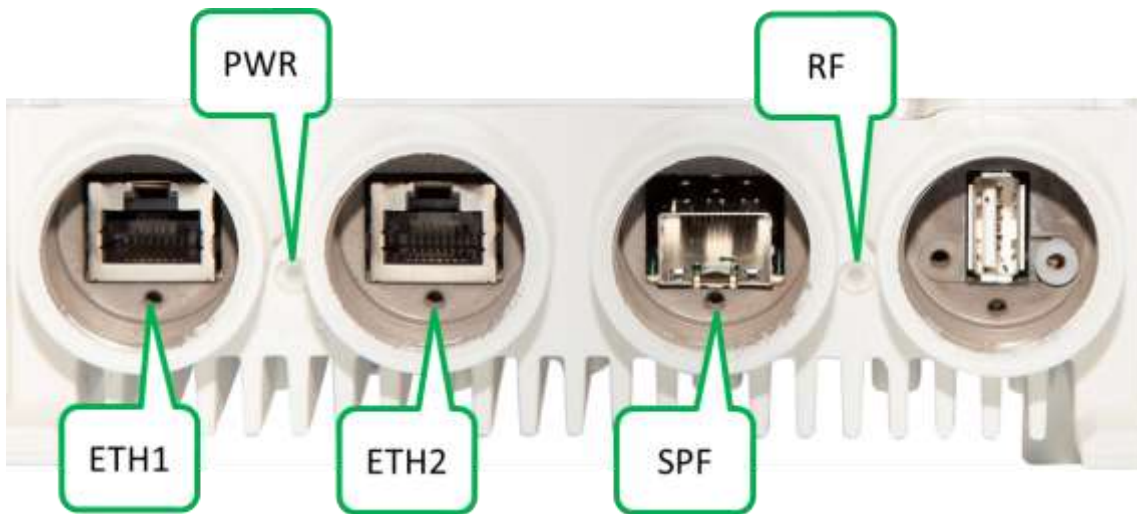
5.7.6 Connecting Other Network Cables

Connect any other network cables (ETH2, ETH3) as required by the deployment plan.



5.8 LED indicators

The MultiHaul™ TG T280 includes the following LEDs on the connector panel under the unit, as shown and described below.



LED	Color	Description
PWR (Power)	Green	- On - power is on. - Blinking - booting up.
	Orange	On - booting up (boot failure if LED remains on for more than 2 seconds).
	Red	Blinking - when reset pushbutton is released.
	Off	No power.
RF	Green	On - connected to the remote unit when in PtP mode; connected to the node when in PtMP mode (future)
	Off	No link.
ETH1	Green	Maximum speed achieved
	Orange	The speed achieved is half of the maximum speed, or less
	Off	No link (carrier).
ETH2 (Node, T265-CCP, T280)	Green	On - 1 GbE link.
	Orange	On - 10/100 Mbps link.
	Off	No Link (carrier).
SFP (Node, T265-CCP, T280)	Green	On - 10 GbE link.
	Orange	On - 1 GbE link.
	Off	No Link (carrier).



5.9 Link Up Verification

5.9.1 TU Checks

Perform the following checks on each T280 TU:

1. Verify that the link is properly aligned (see [section 5.6.4: Performing a Fine Alignment](#)).
2. Verify that the self-locking bands and the elevation and azimuth lock bolts are tightened.
3. Verify that the PWR LED is green.
4. Verify that the RF LED is green, indicating correct association with the remote unit (Link Up), and RSSI not different by +/- 2dB from the peak value achieved during alignment.

5.9.2 Configuring the System

The MultiHaul™ TG units can now pass management and traffic between the units over the radio link, to/from the Ethernet ports.

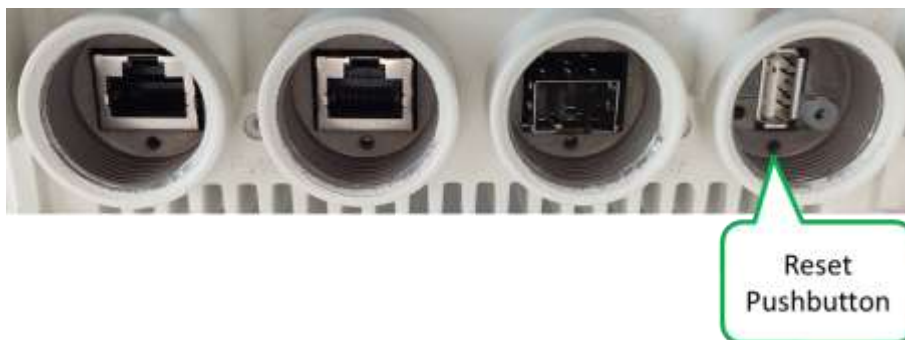
You can use the GUI or CLI for advanced configuration of the units, monitoring their status and troubleshooting.

5.10 Resetting the Unit



Resetting the unit causes all user configurations to be lost.

The MultiHaul™ TG unit includes a pushbutton next to the USB port on the connector panel under the unit, as shown and described below:



Button	Description
Reset	• 10 second or more press - reset to factory default. See section 5.8: LED indicators • 2 second press – T280 only, enter alignment mode (in future software release)



6 Management Concepts

You can manage MultiHaul™ TG units using the Command Line Interface (CLI) only with the current SW version. MultiHaul™ TG supports NETCONF and YANG to easily configure the units and extract data.

NETCONF is a protocol defined by the IETF to install, manipulate, and delete the configuration of network devices. NETCONF operations are realized on top of a Remote Procedure Call (RPC) layer using an XML encoding and provides a basic set of operations to edit and query configuration on a network device.

YANG is a data modeling language for the definition of data sent over NETCONF. It can be used to model both configuration data and state data of network elements.



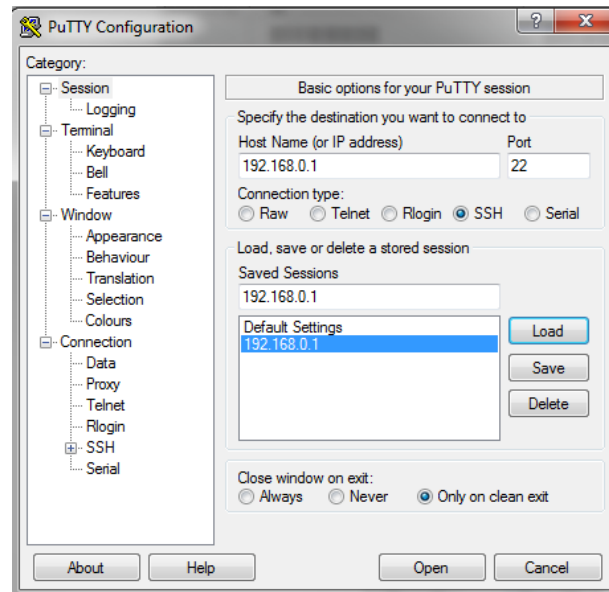
7 Setup Using the Command Line Interface

This section explains how to operate the MultiHaul™ TG units using the Command Line Interface (CLI). The CLI provides a text-based interface for configuring and monitoring the MultiHaul™ TG units.

7.1 Connecting to the CLI

To establish a CLI Session with the MultiHaul™ TG unit:

1. Use any SSH client program, such as PuTTY, available for download from the web.
2. Open an SSH session to the IP address of the unit (default = 192.168.0.1).



3. Configure PuTTY with the following recommended settings:
 - Under Terminal > Keyboard:
The function keys and keypad = Linux
 - Under Window:
Set Lines of Scrollback = 10,000
4. Type a name under **Saved Sessions** and click **Save**. The session will be stored under the Saved Sessions.



Whenever you want to connect, click the saved session name then click Load.

5. After connecting, type the username and password. The default credentials are: username: admin
password: admin
6. After you type your username, the prompt changes to [username]@[unit ip address]:

```
login as: admin admin@31.168.34.110's password:
```



If you typed incorrect credentials, **Access denied** appears. If the password was incorrect, you can retype it. If the username was incorrect, disconnect and reconnect.

7.2 Configuring Management IP Address

MultiHaul™ TG supports up to four IP addresses that can be on different subnets. The IP addresses and gateway are managed through the ip container as follows:

Parameter	Mandatory	Values	Remarks
ipv4	✓	address	List of static IPv4 addresses, for management, and optional prefix length
		default-gateway	Unit default IPv4 gateway

To set management IPv4 addresses and a default gateway, type the following commands:

```
MH-N366@popn110>set ip ipv4 address 10.40.1.100 prefix-length 24
MH-N366@popn110>set ip ipv4 default-gateway 10.40.1.1
MH-N366@popn110>commit
MH-N366@popn110>
```

To delete management IPv4 addresses and the default gateway, type the following commands:

```
MH-N366@popn110>delete ip ipv4 address 192.168.0.1
MH-N366@popn110>delete ip ipv4 default-gateway 10.40.1.1
MH-N366@popn110>commit
MH-N366@popn110>
```

To show the management IP configuration, type the following command:

```
MH-N366@popn110>show ip ipv4
ipv4 {
  address {
    ip 192.168.0.1;
    prefix-length 24;
  }
  address {
    ip 31.168.34.110;
    prefix-length 28;
  }
  default-gateway 31.168.34.105;
}
MH-N366@popn110>
```

-- end --