Axiometric

Gateway

Users Guide

Version 2007.09.01

Gateway 2 User's Guide

1. Overview

This document explains the features and operation of the MeshPlus™ Gateway 2. The Gateway 2 serves three main functions:

- *Mesh controller* – coordinates the wireless communication for thousands of remote MeshPlus™ devices. The Gateway 2 serves as a master timing source for all devices in a mesh.

- *Data collector* – gathers telemetry data from the remote MeshPlus™ devices and stores it in up to 4GB of non-volatile flash memory storage.

- *Network bridge* – transfers the telemetry data from the MeshPlus™ wireless mesh network to a TCP/IP network using Ethernet, 802.11b (WiFi), GPRS/EDGE (cellular), POTS Modem, or other network interfaces.
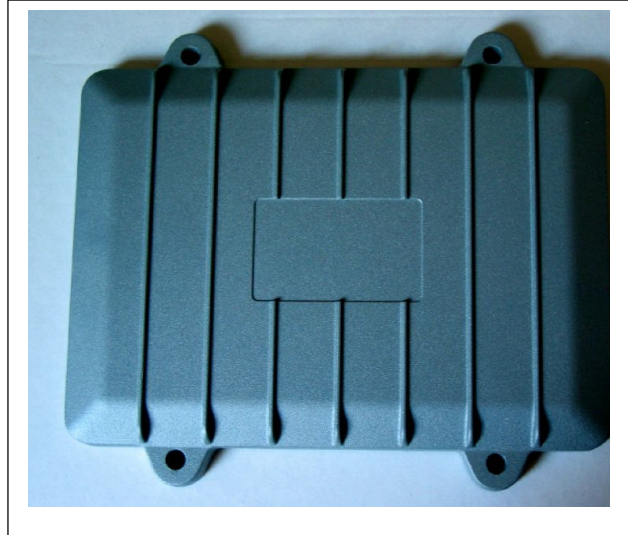
Each function will be addressed in detail in the following chapters.

2. Installation

The Gateway 2 is the heart of every MeshPlus™ wireless mesh telemetry network and is typically the first device deployed. The Gateway 2 is usually mounted outdoors either on a pole or structure using included hardware.

a) Configuration

Prior to mounting and installation, the network bridge interface should be configured and tested. The Gateway 2 is factory configured with one of three network bridge interfaces: Ethernet, WiFi, or Cellular. Consult the chapter for the selected network interface for details on configuration and testing.

b) Mounting

For maximum efficiency, the Gateway 2 should be mounted in a high location with an unobstructed view of as many mesh devices as possible. However, the Gateway will operate correctly as long as it is within wireless range of at least one mesh device.

Gateway 2 Pole Mount

Axiometric Gateway Guide *MeshPlus™*

wall mount bracket   pole-top bracket + U-bolts
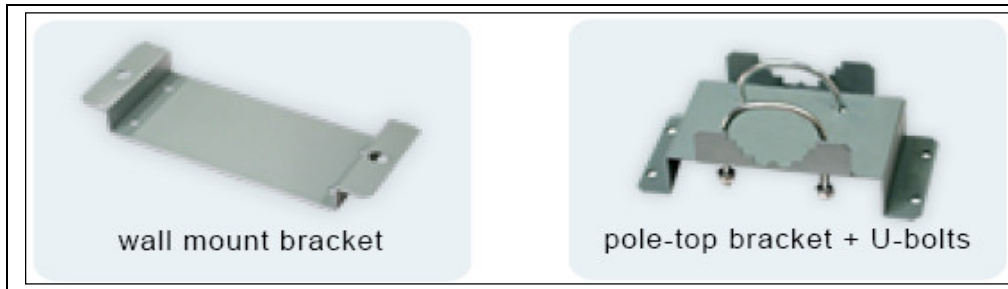
The Gateway 2 requires an external AC (110-220VAC 50/60Hz) or DC (POE or Solar) power source and should be mounted in a location with convenient access to power.

When using solar power, the solar panel should be angled towards the sun in the South to gather maximum energy.

When using Power Over Ethernet (POE), the DC source voltage should be adjusted based on the length of the Ethernet cable to deliver approximately 12vdc to the Gateway 2. An un-interruptible power source (UPS) should be used with the POE DC power source at the injector.

POE Injector

Based on the network bridge function selected (Ethernet, WiFi, POTS, or Cellular), the gateway should be mounted with clear access to the remote network. For example, a Gateway 2 with WiFi bridge option should be mounted with an unobstructed view of the WiFi access point it will communicate with; similarly, a Gateway 2 with Cellular bridge option should be mounted with an unobstructed view of the cell tower it will communicate with.

c) **Startup**

Once configured and mounted, the following steps should be followed to start Gateway 2 operation:

1. With external power **disconnected** remove the four bolts that secure the Gateway 2 front panel; carefully remove the panel and install a UM-1 lithium battery (Tadiran Pulses Plus recommended) in the battery clip on the right side of the gateway. Connect the battery connector to the Gateway 2 main board header JP3 observing the polarity of the header. The LEDs on the Gateway 2 Mesh Stamp should illuminate and begin blinking.

Lithium backup battery

The lithium battery does not supply any power to the Gateway in normal operation and has a typical service life of 10 years. When all other Gateway power sources are lost, the lithium battery can power the mesh controller and data collection functions of the Gateway 2 for over 6 months during an extended power outage ensuring that mesh operation and data collection continue without data loss. The lithium battery does not power the network bridge function. The lithium battery is a primary cell (it is not rechargeable) and should be replaced after an extended power outage (> 6 months total power outages) or when its typical service life has been reached (10 years).

2. If the Gateway 2 is equipped with the optional NiCd battery pack, fasten the pack to the inside of the front panel using the included 3M industrial hook and loop fasteners. Connect the battery pack to the Gateway 2 main board header JP4 observing the polarity of the header. The NiCd battery pack powers all Gateway 2 functions including the network bridge function for up to 48 hours during typical power outages allowing data collection and reporting (including the reporting of the power outage alarm) to continue during most power outages.

NiCd Battery Pack Connector

The NiCd battery pack is rechargeable; during normal operation the NiCd pack does not supply power to the gateway; instead, when external AC or DC power is present, and a constant trickle charge is provided to charge the battery and maintain its maximum level. The NiCd battery pack has a service life of between 5 and 10 years and should be replaced after 5 years of operation.

3. Make sure the battery cables are secure inside the enclosure and will not interfere with the front panel mounting. Check the positioning of the rubber gasket then replace the front panel ensuring the battery cables will not be damaged and secure the panel using the four bolts. The bolts should be tightened carefully to compress the gasket and ensure a water-tight seal.

4. Attach the supplied external antennas. Only the supplied antennas may be used with this unit. Lightning arrestors are recommended for all antenna connections.

Note: To comply with FCC RF exposure requirements, the device and the antenna for this device must be installed to ensure a minimum separation distance of 20 cm or more from a person's body. Other operating configurations should be avoided.

5. Connect the external AC or DC power source to start normal Gateway operation and begin charging the optional NiCd battery pack if present. Ensure a good ground connection is provided for AC or DC power; a missing or poor ground connection presents a serious safety hazard.

Installation is complete!

3. **Network Bridge**
The Gateway 2 is connected to a TCP/IP network via network bridge module. Four network bridge interface modules are presently available providing different physical layer interface options: Ethernet, 802.11b (WiFi), Cellular (GPRS/EDGE), and POTS Modem. The interface option is selected as a factory-installed option and is not field changeable. Each interface requires some amount of configuration the TCP/IP network it will connect to. The configuration procedures are defined below:

a) **Ethernet Network Bridge**

From the factory, the Ethernet bridge module is configured with a default IP address of 192.168.2.1. In most cases, the default network configuration will need to be changed; consult your network administrator for the correct network parameters.

- Connect your computer and the Gateway 2 Ethernet interfaces using an Ethernet hub, switch, or crossover cable.
- Configure your computer to the same subnetwork as the Gateway 2. For example, assign your PC a manual IP address of 192.168.2.2, a subnet mask of 255.255.255.0, and a gateway address of 192.168.2.1.
- Connect to the Gateway 2 using a telnet program. For example: telnet 192.168.2.1
- Enter the default Login "admin" and Password "admin" (note: when typing the password your characters will not be echoed)
- Configure the Gateway 2 Ethernet interface using the command line interface as shown below:
  1. # set serial s0 baud-rate 57600
  2. # set serial s0 data-bits 8
  3. # set serial s0 parity none
  4. # set serial s0 stop-bits 1
  5. # set serial s0 host-interaction-mode disable
  6. # set serial s0 auto-dialout enable
  7. # set serial s0 auto-dialout-protocol all
  8. # set serial s0 raw-dialout enable
  9. # set login auto-dialout-login disable
  10. # set bridge disable
  11. # set boot-messages disable

Configure the Ethernet network interface to the parameters provided by your network administrator. Typically, the network interface will either be configured for DHCP (step 15) or set to a static IP address (steps 12-14), not both.

- Steps 12-14 show how to configure the static IP address 172.30.1.31 and a subnet mask of 255.255.255.0 with a gateway at 172.30.1.1. You should use the parameters provided by your network administrator instead:
  - 12. # set ip eth0 dhcp-client disable
  - 13. # set ip eth0 ip-address 172.30.1.31 mask 255.255.255.0
  - 14. # set ip def-gway 172.30.1.1

- Step 15 shows how to configure the Gateway 2 for DHCP:
  - 15. # set ip eth0 dhcp-client enable

- Finally configure the Gateway 2 for access on a particular TCP port (e.g. 2100 or substitute the port specified by your network administrator):
  - 16. # set serial s0 auto-dialout-port 2100
  - 17. # set ip hostname MyGW2name
  - 18. # set ip auto-dialout enable
  - 19. # set ip telnet raw-mode enable
  - 20. # save

- Other useful CLI commands:
  - help
  - exit
  - restore default-config
  - show config
  - show serial s0 config
  - show serial s0 statistics
  - show sys-info
  - set ip pri-dns <ip addr>
  - set ip sec-dns <ip addr>
  - set ip dns <enable/disable>
  - set ip tcp-keepalive[3-120 minutes] (default = 3)
  - show ip eth0 configuration
  - show ip eth0 statistics
  - show ip eth0 link-status <ping ip addr> (pings specified address)

  For additional CLI commands, consult the MultiTech Developer Guide MTXCSEM Commands.

b) 802.11b (WiFi) Network Bridge

From the factory, the WiFi bridge module is configured with a default SSID of "mt800swm", infrastructure mode, no encryption and an IP address of 192.168.1.100. In most cases, the default configuration will need to be changed; consult your network administrator for the correct network parameters. In the example below, you will configure the Gateway2 for:

- SSID=MeshPlus
- IP Address = 172.30.1.34
- Subnetwork = 255.255.255.0

Axiometric Gateway Guide   *MeshPlus*™

- Default Gateway = 172.30.1.2
- Primary DNS = 172.30.1.1
- Domain = meshplus.com
- TCP access port 2100

You should substitute the correct values for your network.

Before you start, you will need:
-- Serial debug cable
-- a laptop or other RS-232 Terminal (DTE) device with serial communications software
that can generate a BREAK character.
   NOTE: the default HyperTerm cannot send a break character;
        download either HyperTerm Private Edition from Hilgraeve
        or another communications program (e.g. TeraTerm)

1. Configure GW2 socket modem for 3.3 volts (MT800SWM-L module) or 5.0 volts (MT800SWM module) if jumper JP1 is present.
2. Connect serial debug cable to MeshStamp 6-pin connector
3. Connect to Mesh Module console at 57600bps using serial communications software.
4. Configure the MeshStamp connection to the SocketModem for 115200bps:
        GW2> console baud 115200
5. Establish pass-through serial connection from MeshStamp to SocketModem:
        GW2> console null
6. AT#VVERSION<enter> (should be version 1.20 or higher)
7. AT&F<enter> (resets to factory defaults)
8. AT#IPADDR=172.30.1.34
9. AT#IPDEFGW=172.30.1.2
10. AT#IPDNSSERV1=172.30.1.1
11. AT#IPQUERY=meshplus.com   (sets domain name)
12. AT#WLANSSID=MeshPlus (configure SSID)
13. AT#WLANENABLE=1   (automatically connect to WAP)
14. AT#TCPPORT=2100
15. AT#TCPAUTOLISTEN=1 (automatically establish listen socket)
16. AT#BOOTMSG=0
17. AT#UARTBAUDRATE=57600<enter> (should respond with "OK")
18. ATE   (turns off echo)
19. Generate a BREAK using the serial communications software to return to the GW2> prompt

The SocketModem WiFi module is now configured for remote access.
Power cycle or reset GW2 to initiate communications.

To set up an AdHoc Wireless connection add these steps:
16.1   AT#WLANNETWORKMODE=1 (sets mode to adhoc)
16.2   AT#WLANIBSSCHANNEL=11 (default=9, range= 1-14)

Other useful commands for configuration and control of the Gateway 2 WiFi

functionality: "AT#IP?", "AT#WLAN?", "AT#VVERSION", "AT#VSTATE", "AT#VALL", "AT&F" (restore factory defaults).

Note that once this command sequence has been completed, any future changes to the WiFi configuration should skip step 4 since step 17 permanently configures the interface to 57600bps (the default).

c) GPRS/EDGE Network Bridge

Before you start, you will need:
-- Serial debug cable
-- a laptop or other RS-232 Terminal (DTE) device with serial communications softare
that can generate a BREAK character.
   NOTE: the default HyperTerm cannot send a break character;
        download either HyperTerm Private Edition from Hilgraeve
        or another communications program (e.g. TeraTerm)
-- Gateway 2 with SocketModem MTSMC-G-F2 for use in the USA
-- activated SIM card for data account from Cingular or other carrier
---- (When setting up the account, you should specifically request:
     'Mobile Terminating Data' and a 'Public Static IP Address'
    [If you don't ask for this, you won't get it; it is NOT the default])
-- Login information from Cingular for your specific SIM/Account:
---- APN (Access point name): (a string: e.g. 'wwan.ccs', 'cingular.isp')
---- APNUN (username): (e.g. "foobar@wwan.ccs")
---- APNPW (password): (e.g. "bwahahahaaaaaa!")

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Hardware Installation:

-- Remove main power (POE, AC, etc.) from gateway
-- disconnect backup power sources (Lithium/NiCd batteries) from Gateway 2
-- Remove JP1 (5v/3v3 selector near socket modem) if present
-- verify Gateway stuffing option R2 is populated (1M-Ohm) and R1 is not.
   (this defaults SocketModem Enable line to true, and ensures GPRS connection
   stays up when the gateway is reset.)
-- insert SIM card into socketmodem
-- replace JP1, connecting the center pin to the "5V" side.
-- reconnect backup power sources (lithium/nicad batteries)
-- reconnect main power.
-- wait ~10 seconds for everything to start-up.

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SocketModem One-Time Setup

Establish communications with the SocketModem:

-- connect to Gateway 2 console via console debug connector.
   (57.6kbps, 8N1, no flow ctrl.) Should see a 'GW2> ' prompt.

-- setup passthrough to socketmodem:
  type: "console null<cr>"
    to relay typed characters directly to the SocketModem
  type: "AT<cr>"
    to cause modem to auto-baud (should see "OK" response)
    [note: you may have to do this two or three times]

The SocketModem has on-board flash storage for most parameters;
erase any non-volatile parameters to start from a clean slate.

-- erase non-volatile storage on the SocketModem
  type: "AT&F"
    (wait for "OK")
  type: "AT&W"
    (wait for "OK")
  type: "AT+WOPEN=1"
    (wait for "OK")
  type: "AT#DELFLASH"
    (wait for "OK")
-- wait 5 seconds
-- remove JP1
-- wait 5 seconds
-- replace JP1, again in the "5V" position
-- wait for the RED led on the SocketModem to transition from SOLID to SLOW
BLINK

Configure permanent parameters on the SocketModem:
NOTE: unless otherwise specified, assume "(wait for "OK)" after entering
    any 'AT' command.

-- Fix the DTE rate to 57600bps:
  type: AT+IPR=57600
-- Fix the communications parameters to 8N1
  type: AT+ICF=3,4
-- Set Gateway/SocketModem flow control to 'none'
  type: AT+IFC=0,0
-- Tell the SocketModem to always leave CD on:
  type: AT&C0
-- Tell SocketModem to switch to command mode when DTR goes from 1 to 0
  type: AT&D1
-- Tell SocketModem to always keep DSR on:
  type: AT&S0
-- Save Modem Configuration: (Write to EEPROM)
  type: AT&W

Advanced (IP or GPRS modem-specific) configuration
-- turn on IP/GPRS stack
  type: "AT+WOPEN=1"

(wait for "OK")
-- Force attachment as class 'CG'
   [The default is a 'class B' device.]
   (GPRS-only - no voice service, no GSM service, auto-activate the IP stack,
    and auto-attach on power-up)
   type: AT+CGCLASS="CG"

-- set DLE mode ON for connection ID 1
   type: AT#DLEMODE=1,1
-- set TCP PORT for listen:
   type: AT#TCPPORT=1,2100
-- set TCP SERVER to allow incoming call from any host:
   type: AT#TCPSERV=1,"255.255.255.255"

-- set DLE mode ON for connection ID 2
   type: AT#DLEMODE=2,1
-- set TCP PORT for listen:
   type: AT#TCPPORT=2,2100
-- set TCP SERVER to allow incoming call from any host:
   OPTION:
   NORMAL: type: AT#TCPSERV=2,"255.255.255.255"
   OR, TO ENABLE BACKUP COLLECTOR: type: AT#TCPSERV=2,"64.32.161.115"

-- set your APN, username, and password (wait for "OK" after each one)
   **** NOTE: double-and-triple check the username and password; Cingular
         mixes up ones and 'I's and 'L's and zeroes and 'o's in their passwords.
   **** NOTE: the quotes around strings, (e.g.username/password/apnserv are required)
   type: AT#APNSERV="your APN [e.g. wwan.ccs]"
   type: AT#APNUN="your username"
   type: AT#APNPW="your password"

Once all the other configuration is done, turn off local echo and save
that state to EEPROM:
-- type: ate0
   (wait for "ok")
-- type: at&w
   (wait for "ok")

Configuration is complete. Confirm connectivity with the Gateway2 prior to
installation.

   d) POTS Modem Network Bridge

   The POTS modem bridge function is not supported in the current firmware

4. Redundant Configurations

Multiple Gateway 2s may be deployed in a mesh for redundancy. If a primary Gateway 2 is

damaged or removed, the mesh network will automatically fail-over to any available alternate Gateway 2. The secondary Gateway 2 should be deployed with identical mesh communication parameters (sync word, encryption key).

5. Gateway Replacement

When a Gateway 2 fails or needs to be replaced for service, the following steps should be taken to ensure successful replacement:

1. Remove external power from old Gateway 2
2. Open old Gateway 2 and disconnect backup power sources (NiCd, Lithium batteries)
3. Install new Gateway 2 according to directions provided in section 2 above.
4. Wait for top left LED on Gateway 2 mesh stamp to change from blinking to solid on.
5. Add entry for new Gateway 2 in collector software to initiate data collection. NOTE: step 4 should be performed before step 5 to assure fastest mesh restoration.

6. Specifications

Dimensions: 8.5" x 6" x 2"
IP67 Waterproof
Operating temperature range: -27.5C to +63C (-17.5 to +145F) ambient
      Note: secondary battery charges only from 0 to +45C to prevent damage
Enclosure heat trap (full sun): +6.5C
Internal power dissipation (max power): +5.5C
Humidity: 0 – 100%

External AC power: 100-240VAC 50/60Hz
External DC power: 9-16VDC
External AC surge suppression: ANSI C62.41 (6kV/3kA)
External AC over-current protection: self-resetting fuse (Polyswitch)
Primary backup battery: Lithium 3.6vdc 19AH UM-1 (Tadiran Pulses Plus recommended)
Optional secondary backup battery: NiCd 9.6vdc (8-cell AA) (Panasonic F-type recommended)

Mesh operating frequency: 902-928MHz
Mesh operating method: FHSS over 50 channels
Mesh transmit power: 22.8dBm
Mesh receive sensitivity: > 109dB
Mesh connector: N-type
Mesh encryption: 128-bit

Data collection storage: 1GB standard (4GB max) (RiData recommended)

7. <u>**United States of America, FCC:**</u>

The Gateway 2 contains a radio frequency transceiver. Operation of the Gateway 2 in the United States is governed by the rules and regulations of the Federal Communications Commission (FCC). The Gateway 2 has been tested and found to comply with FCC rules and regulations; a label is affixed to the Gateway 2 indicating the Gateway model, FCC Identification Number, and the additional FCC IDs of any contained modular devices; this label should not be removed.

NOTE: Changes or modifications not expressly approved by the manufacturer could void the user's authority to operate the equipment

NOTE: 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 a particular installation. 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.

Network Interface	Model	FCC ID	Also Contains
802.11b	GW2-AC-WF	VE4-GW2-AC	AU792U07B06821
GSM/GPRS	GW2-AC-GPRS	VE4-GW2-AC	AU792U03G23710
Ethernet	GW2-DC	VE4-GW2-DC	

To comply with FCC RF exposure requirements, the device and the antenna for this device must be installed to ensure a minimum separation distance of 20 cm or more from a person's body. Other operating configurations should be avoided.

The installer of this radio equipment must ensure that the antenna is located or pointed such that it does not emit RF field in excess of Health Canada limits for the general population; consult Safety Code 6, obtainable from Health Canada's website www.hc-sc.gc.ca/rpb

8. Troubleshooting

a) External Power
- Disconnect external power
- Unscrew the four bolts that fasten the chassis front panel
- Remove the front panel.
- Reconnect external power (when operating on AC power, **DO NOT TOUCH GATEWAY INTERIOR**).
- If external power is 110-240VAC, AC LED should illuminate.
- If external power is 8-18VDC, the DC LED should illuminate.
- If the appropriate LED does not illuminate, a qualified technician should check to ensure power is present at the supply cable.
- If external power is 8-18VDC, ensure the external RJ-45 connector is securely fastened and that the internal RJ-45 cable is plugged into the proper jack (J2) labeled Ethernet.
- If power is present but the LEDs fail to illuminate, return the Gateway for factory service.

b) Optional NiCd Backup Battery
- Disconnect external power
- Unscrew the four bolts that fasten the chassis front panel
- Remove the front panel.
- Check that the battery is securely fastened to the inside of the front panel
- Check that the battery connector is securely plugged into JP4 and that the proper polarity has been observed (positive/red wire connects to pin 1)
- The LED indicators for the Network Bridge Interface (SocketModem) should illuminate periodically.
- A properly qualified technician may measure the battery voltage using a voltmeter and should observe a voltage higher than 8.8vdc; if the voltage is lower, the battery pack has failed and should be replaced.

c) Lithium Backup Battery
- Disconnect external power
- Unscrew the four bolts that fasten the chassis front panel
- Remove the front panel.
- Check that the battery is securely held in the battery clip
- Check that the battery connector is securely plugged into JP2 and that the proper polarity has been observed (positive/red wire connects to pin 1

- The LED indicators for the MeshStamp should illuminate periodically (at least once per minute)
- A properly qualified technician should check the lithium battery voltage. A battery with a nominal voltage less than 3.4vdc should be replaced.

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