

GENERAL DESCRIPTION OF MODEL SHOUT ns

Revision B

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B	7/12/19	Editorial and format updates. Added Reference Documents and sections for Quick Start User Guide, SHOUT Android App, and Nal Vue Management Tool.	A. Schiltz

REFERENCE DOCUMENTS

The latest revision of these documents are available from the NAL Research website at (<http://www.nalresearch.com/Downloads.html>).

Reference	Title	Revision / Date
[1]	AT Commands for Model SHOUT ns	Revision 1.0.5, 23 March 2018
[2]	NAL GPS Report Version 6 Format	Revision 3, 26 September 2018
[3]	PECOS Message Definition Specification, 200907-001	Version 1.7 July 29, 2009
[4]	SHOUT App User Guide	
[5]	NAL Vue Users Guide	

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GLOSSARY

AES	Advanced Encryption Standard
BIS	Bureau of Industry and Security
CE	Conformité Européen
CEP	Circular Error Probability
CFR	Code of Federal Regulations
DGPS	Differential Global Positioning System
DoD	Department of Defense
DoD EMSS	DoD Enhanced Mobile Satellite Services
DTE	Data Terminal Equipment
DSN	Defense Switch Network
EAR	Export Administration Regulations
EMI	Electromagnetic Interference
ETSI	European Telecommunications Standards Institute
FCC	Federal Communications Commission
FDMA	Frequency Division Multiple Access
GND	Ground
GPS	Global Positioning System
GSM	Global System for Mobile Communication (Groupe Spécial Mobile)
GUI	Graphical User Interface
ID	Static Identifier
IMEI	International Mobile Equipment Identification
ISU	Iridium Subscriber Units
LED	Light Emitting Diode
Li-Ion	Lithium Ion
LNA	Low Noise Amplifier
LP	Low Power
NOC	Network Operation Center
OFAC	Office of Foreign Asset Controls
PMS	PECOS Message Structure
PSTN	Public Switch Telephone Network
PWR	Power
RHCP	Right Hand Circular Polarization
RUDICS	Router-Based Unrestricted Digital Internetworking Connectivity Solution
SatTerm	Satellite Terminal Emulator Software

SBD	Short Burst Data
SMA	Sub-Miniature Version A
SMS	Short Message Service
TDD	Time Division Duplex
TDMA	Time Division Multiple Access
VSWR	Voltage Standing Wave Ratio

1.0 **PURPOSE**

The SHOUT ns is a pocket-sized, low-cost, low-power, Iridium satellite network tracking device. It is designed to relay, via the Iridium satellite network, GPS location data and other critical data such as emergency messages, geofence data, and callouts from the device and text messages from the NAL SHOUT smart phone app. It has a rugged plastic housing with embedded Iridium, GPS, and Bluetooth antennas. This device can easily be carried by a person or attached to high value, un-tethered or non-powered assets.

The SHOUT ns comprises an Iridium 9603 transceiver module, a built-in 72-channel u-blox GPS receiver, and low power micro-controllers. The SHOUT ns can send short-burst data (SBD) messages over the Iridium satellite network. The SHOUT ns can transmit messages in NAL Research's defined report formats compatible with models 9602-LP, 9602-AB, the A3LA series modems, and SHOUT series tracking devices. The SHOUT ns can also transmit in PECOS Message Structure (PMS). The PMS complies with the Blue Force Tracking Data Format Specification as defined in the document PECOS Message Definition Specification, 200907-001 Version 1.7 [3]. When requested by an authorized user, NAL Research can enable the SHOUT ns to utilize the DoD DISA EMSS (Enhanced Mobile Satellite Services) Gateway when sending over the Iridium satellite network.

IMPORTANT: *EMSS-enabled SHOUT ns must first be provisioned (signed up for airtime) with EMSS SBD Service before testing or field use. Accessing the DoD EMSS Gateway is not authorized until the SHOUT ns is provisioned. Unauthorized attempts to access the DoD EMSS Gateway will result in immediate disabling of the offending device, which must then be returned to NAL Research for repair. See <https://sbd.pac.disa.mil/> for more information regarding EMSS service provisioning.*

The SHOUT ns is designed with ultra-low power consumption electronics. It is capable of delivering uninterrupted service for up to 20 days at one report per hour. Power consumption can be further reduced by using the device's built-in motion sensor and/or geofencing features to reduce reporting frequency when a platform is not in motion or is outside an area of interest. In addition to normal tracking, the SHOUT ns also has a real-time clock allowing power-up delay as well as scheduled daily Call Outs.

Externally, the SHOUT ns has two buttons and six LEDs to provide the user control and status of the device. The six LEDs provide the status of power state, battery charging status, GPS fix, Bluetooth connection status, report transmission status, and Iridium connection

status to the user. Using the Power and Bluetooth buttons, the user can activate an Emergency/911 Mode to send an emergency message with an increased reporting rate. An available micro USB port can be used to communicate with a laptop for configuration or data collection.

The SHOUT ns also has an associated Android app for use with a Bluetooth enabled smartphone or tablet to provide the same functionality as other NAL SHOUT devices with displays. Functionality provided includes text messaging, managing tracking parameters such as reporting rate, reporting format, and geofencing, diagnostic utilities, and configuring the SHOUT ns. This application is available from NAL Research via the Google Play App Store. More details are provided in Section 7.0 NAL SHOUT Android App Overview.

2.0 GENERAL SPECIFICATIONS

2.1 Mechanical Specifications

Dimensions:	3.30 x 1.80 x 0.74 inches (84 x 46 x 19 mm) (see drawing in Appendix)
Weight:	3.0 oz. (85 g)
Enclosure:	Hard ABS plastic
Interface Connector:	USB Micro B receptacle
Antennas:	Embedded Iridium, GPS, and Bluetooth antennas
ON/OFF button:	Dome push button
Bluetooth Switch:	Dome push button
Status LED Displays:	Power, Battery, GPS, Bluetooth, message sent status, Iridium



Figure 1. SHOUT ns Buttons and Indicators.



Figure 2. SHOUT ns Accessories.

2.2 Iridium RF Specifications

Operating Frequency:	1616.0 to 1626.5 MHz
Duplexing Method:	TDD
Multiplexing Method:	TDMA/FDMA
RF TX output power (Average):	1.6 W
Rx Sensitivity at 50 Ω (Typ):	-117 dBm
Link Margin – Downlink:	13 dB
Link Margin – Uplink:	7 dB

2.3 GPS Specifications

Type of GPS Receiver:	u-Blox MAX-8MQ	
Receiver Type:	72-Channel GPS L1 C/A, SBAS, QZSS, GLONASS	
Update Rate:	4 Hz	
Accuracy:	Position	8.2 feet (2.5 meters) CEP
	Position SBAS	6.6 feet (2.0 meters) CEP
Acquisition (typical):	Hot starts	1 second
	Aided starts	2 seconds
	Cold starts	29 seconds
Sensitivity:	Tracking	-166 dBm
	Reacquisition	-160 dBm
	Cold starts	-148 dBm
Operational Limits:	Altitude	164,000 feet (50,000 meters)
	Velocity	1,640 feet/sec (500 m/s)
	Dynamics	$\leq 4g$

As long as power is provided to the SHOUT ns, the GPS receiver will provide Real-Time clock functionality and will store ephemeris data in its memory before powering down (sleep between reports). The ephemeris data are valid up to two hours and can be used in future startup to improve time-to-first-fix.

2.4 Bluetooth RF Specifications

Operating Frequency:	2.4 GHz
Protocol:	Bluetooth Low Energy v4.0
Data Rate:	2.178 Mbps
Power Output:	+10 dBm
Sensitivity:	-93 dBm

2.5 Electrical Specifications

Voltage Input Range:	+3.0V to +4.2V (+3.7V DC nominal)
Power Input Type:	Internal CR123 650 mA-Hr rechargeable battery or external DC power via the USB port
USB Input Power:	+4.3V to +5.5VDC, up to 1A
Current in Between Reports (sleep):	Less than 110 μ A @ +3.7V

NOTE: *The average current drawn during transmission may vary depending on the field-of-view between the SHOUT ns antenna and the Iridium satellite.*

2.6 Environmental Specifications

Design Operating Temperature Range:	−4°F to +140°F (−20°C to +60°C)
Charging Temperature Range:	+32°F to +113°F (−0°C to +45°C)
Ingress Protection:	IP67
Operating Humidity:	≤ 75% RH

2.7 Data I/O Specifications

Short-Burst Data Mobile-Originated:	340 bytes per message (Iridium)
Short-Burst Data Mobile-Terminated:	270 bytes per message (Iridium)
Multi-Interface connector:	USB
Software Interface:	AT commands via USB

2.8 Related Hardware

AC Power Adapter:	LA-3098 (100-240VAC, 47-60Hz input)
12V Car Adapter:	LA-7021 (12VDC car battery input)

3.0 USER INTERFACES

3.1 Power Button

The SHOUT ns has a single power ON/OFF button. The SHOUT ns can be turned off and on again by momentarily holding down the power button for two seconds and releasing it. If the device is sleeping, briefly pressing the Power button will turn the SHOUT ns on for 10 seconds. The ON/OFF button is also used with the Bluetooth button for Emergency Mode activation. See Section 3.3 Emergency / 911 Mode Activation for details.

3.2 Bluetooth Button

The SHOUT ns has a single Bluetooth ("BT") button. When this button is pressed for two seconds, the Bluetooth link is activated. When the Bluetooth button is pressed again for two seconds, the Bluetooth link is de-activated. If the device is sleeping, pressing the Bluetooth button will turn the SHOUT ns on for 2 minutes. This extended duration as compared to the power button is to give sufficient time to connect and pair with the Bluetooth interface. Refer to Section 3.6 Bluetooth for details on use of the Bluetooth interface. The Bluetooth button is also used with the power button for Emergency Mode activation. See Section 3.3 Emergency / 911 Mode Activation for details.

3.3 Emergency / 911 Mode Activation

The SHOUT ns has an Emergency / 911 mode which will immediately send a location report with the Emergency bit set and thereafter send location reports at a rate configured in the Emergency Report Rate parameter until the Emergency / 911 mode is canceled. All text messages sent when the Emergency / 911 mode is active will also have the Emergency flag set. In order to activate the emergency / 911 mode feature on the SHOUT ns, a four (4) button press sequence must be initiated. This sequence involves alternating between the Power Button (first) and Bluetooth Button for a total of two (2) times each. This action will result in all six (6) LEDs blinking at the same time once per second until the device is turned off. This sequence can be activated with the SHOUT ns powered on or off. Emergency is deactivated when the SHOUT ns is powered off and will not resume emergency operation until it is the emergency mode is activated again.

3.4 Status LEDs

The SHOUT ns has six status LEDs, as shown in Figure 3, which include: power (⏻), Bluetooth state (BT), GPS fix (GPS), Iridium signal (IRDM), battery level (BATT), and transmission status (STAT). They offer users a quick visual check to ensure proper operations.

Each LED can be enabled and disabled through a setting in the general configuration profile (^LEDS) (see Section 6.2.2.1 General Profile Settings). Table 1 below describes the function of each LED.

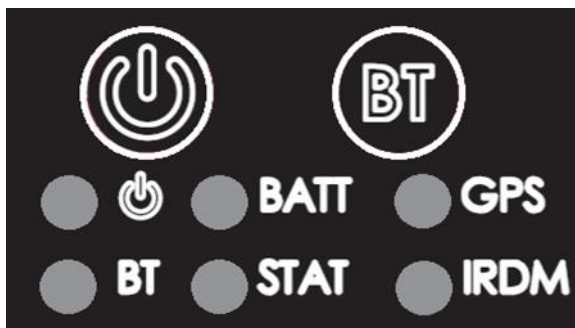


Figure 3. Control Buttons and Status LEDs on the SHOUT ns front face.


LABEL	NAME	LED OFF	LED BLINKING	LED SOLID
	Power	Device is off	Once every 5 sec: Device is on and sleeping in Normal Mode Once every 2.5 sec: Device is on and sleeping in Emergency Mode	Device is on and awake
BATT	Battery	During Operation: Charge Required	During Operation: Charge under 80%; 1.25 sec On, 0.25 sec Off Charge under 20%; 0.125 sec On, 1.00 sec Off While Charging: Charge in Progress; 1.25 sec On, 0.25 Off	During Operation: Charge over 80% While Charging Charge Complete
GPS	GPS	GPS Off or time only	2-D fix or dead reckoning	3-D fix
BT	Bluetooth	Bluetooth off	1 sec: Bluetooth on and not connected / pairing	Bluetooth on and connected
STAT	Status	No successful report transmission	1 sec: Last report transmission failed	Last report transmission succeeded
IRDM	Iridium	Off or has no signal	Has 1 - 2 bars of signal	Has 3 - 5 bars of signal

Table 1. Description of LED states.

Special Functions - The SHOUT ns features two (2) special LED patterns that indicate the following:

- **Emergency Mode Active** - All six (6) LEDs blink simultaneously in a 0.5 sec on and 0.5 sec off pattern for as long as the emergency mode is active and the device is awake. When the device is asleep, the 6 LED pattern stops but the power LED blink rate changes from once every 5 seconds for Normal mode to once every 2.5 seconds for Emergency mode.
- **Upon Charger Connection** - When power is on*, the Battery, GPS, Iridium, and Status LEDs blink in clockwise sequence for 3 seconds when power is applied.

After a Special Function has ended, the LEDs revert to their standard operating state.

** NOTE: There are no LED indicators while the SHOUT ns is powered off and while plugged in and charging. To verify charge status, the SHOUT ns must be turned on.*

3.5 USB Port



Figure 4. Position of USB Connector.

The USB connector on model SHOUT ns is a USB micro B receptacle located on the right of the chassis as shown in Figure 4. This connector has a rubber O-ring sealed cover required to achieve the IP67 rating of the device. The USB connector pin assignments are detailed below in Table 2.

PIN #	SIGNAL	DESCRIPTION	INTERFACE	IN/OUT
1	VBUS	USB VBUS	USB	I
2	USBD-	USB data	USB	IO
3	USBD+	USB data	USB	IO
4	ID	USB OTG ID	USB	IO
5	GND	Ground	USB	--

Table 2. Pin assignments for the SHOUT ns USB connector

IMPORTANT: Ensure proper closure of the rubber sealing cover shown in Figure 4 before exposing the SHOUT ns to water.

3.5.1 USB Data

The SHOUT ns communicates to computer equipment using the USB Micro B port located on the right side of the chassis (see Figure 4). The USB connection allows configuration of and data collection from the SHOUT ns using NAL Research's defined AT commands and NAL's SatTerm console window. These AT commands can be found in the manual "AT Commands for Model SHOUT ns" [1] and also see Section 5.2 Modes of Operation. NAL Research recommends the use of SatTerm graphical user interface (GUI) software to configure the SHOUT ns instead of trying to memorize various AT commands. The latest version of this software can be downloaded on the NAL Research webpage (<http://www.nalresearch.com/Downloads.html>).

3.5.2 DC Power Inputs

The device can be powered from and recharge the internal battery through the USB Micro B port. A USB 1.0 host (100 mA) can charge the battery within 8 hours and a USB 2.0 host (500 mA) can charge the battery within 2 hours.

3.6 Bluetooth

The SHOUT ns utilizes a Bluetooth Low Energy (BLE) transceiver to provide a secondary command interface to the micro USB port. This interface can be used to interface with SatTerm and the NAL SHOUT Android app.

To pair a device with the SHOUT ns, an initial connection to the USB interface is required. During the pairing process utilizing SatTerm, the command AT^BTPASS is used to enter the passkey. Devices without a display such as the SHOUT ns will require passkey entry on the master device. If this occurs, the SHOUT ns will provide the passkey to be entered. Refer to the document "AT Commands for Model SHOUT ns" [1] for additional details. The SatTerm

application is described in more detail in Section 6.2 Using SatTerm. The NAL SHOUT Android app is described in more detail in Section 7.0 NAL SHOUT Android App Overview.

The Bluetooth interface has a 10-minute idle timer which will turn off the Bluetooth interface when there is no data transfer or it is disconnected for 10 minutes. To keep the interface alive, an AT command such as just "AT" (the SHOUT ns will simply respond with "OK") should be sent periodically.

4.0 QUICK START USER GUIDE



This quick start user guide provides an overview for the user to receive the SHOUT ns and transition it to operational use.

4.1 Device Preparation

Prior to use of the SHOUT ns, airtime must first be purchased from NAL Research or from any Iridium certified airtime reseller. The SHOUT ns IMEI number must be registered by an airtime reseller to “point” to a Network Operations Center (NOC) server. This section covers how the user can quickly set up the SHOUT ns as a tracking device.

Remove the SHOUT ns, the wall charger and the USB cable from the packaging. Remove the SHOUT ns USB port cover (see Figure 4) and connect the USB cable USB micro port to the SHOUT ns. Connect the USB-A connector to the wall charger.

4.2 Device Start-up

Activate the SHOUT ns by pressing the power button () for two seconds until the Power LED () illuminates. The Power LED should remain steadily illuminated. The Battery LED should then start blinking in a 1.25 sec On and 0.25 sec Off pattern to indicate the battery requires charging. If the battery is blinking in a 0.125 sec On and 1.0 sec Off pattern, this indicates the battery is at less than 20% charge and will take longer to fully charge.

NOTE: If the device is not used for 10 minutes, the SHOUT ns will enter sleep mode and the Power LED will change to blinking once every 5 seconds to indicate it is asleep. The SHOUT ns can be removed from the sleep mode by pressing the Power button for two seconds.

Before charging the unit, test the Emergency / 911 Mode activation feature with the following button press combination; Power, Bluetooth, Power, Bluetooth. The SHOUT ns should enter the Emergency / 911 Activation mode and all six LEDs should start flashing once per second to indicate this mode is active. To cancel this mode, hold the power button for two seconds to shut the device off. Hold the power button again for two seconds to power the device back on. Again confirm the Power LED should remain steadily illuminated and the Battery LED begins to blink as described above.

4.3 Device Charging

The SHOUT ns is shipped with a partially charged battery. Before use, the SHOUT ns should be charged for one hour.**

**** NOTE:** Upon battery depletion, the SHOUT ns should reach full charge within 2 hours of being continuously plugged in.

Plug the wall charger into a 115V AC power source. Confirm that when the wall charger is plugged in and power is applied to the SHOUT ns USB port, the Battery, GPS, Iridium, and Status LEDs blink in clockwise sequence for 3 seconds. Let the SHOUT ns charge for several hours or until the BATT LED changes to steady illumination.

4.4 Device GPS reception and Iridium Registration

After charging the SHOUT ns, the device is ready to use. Hold the Power Button for 2 seconds. The Power LED and Battery LED will light up and the device will begin functioning. Ensure the top of the SHOUT ns has a clear view of the sky. The standard LED sequence during a successful report is as follows:

- a) The GPS LED lights first when a signal has been acquired.
- b) The Iridium (IRDM) LED will begin lighting when an Iridium signal has been acquired, either solid or blinking based on signal strength.
- c) The Status (STAT) LED will begin lighting when a report has been transmitted.

Once this has been accomplished, all LEDs will turn off and the power LED will blink intermittently, indicating the device is in sleep mode awaiting the next report transmission.

4.5 Configuring the SHOUT ns with the SatTerm Application

The SHOUT ns is shipped with default settings below:

- Report Rate5 Minutes
- Emergency Report Rate5 Minutes
- Transmit Report Without GPS FixYes
- Message Format.....NAL Message Format

If these default settings are not what the user desires, the SHOUT ns supports a micro USB connection to a computer with SatTerm software (or any terminal emulator software) to configure its operating profile using NAL Research's defined AT commands. These AT commands can be found in the manual "AT Commands for Model SHOUT ns" [1].

The required hardware and software for the configuration of the SHOUT ns include:

1. A desktop or laptop computer (not provided).
2. A USB-A to USB micro B cable (provided with the SHOUT ns).
3. A USB AC Adapter (provided with the SHOUT ns).

4. SatTerm software or any terminal emulator software (SatTerm is available for download from NAL Research for use with the SHOUT ns).

STEP 1 - Install SatTerm software on a computer. Connect the provided USB-to-micro USB cable to the computer and to the SHOUT ns and hold the Power Button for 2 seconds to turn the device on.

STEP 2 - Run the SatTerm software while the SHOUT ns is connected to a computer. An NAL Research message will appear along with firmware version to indicate proper communications and power input.

STEP 3 - Use SatTerm (or any terminal emulator) installed on the computer to set the SHOUT ns operating parameters. The SHOUT ns is now ready for use. Make sure the antennas have full view of the sky to ensure optimal tracking.

IMPORTANT - An EMSS-enabled SHOUT ns must first be provisioned (signed up for airtime) with EMSS SBD Service before testing or field use. Accessing the DoD EMSS Gateway is not authorized until the SHOUT ns is provisioned. Unauthorized attempts to access the DoD EMSS Gateway will result in immediate disabling of the offending device, which must then be returned to NAL Research for repair. See <https://sbd.pac.disa.mil> for more information regarding EMSS service provisioning.

More details regarding the SatTerm tool can be found in Section 6.2 Using SatTerm.

4.6 Device Bluetooth pairing with the SHOUT Android App

After the NAL SHOUT Android app has been downloaded to the desired device, the user can proceed to pair the device with the SHOUT ns. To pair an device such as a smartphone or tablet with the SHOUT ns for the first time, a connection to the USB interface of a PC is required to use the SatTerm PC based Terminal Emulation application (see Section 6.2 Using SatTerm).

STEP 1 – Insure the SHOUT app is installed on the Android Device.

STEP 2 – Connect the SHOUT ns to the PC with a USB cable. Launch the SatTerm application. Put the SHOUT ns in command mode with the command ++.

STEP 3 – Activate the Bluetooth link on the SHOUT ns by pressing the BT button for at least two seconds. Verify the Bluetooth “BT” LED starts blinking to indicate it is pairing mode.

STEP 4 – Using the Android device Bluetooth pairing Menu, find the SHOUT ns device and select it.

STEP 5 – The Android device will provide a passkey for pairing. Using the AT^BTPASS ##### command, enter the pairing key into the SHOUT ns. After several seconds, the SHOUT ns BT LED should change from blinking to steady illumination to indicate it has paired successfully.

STEP 6 – Remove the SHOUT ns from Command mode by sending the ^TRK command. Unplug the SHOUT ns from the USB cable.

Once the devices have been paired, the user can launch the NAL SHOUT Android app on the smartphone. Once the SHOUT ns has been successfully paired with a device, the SHOUT ns should automatically pair with the Android device in the future.

4.7 AT Command Mode

For scenarios where computer control of the SHOUT ns is desired, this can be achieved using a computer attached to SHOUT ns USB interface through a USB cable. For example, the SHOUT ns can be turned off using the AT command ^SHUTDOWN. If the device is sleeping or in low-power in between reporting cycles, pressing the power button will turn the SHOUT ns on for 10 seconds. During this time, user can take the device out of Tracking mode and put it into Command mode by entering a sequence three pluses, “+++”. If “+++” is not entered within 10 seconds, the SHOUT ns goes back to “sleep”. See Section 5.2 Modes of Operation for a more detailed description of the Command Mode and see the NAL document “AT Commands for Model SHOUT ns” [1] the full list of capabilities of the AT Commands.

5.0 IMPORTANT FEATURES

5.1 Communication Links

The SHOUT ns uses the Iridium network to send its location reports. To use Iridium service, the IMEI number must be activated with an SBD service plan through an authorized Iridium reseller. When an IMEI is provisioned for service, up to five SBD delivery destinations can be specified. These are delivery endpoints for the data transmitted by the SHOUT ns and can be any combination of three types: IP Address, Email, and IMEI.

5.2 Modes of Operation

The SHOUT ns is always in one of two modes: (1) Command mode, or (2) Tracking mode. It can be configured to power up in one of these modes. The factory-set "Start-Up Mode" mode is Tracking mode, which can be changed using the ^START command (see Section 6.2.2.1 General Profile Settings). For normal operational tracking scenarios, the "Start-Up Mode" should be set to Tracking mode so that the unit will continue tracking after waking up from sleep.

5.2.1 Command Mode

When in Command mode, the SHOUT ns accepts AT commands through the USB connection. The command set is detailed in the document "AT Commands for Model SHOUT ns" [1]. The commands can be used to configure the SHOUT ns operating parameters, to allow the SHOUT ns be operated as a modem, and to query the GPS receiver. Command mode can be switched to Tracking mode by the AT command ^TRK. To switch back, the escape sequence `+++` is used.

5.2.2 Tracking Mode

When in Tracking mode, the SHOUT ns automatically transmits positional reports (GPS) using parameters contained in a tracking profile (see Section 6.2.2.2 Tracking Profile Settings). The SHOUT ns can transmit messages in NAL Research's defined report formats and can also transmit messages according to the PECOS Message Structure (PMS) compatible with the US NORTHCOM Mission Management Center (MMC) server. The PMS complies with the Blue Force Tracking Data Format Specification as defined in the document PECOS Message Definition Specification, 200907-001 Version 1.7 (3).

The SHOUT ns Tracking mode has configuration parameters that control the reporting capabilities and power consumption. The SHOUT ns can be configured to send reports at an interval ranging from continuous (as fast as the transmitter can handle) to once every 7 days.

The SHOUT ns can operate in a low-power mode whereby the device powers down and sleeps between reports. When operating in low-power mode, the device consumes less than 110 μ A of current during sleep.

Tracking may enter the low-power mode while the USB and Bluetooth user interfaces are in use. The command AT[^]PWRAO (Power Always On) should be used to keep the SHOUT ns power on in this situation. This setting prevents the SHOUT ns device from sleeping and greatly increases power consumption so the user must remember to disable this command when use of the USB or Bluetooth interface is complete. Refer to the document "AT Commands for Model SHOUT ns" [1] for additional details.

The more commonly used tracking parameters are: "Time Between Reports" (^TBR), "Time to Keep Trying" (^TTKT), and "Callable" (^CAL). The following features can also be utilized to further tailor Tracking mode to a specific application: "GPS power" (^GAO), "communication link availability" (^LNK), "profile selection" (^TPN, ^TPT, ^TPE), motion detection, and geofencing.

"Time Between Reports" (^TBR) and "Time to Keep Trying" (^TTKT) adjust how often to send reports and how long the SHOUT ns tries to achieve a successful report transmission. Decreasing the "Time Between Reports" increases data points for more detailed situational awareness and increasing the "Time to Keep Trying" improves the chances of transmission success. Both of these options also directly affect the SHOUT ns power consumption.

For supporting message receiving scenarios, referred to as "Callable," the SHOUT ns Iridium modem can be set to ON at all times by using the ^CAL command. This configuration prevents the SHOUT ns device from sleeping and greatly increases power consumption.

To facilitate power management and time to acquire location, the SHOUT ns can be configured to control the power state of the GPS module. The module can be set to be ON at all times using the commands ^GAO which prevents the GPS from powering OFF after a valid fix is obtained.

While in Tracking mode, the SHOUT ns can load tracking profiles dynamically. By default, there are two tracking profiles set aside for Normal tracking and Emergency tracking. Typically, when Tracking mode starts, the tracking profile for Normal tracking is loaded, specified by the "Tracking Profile Normal" (^TPN) setting. When the Emergency mode is triggered, Tracking mode will switch to using the tracking profile for Emergency Tracking, specified by the "Tracking Profile Emergency" (^TPE) setting. This allows the user to configure the SHOUT ns to operate differently when there is an external stimulus.

Tracking mode will also load a different tracking profile if Geofences are enabled and the SHOUT ns enters or exits a geofence. Priorities are assigned to the different stimuli and the SHOUT ns will only switch to the associated tracking profile if it has a higher priority. Emergency tracking has the highest priority, Geofence is the second highest, and Normal tracking is the default.

5.3 Call-Outs and Power-Up Delay

Using an onboard real-time clock, the SHOUT ns can be configured to send daily call-out reports at specified UTC times. These call-out reports are in addition to tracking reports sent at a pre-defined tracking interval and they are indistinguishable from each other. Call-outs can be used as a heartbeat to determine if the device is still operational (see Section 6.2.4 Call Out).

In addition, using the onboard real-time clock, the SHOUT ns can be configured for a power-up delay. A power-up delay is set for a specific UTC time and date up to 45 days in the future. When a delay is set and tracking is started, the device will remain in its low-power sleep mode until the configured date and time upon which the device will power on automatically and enter the start-up mode. This is useful for conserving battery power while the tracker is in transit to a destination (see Section 6.2.2.3 Additional Setup Parameters).

5.4 Geofencing

The SHOUT ns can utilize location information from its GPS receiver to determine whether it has entered or exited the bounds of preconfigured geofences. A geofence is a set of connected latitude and longitude coordinates that defines a region or zone of interest (see Section 6.2.3 Geofencing). A geofence is defined by a minimum of 3 coordinates and a maximum of 50. Multiple geofences can be configured, each with a unique set of tracking parameters that will cause the SHOUT ns to change its tracking behavior while in a specific geofence. Each geofence can also be configured to send a report upon entering and exiting the defined geofence region. In addition, geofences can be configured to turn off the Iridium modem for regions that require radio silence.

5.5 Motion Detection

The SHOUT ns has a built-in sensor that can reliably detect motion. It is an omnidirectional movement sensor and will function regardless of how the SHOUT ns is mounted or aligned. It is sensitive to both tilt (static acceleration) and vibration (dynamic acceleration). The signal level is fed directly into the SHOUT ns micro-controller to “wake up” the SHOUT ns out of low-power mode when activity is sensed and to transmit location report. The motion

sensor has a variety of settings that impact its detection sensitivity. The motion sensor can be enabled or disabled (see Section 6.2.2.1 General Profile Settings).

5.6 Encryption

The SHOUT ns can be configured to encrypt/decrypt all transmitted and received data using 256-bit AES encryption. To enable encryption, the user needs to assign a cryptographic administrator for the device who will be responsible for modifying the encryption and decryption keys and setting the device to use encryption (see Section 6.2.2.3 Additional Setup Parameters). The 256-bit AES encryption algorithms implemented here comply with NIST FIPS140-2 (see documents *Security Requirements for Cryptographic Modules, FIPS PUB 140-2, US Department of Commerce, National Institute of Standards and Technology, May 25th, 2001* and *Security Requirements for Cryptographic Modules, Annex A: Approved Security Functions for FIPS PUB 140-2, US Department of Commerce, National Institute of Standards and Technology, February 19th, 2003*).

5.7 Remote Updates

Using the configurable required remote update password, the SHOUT ns can be configured over the air through the use of remote update option. This allows for remote unattended trackers to be reconfigured without requiring direct access to the device. All of the tracking profile parameters and most of the general parameters can be configured via remote updates (see Section 6.2.2.3 Additional Setup Parameters). NAL Research provides two software applications that can be used to compose and transmit remote updates: Server for Trackers and Remote Configure. These programs can be downloaded from the NAL Research's website (<http://www.nalresearch.com/Downloads.html>). Users are referred to the software applications for the list of remotely configurable parameters.

6.0 CONFIGURING THE SHOUT NS

The SHOUT ns can be configured in one of three ways from a computer connected to the SHOUT ns USB port; 1) manually through the SatTerm PC based application (see Section 6.2 Using SatTerm), 2) through a file download using SatTerm (see Section 6.2.2.4 Configure Settings), and 3) via AT Commands (see Section 5.2.1 Command Mode).

6.1 Profile Descriptions

A profile is a group of user-modifiable settings saved to non-volatile memory. There are three types of profiles on the SHOUT ns: general profiles, tracking profiles, and additional setup parameters ('Other').

6.1.1 General Profiles

General profiles contain settings that have a general impact on the operation of the SHOUT ns. There are two stored general profiles numbered 0 and 1. In addition to the stored general profiles, there is an "active" general profile, which is the set of general settings that are currently in effect. At power-up, by default, general profile 0 is loaded into the "active" general profile. However, user can change the power-up profile using AT command &Y. After power-up, user can load the "active" general profile with any stored general profile using the Soft Reset command Z. Alternatively, &F can be used to load factory default settings back into the "active" general profile. Any modifications made to general profile settings apply to the "active" general profile and are temporary. To save the modifications, user must write the "active" general profile to one of the stored general profiles using &W. Settings that fall under general profiles can be displayed using &V.

6.1.2 Tracking Profiles

Tracking profiles contain settings that have an impact on the SHOUT ns during Tracking mode. There are twelve stored tracking profiles numbered from 0 to 11. In addition to the stored tracking Profiles, there is an "active" tracking profile, which is a temporary tracking profile for the purpose of modifying a stored tracking profile. The "active" tracking profile is not used in Tracking mode. Instead, tracking mode loads the stored tracking profiles directly based on the current state. At power-up, tracking profile 0 is always loaded into the "active" tracking profile. However, after power-up, user can load any of the stored tracking profiles using the Soft Reset AT command ZT. Alternatively, &FT can be used to load factory default settings back into the "active" tracking profile. Any modifications made to tracking profile settings apply to the "active" tracking profile and are temporary. To save the modifications,

user must write the "active" tracking profile to one of the stored tracking profiles using &WT. Settings that fall under tracking profiles can be displayed using &VT.

6.1.3 Additional Setup Parameters

Additional setup parameters affect the SHOUT ns globally and immediately. Unlike general profiles and tracking profiles, there is no "active" profile associated with these parameters to be saved or retrieved. Any modifications to these settings are saved to non-volatile memory directly.

6.2 Using SatTerm

SatTerm, short for Satellite Terminal Emulator, is software developed by NAL Research that runs on Windows® operating system. It is used to communicate with the family of NAL Research devices through RS232 or USB interface. The following sections cover how to use SatTerm 8.9.0 (or later) to configure the SHOUT ns (Please reference the SatTerm Software Manual for installation instructions).

6.2.1 Connecting SatTerm to the SHOUT ns

SatTerm can connect to the SHOUT ns using the USB port or through the Bluetooth link. Each method is detailed in the following two sections.

6.2.1.1 Connecting with USB

Follow the steps below first to synchronize communication between the SHOUT ns and a connected USB device.

1. Launch SatTerm software from the Windows® Start tab. If SatTerm is not installed, the SatTerm installer can be downloaded from NAL Research's website (<http://www.nalresearch.com/Downloads.html>).
2. Use the *Options>Properties* menu to configure the modem type. Choose **Options > Properties > Device Type > SHOUT ns**. This option selects the type of device connected to the computer. Only NAL Research devices appear on the list.
3. Unselect the checkbox "Connect when device is present" in SatTerm's Icon Bar.
4. Attach one (or more) powered SHOUT ns devices to the computer's USB port.
5. Use the *Options>Properties* menu to configure the communications port settings (see Figure 5). The default should already be set to USB for the SHOUT ns. Choose **Options > Properties > Set Port Properties**. This option sets the computer's communication parameters to communicate with a connected and powered SHOUT ns. If the USB port is not already selected, select the "Connect Using..." drop-down menu and choose USB.

Choose the desired SHOUT ns from the "USB Devices Connected:" selection box. If multiple SHOUT ns devices are attached, they can be differentiated by the IMEI number of the internal Iridium modem.

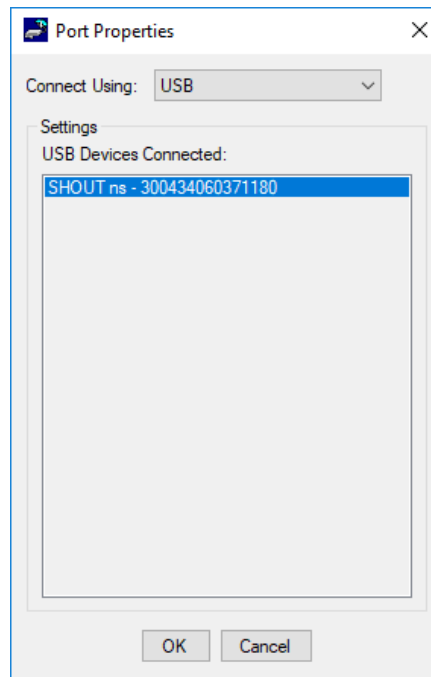


Figure 5. Port Properties Window option.

6.2.1.2 Connecting with Bluetooth

This section describes how to connect and pair the SHOUT ns to SatTerm via Bluetooth. Connecting to Bluetooth also is done through the Port Properties. The Bluetooth port properties window (see Figure 6) has several buttons, and the functionality of each are as follows:

Refresh icon

Refreshes the connections list, and searches for a SHOUT ns device.

Pair

Pairs a selected device from the Unpaired Bluetooth list.

Unpair

Unpairs the selected from the Paired Bluetooth list.

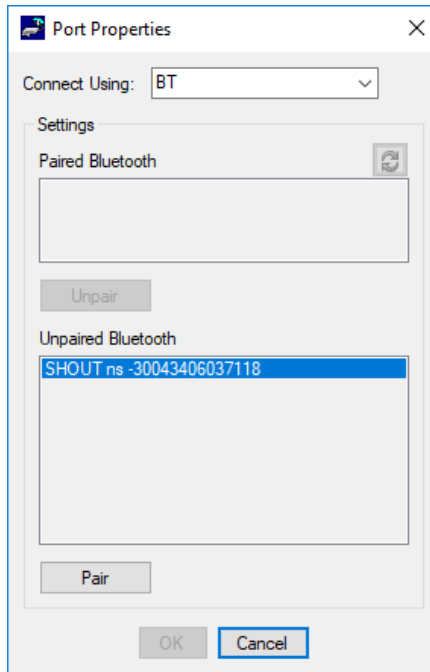


Figure 6. Bluetooth Port Properties Window Unpaired.

The procedure is similar to connecting to USB, but requires Bluetooth capabilities on the PC. Follow the steps below to connect the SHOUT ns to SatTerm using Bluetooth.

1. Use the *Options>Properties* menu to configure the modem type. Choose **Options > Properties > Device Type > SHOUT ns**. This option selects the type of device connected to the computer. Only NAL Research's devices appear on the list.
2. Unselect the checkbox "Connect when device is present" in SatTerm's Icon Bar.
3. Make sure that Bluetooth is powered on the device by pressing and holding the BT button for 2 seconds. The BT LED should blink, indicating that it is ready for pairing.
4. Attach the SHOUT ns to the computer's USB port. This is important, as the SHOUT ns must be connected to USB for first time pairing.
5. Use the *Options>Properties* menu to configure the communications port settings (see Figure 5). The default should be set to USB for the SHOUT ns. Choose **Options > Properties > Set Port Properties**. This option sets the computer's communication parameters to communicate with a connected and powered SHOUT ns. If the Bluetooth port is not already selected, select the "Connect Using..." drop-down menu and choose BT.

6. On the Bluetooth Ports properties, a list of any nearby SHOUT ns devices with Bluetooth activated is shown (see Figure 6). Find and select the desired SHOUT ns device, and click Pair to pair the device to SatTerm. When paired, SatTerm will output "PAIRING COMPLETE" to state it has successfully paired the device. If the SHOUT ns device is not shown, check that Bluetooth is on and click the refresh button to search for the device again.
7. Next, click on your SHOUT ns device from the Paired Bluetooth list (see Figure 7), and click the OK button to connect. If connect is a successful, the window will close and SatTerm is properly connected to the SHOUT ns.

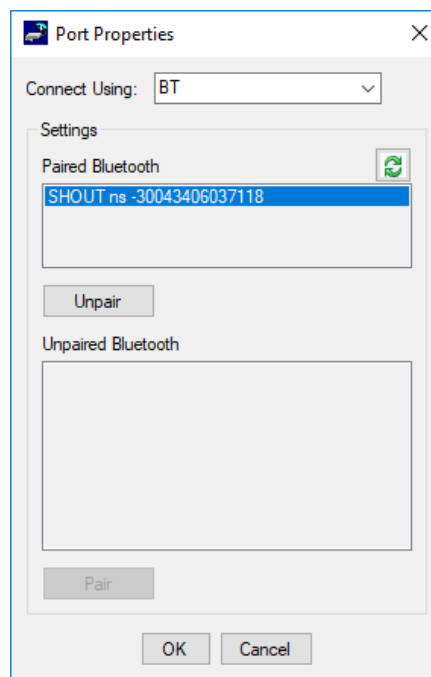


Figure 7. Bluetooth Port Properties Paired.

6.2.2 Configure Window

SatTerm *Configure Window* option allows users to setup of the profiles described in Section 6.1 Profile Descriptions.

After the hardware setup is completed using the steps above, select **Options > Configure Windows...** to configure the specific settings for the SHOUT ns (see Figure 8). Each part of the *Configuration* window is described below.

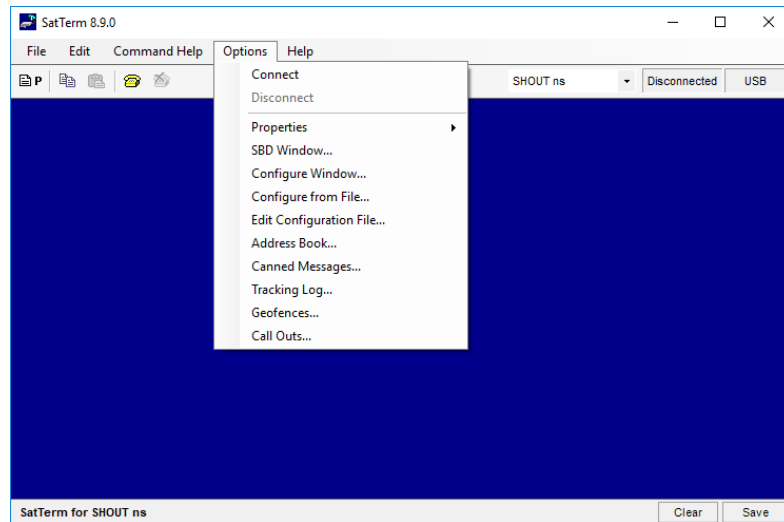


Figure 8. Options menu item *Configure Window...* menu item.

6.2.2.1 General Profile Settings

This section describes the general profile settings using SatTerm. After the *Configure Window...* menu item is chosen, the *Configuration* window will appear. To access settings for a general profile, first select *General Profile* as the profile type and then use *Store Profile* to select the profile number. The *Configuration* window organizes the general profile settings onto five tabs – Miscellaneous, Tracking, Motion, LED, and GPS, as shown in Figure 9.

6.2.2.1.1 Tracking Tab

Tracking offers five settings as shown in Figure 9: Remote Message Format, GPS Always ON, Start-Up Mode, Tracking Log, and Max. Queued Reports.

6.2.2.1.1.1 Remote Message Format

This option sets the format of the messages that will be sent from the SHOUT ns to the recipient. Currently available message formats are:

NAL Type 3	Same format as on the A3LA trackers.
NAL Type 4	Includes HDOP and VDOP GPS values, and motion.
NAL Type 5	Includes I/O pin states.
PECOS P3	
PECOS P4	
NAL Type 6	Includes short codes and free text fields.

NAL 10 Byte Ver 0 A 10-byte message format to reduce data usage.

The AT command associated with this setting is ^RMF.

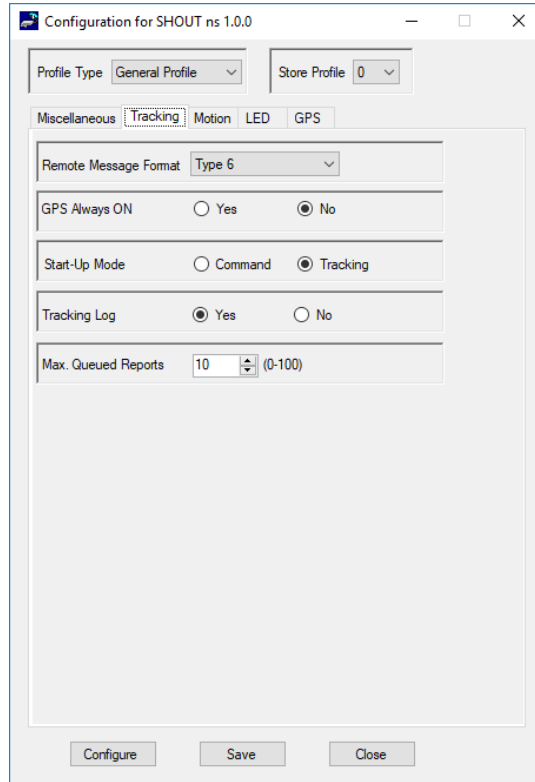


Figure 9. *General Profile* window with *Tracking* tab.

6.2.2.1.1.2 GPS Always On

This option forces the GPS receiver to remain ON in between reports allowing the SHOUT ns to have immediate location information (GPS hot start assuming the SHOUT ns always has full view of the sky) each time it is ready to transmit a tracking report. When low-power consumption is not critical, enabling this option is recommended for faster GPS acquisition and more accurate location information. If the SHOUT ns powers down to sleep while idle, the GPS receiver will also turn off. The AT command associated with this setting is ^GAO.

6.2.2.1.1.3 Start-Up Mode

This option sets the operating mode for when the unit is powered on or wakes up from sleep. The default is to power-up the unit in Tracking mode to allow the unit to begin tracking after a power cycle and to automatically send reports at a pre-determined interval. Alternatively, the SHOUT ns can also be configured to power-up in Command mode allowing

users to enter AT commands via a connected computer. The AT command associated with this setting is ^START.

6.2.2.1.1.4 Tracking Log

This option forces the SHOUT ns to save all tracking reports, whether successfully sent or attempted during Tracking mode, to non-volatile memory. The device can save up to about 4,000 reports in a circular memory (oldest saved reports are over-written when memory reaches maximum capacity). SatTerm can be used to retrieve tracking reports at a later time using **Options > Tracking Log...** The AT command associated with this setting is ^DLTRK.

6.2.2.1.1.5 Max. Queued Reports

This option sets the maximum number of reports that can be queued on the SHOUT ns for re-transmit. This setting applies only if either *Queue Failed Reports* or *Queue Restricted Reports* or both are set (see Section 6.2.2.2 Tracking Profile Settings). A restricted report is a report that attempts to send while the Iridium link is configured to be disabled. For example, in the case where Iridium is disabled in a certain geographic area by a geofence, any reports that attempt to send while in the geofence would be considered a restricted report. In this case, queuing restricted reports would cause these reports to be queued to re-transmit when outside that geographic area. Failed reports are reports that are unable to send after the specified Time to Keep Trying value (see Section 6.2.2.2 Tracking Profile Settings). When the number of queued reports reaches its maximum number, the oldest queued reports are over-written. The AT command associated with this setting is ^ERQM.

6.2.2.1.2 Motion Tab

The SHOUT ns has a built-in sensor that can reliably detect motion. The *Motion* tab, as shown in Figure 10, offers users ways to detect different motion characteristics without having to interpret the raw motion sensor signals. Motion detection can be enabled or disabled through the *Motion Enabled* option in the tracking profile (see Section 6.2.2.2 Tracking Profile Settings).

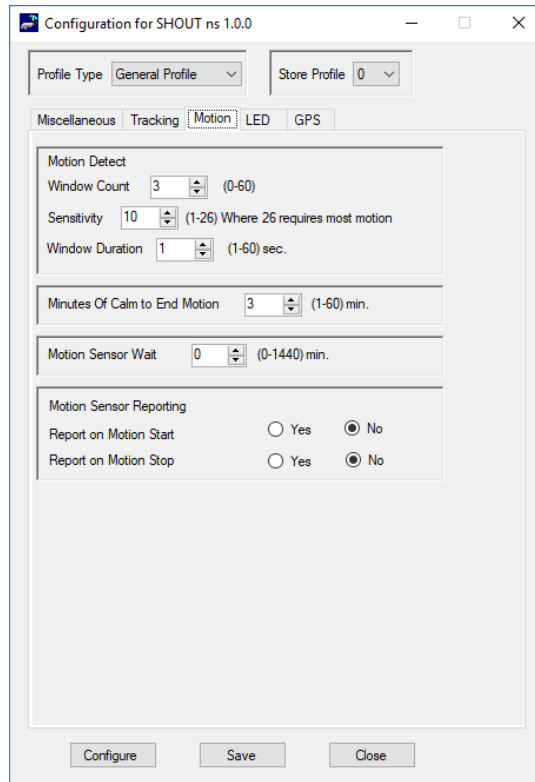


Figure 10. *General Profile* window with *Motion* tab.

When motion detection is enabled, the device will monitor the motion sensor to detect when the device is in motion. To detect the start of motion, an algorithm involving motion detection windows is used. This algorithm succeeds to detect motion when a certain number of contiguous windows are each satisfied by a minimum number of TTL pulses from the motion sensor. Figure 11 illustrates the algorithm with a window count of 3, window duration of 1 minute, and a sensitivity of 2 TTL pulses.

NOTE: The motion detection algorithm will start over whenever the device receives a remote update. A remote update, in addition to restarting the motion detection algorithm, will also reset the motion state of the device back to motionless.

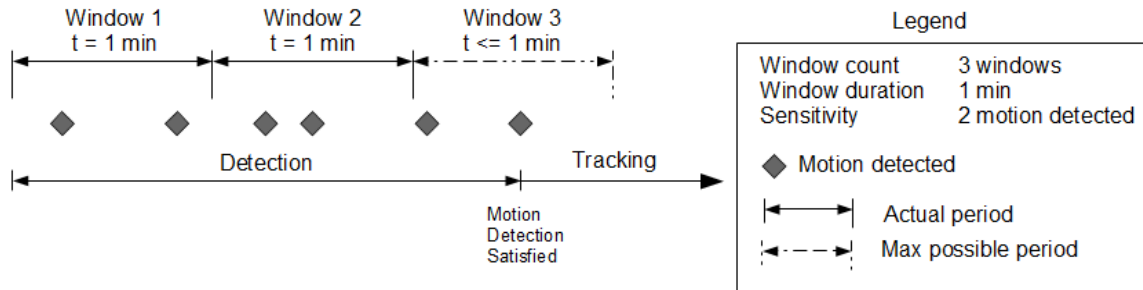


Figure 11. Motion detection example.

Once motion has been detected using the motion detection algorithm, the device will be considered in motion and report formats which support motion indication will have the motion indicator set. While in motion, the device will switch to a different algorithm for detecting the end of motion. The device will be considered motionless if there is a certain duration of calm. The definition of calm for this algorithm differs depending on whether the device is awake or sleeping. While awake a single TTL pulse will reset the calm timer whereas while sleeping the same algorithm used for detecting the start of motion is used to detect motion that will reset the calm timer. An example of this algorithm is shown in Figure 12.

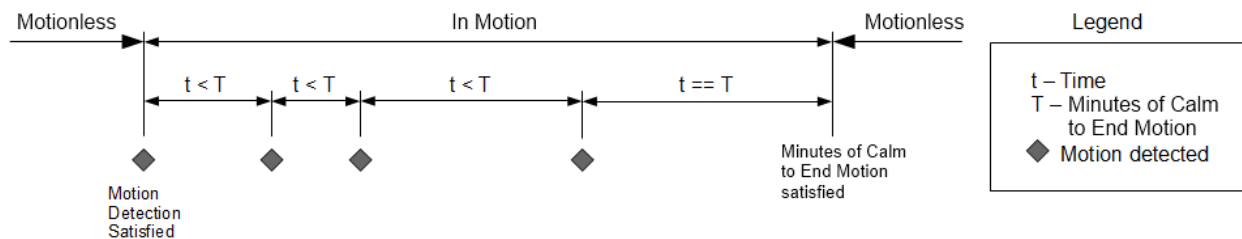


Figure 12. End of motion example.

6.2.2.1.2.1 Window Count

This setting specifies the number of contiguous windows for the motion detection algorithm. If set to 0, then a single TTL pulse from the motion sensor will satisfy the motion detection algorithm. The AT command associated with this setting is ^MSB.

6.2.2.1.2.2 Sensitivity

This setting specifies the minimum number of motion sensor TTL pulses that must be detected in order to satisfy a single motion detection window for the motion detection algorithm. The AT command associated with this setting is ^MSB.

6.2.2.1.2.3 Window Duration

This setting specifies the duration of each motion detection window for the motion detection algorithm. The AT command associated with this setting is ^MSB.

6.2.2.1.2.4 Minutes of Calm to End Motion

This setting specifies the duration of calm needed in order for the device to return to the motionless state. The AT command associated with this setting is ^MSE.

6.2.2.1.2.5 Motion Sensor Wait

This setting specifies the duration of time to ignore the motion sensor whenever the SHOUT ns goes to sleep. Once this time has elapsed, motion detection will begin again. The related AT command is ^MSW.

6.2.2.1.2.6 Motion Sensor Reporting

This setting determines whether to send a report when motion starts and/or when motion ends. For this setting to have an effect, it is required that the *Motion Enabled* option is enabled. If the *Report on Motion Start* option is enabled, a NAL format GPS version 6 report with short code 20 (GPS Report Version 6 Format [2]) will be transmitted when motion starts. If the *Report on Motion Stop* option is enabled, a version 6 report with short code 21 will be transmitted when motion ends. The AT command associated with this setting is ^MSR.

6.2.2.1.3 LED Tab

For applications where prolonging battery life is essential, the LEDs can be turned OFF using the ^LEDS AT command or the SatTerm LED tab (see Figure 13). The SHOUT ns is shipped with all LEDs set to ON.

6.2.2.1.3.1 Power LED While Asleep (Normal and Emergency)

The Power "⏻" LED has two illumination modes when the device is asleep. While in Tracking mode with emergency active, the LED will blink rapidly (once every 2.5 seconds); otherwise, the LED will blink slowly (once every 5 seconds). Using these settings, the emergency and normal behavior can be turned on and off independently. If the emergency behavior is turned off, the device will fall back to using the normal behavior.

6.2.2.1.3.2 Power LED While Awake (Normal)

While the Power "⏻" LED is awake in Normal mode, the LED will remain solid. Using this setting will turn on and off this functionality.

6.2.2.1.3.3 Emergency Awake LED Sequence

This parameter sets whether to display the Emergency LED Sequence. In this state, all six (6) LEDs blink simultaneously, at a one (1) second interval, for as long as the emergency mode is active and the device is awake. If the emergency behavior is turned off, the device will fall back to using the normal behavior.

6.2.2.1.3.4 Iridium LED

This parameter sets whether to display the *Iridium "IRDM" LED*. When enabled, the *Iridium LED* stays solid when the Iridium signal strength is between 3–5 bars, blinks when the Iridium signal strength is between 1–2 bars, and stays off when the Iridium signal strength is at 0 bars.

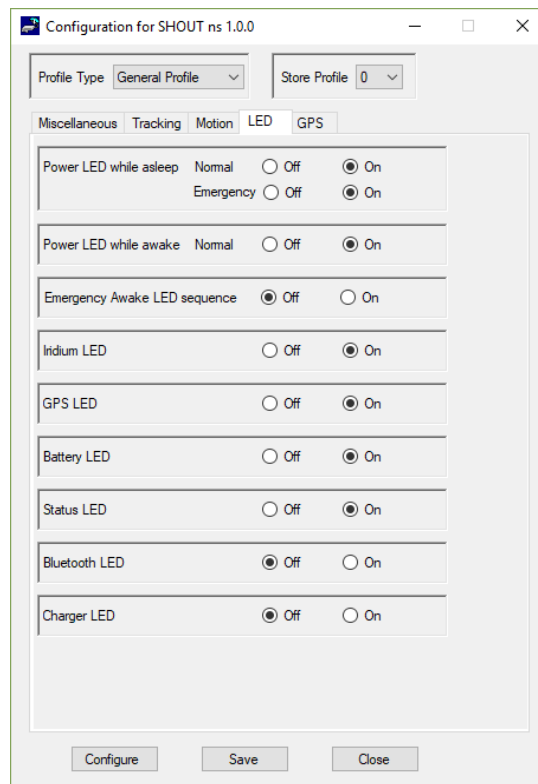


Figure 13. General Profile window with LED tab.

6.2.2.1.3.5 GPS LED

This parameter sets whether to display the *GPS "GPS" LED*. When enabled, the *GPS LED* stays solid when there is a valid GPS position fix, blinks when there is 2D fix or using dead reckoning, and stays off when unable to obtain a position fix.

6.2.2.1.3.6 Battery LED

This parameter sets whether to display the *Battery "BATT" LED*. When enabled, the LED stays solid when the charge is over 80% or charge complete. When under 80%, the LED blinks for 1.25 seconds while on, or 0.25 seconds while off. When under 20%, the LED blinks for 0.125 seconds while on, or 1.00 second while off. When the device is charging, the LED blinks for 1.25 seconds while on, or 0.25 seconds while off. Please note that the *Battery "BATT" LED* will only blink when charging if the device is powered on and not in sleep mode. The battery will still charge if the device is off or in sleep mode while plugged into a power source.

6.2.2.1.3.7 Status LED

This parameter sets whether to display the *Status "STAT" LED*. When enabled, the LED stays solid if the last transmission was successful, blinks if the last transmission was unsuccessful but an earlier transmission was successful, and stays off if transmission has not been successful since powering on. This LED is reset to be off when switching between tracking and command mode.

6.2.2.1.3.8 Bluetooth LED

This parameter sets whether to display the *Bluetooth "BT" LED*. When enabled, the LED stays solid when the device is paired with another device, blinks if the device is in pairing mode but not yet paired, and stays off if the Bluetooth link is off.

6.2.2.1.3.9 Charging Sequence LED

This parameter sets whether to display the charger LED sequence when power is first connected to USB. When power is applied, the Battery, GPS, Iridium, and Status LEDs blink in clockwise sequence for 3 seconds, in that order.

6.2.2.1.4 GPS

The *GPS* tab, shown in Figure 14, offers users the option to configure the GPS receiver and stream NMEA formatted GPS data from the SHOUT ns serial port while in Command, Tracking or both modes.

6.2.2.1.4.1 Invalid Course Value

This value is sent in GPS reports to indicate an invalid course when the GPS receiver is unable to determine the course. The AT command associated with this setting is ^ICV.

6.2.2.1.4.2 Position Model

This setting allows the GPS receiver to be more accurate by telling the unit what its environment is like. For most applications operating below 12 km, the Portable setting is sufficient. Those requiring operation above 12 km should refer to the “AT Commands for Model SHOUT ns” [1] document for detail. The AT command associated with this setting is +PNAV.

6.2.2.1.4.3 Stream NMEA

This parameter sets NMEA streaming on or off. The AT command associated with this setting is +PG.

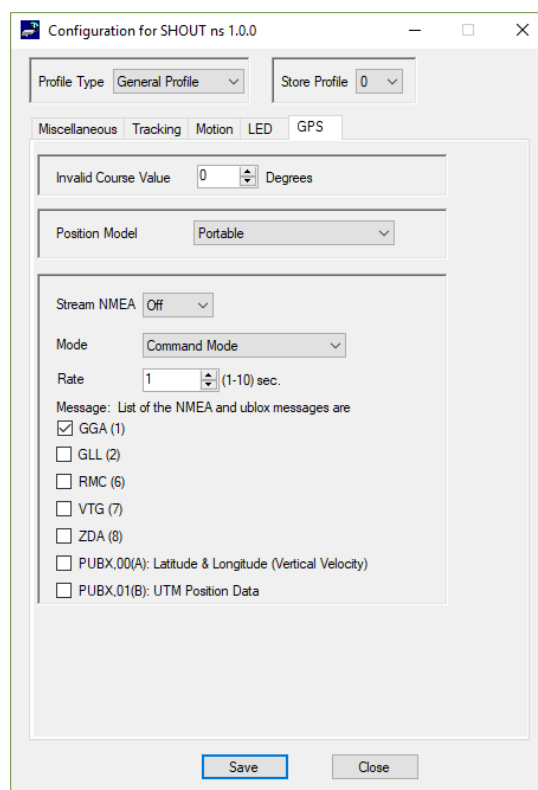


Figure 14. General Profile window with GPS tab.

6.2.2.1.4.4 Mode

This parameter selects the mode (Tracking, Command or both) in which GPS data streaming is active.

6.2.2.1.4.5 Rate

This parameter sets the NMEA streaming update rate in seconds.

6.2.2.1.4.6 Message

The checked boxes select which NMEA sentences are streamed through the SHOUT ns USB serial port.

6.2.2.1.5 Miscellaneous Tab

Miscellaneous tab offers seven settings as shown in Figure 15: *Successful Send Required for State Change*, *Startup Information*, *Bluetooth Power*, *Normal Tracking Profile*, *Emergency Tracking Profile*, *Power Up Time Refresh Frequency*, and *Remote Update Time Check*.

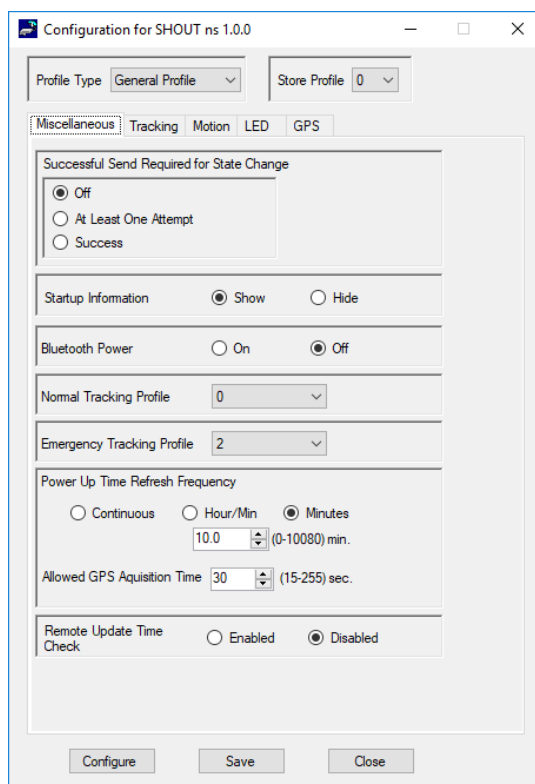


Figure 15. *General Profile* window with *Miscellaneous* tab.

6.2.2.1.5.1 Successful Send Required for State Change

This option restricts the SHOUT ns from changing to a lower priority tracking mode based on whether or not a tracking report has been transmitted. Among the three tracking modes the order of priority is Emergency, Geofence, and then Normal. When set to off, a change to the tracking mode takes effect immediately (i.e. Emergency to Normal). When set to "At Least One Attempt", the mode change will be delayed until at least one report transmission attempt has been made. When set to "Success", the mode change will be blocked until a tracking report is transmitted successfully. The AT command associated with this setting is ^SSR.

6.2.2.1.5.2 Startup Information

This option hides/shows the power-up text (copyright, model number, etc.) that is echoed to the SHOUT ns device's USB serial port. The AT command associated with this setting is ^SSI.

6.2.2.1.5.3 Bluetooth Power

This option sets whether the Bluetooth transceiver is powered up when the device is turned on. The AT command associated with this setting is ^BTPWR.

6.2.2.1.5.4 Normal Tracking Profile

This option selects the stored tracking profile to be used in Normal tracking mode. The AT command associated with this setting is ^TPN.

6.2.2.1.5.5 Emergency Tracking Profile

This option selects the stored tracking profile to be used in Emergency tracking mode. The AT command associated with this setting is ^TPE.

6.2.2.1.5.6 Power Up Time Refresh Frequency

When a power up delay is set, the SHOUT ns periodically wakes up from sleep to adjust its internal clock against the GPS receiver timing signal. In the case when the GPS receiver does not yet have a time fix, the SHOUT ns will stay awake for a specified period of time (*Allowed GPS Acquisition Time*) waiting for a GPS time fix. After which, the SHOUT ns will sleep for another period of time (*Power Up Time Refresh Frequency*) before retrying to find a time fix. These values are configured through the AT command ^PUPT.

6.2.2.1.5.7 Remote Update Time Check

This enables a time check for incoming remote updates. When enabled, remote updates with a timestamp less than or equal to the last remote update time are not applied. The associated AT command is ^RUTC.

6.2.2.2 Tracking Profile Settings

This section covers the configuration tabs associated with the tracking profile settings. After the *Configure Window...* option is selected, users can go to Profile Type on the top left of the window and select Tracking Profile along with the Store Profile number (see Figure 16).

6.2.2.2.1 Tracking Tab

Tracking tab has eight settings: *Report Flood*, *Blocked Invalid Reports*, *Queue Failed Reports*, *Queue Restricted Reports*, *Motion Enabled*, *Callable*, *Skip Reporting when Stationary*, and *Iridium Allowed*.

6.2.2.2.1.1 Report Flood

This parameter sets the number of tracking reports that are to be transmitted continuously when first entering Tracking mode and when the tracking mode changes (for example, from Normal to Emergency). After the specified tracking reports have been transmitted, the pre-programmed reporting interval will take effect. If in the Emergency tracking mode, the report flood will be ended prematurely if an emergency acknowledgement is received. The AT command associated with this setting is ^RF.

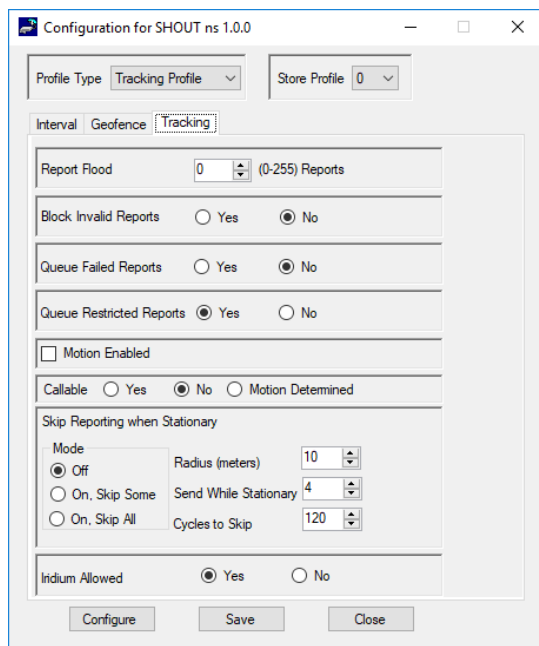


Figure 16. *Tracking Profile* window with *Tracking* tab.

6.2.2.2.1.2 Block Invalid Reports

When this setting is enabled, only tracking reports with a valid GPS position fix are transmitted. This can be useful in filtering out possibly misleading GPS data points. The AT command for this setting is ^BIGR.

6.2.2.2.1.3 Queue Failed Reports

When this setting is enabled, tracking reports that failed to transmit will be queued for retransmission. A tracking report that cannot be sent before the specified *Time-to-Keep-Trying* value is considered a failed report. The AT command associated with this setting is ^ERQ.

6.2.2.2.1.4 Queue Restricted Reports

When this setting is enabled, tracking reports that are restricted from transmitting will be queued for later transmission. A report is considered restricted when the Iridium link has been disabled. For example, in the case where Iridium is disabled in a certain geographic area by a geofence, tracking reports collected while in the geofence would be considered restricted reports. And, if configured for queuing, the restricted reports will be later transmitted when outside that geographic area or in an area that allows transmitting. The command related to this setting is ^ERQ.

6.2.2.2.1.5 Motion Enabled

Selecting this checkbox enables the motion sensor in Tracking mode. This setting can vary between tracking profiles. For example, the motion sensor could be enabled for normal tracking, but disabled while operating inside in a geofence. The AT command associated with this setting is ^MSA.

6.2.2.2.1.6 Callable

This parameter sets the callable state of the SHOUT ns in Tracking mode. When *Callable* is set to "Yes", the Iridium modem will remain powered on between reports to listen for incoming messages. Any incoming messages or updates from a control center will occur immediately. However, the SHOUT ns will consume the most power because the device will never go into sleep mode. When *Callable* is set to "No", the SHOUT ns puts all its internal circuitry in sleep mode while idle. Any incoming messages or updates from a control center will have to wait until the next reporting cycle (when the RF module wakes up for sending). For this configuration, the SHOUT ns will consume the least power in between reports. When *Callable* is set to "Motion Determined", the SHOUT ns is callable when the device is in motion and is in sleep mode when the device is stationary. The AT command associated with this setting is ^CAL.

6.2.2.2.1.7 Skip Reporting when Stationary

This parameter limits the SHOUT ns from sending tracking reports when it has not moved out of a specified radius. When enabled, this causes the unit to be bounded by a sphere with a specified radius. While the unit remains in the sphere, report sending skips a specified *Cycles to Skip* number of report cycles. When the *Cycles to Skip* value is reached, the SHOUT ns will report for a specified number of *Send While Stationary* cycles. The process is repeated until the unit leaves the sphere. Upon leaving the bounding sphere, a new boundary will be created at the current location of the unit and the SHOUT ns will report for the specified *Send While Stationary* cycles. If *On, Skip All* is selected, the *Cycles to Skip* parameter is disregarded and the unit only sends the *Send While Stationary* cycles each time a new sphere is established. The AT command associated with this setting is ^SPSR.

6.2.2.2.1.8 Iridium Allowed

This setting lets the user enable/disable the Iridium link. Refer to the *Queue Restricted Reports* option for additional details. The AT command associated with this setting is AT^LNK.

6.2.2.2.2 Geofence Tab

The *Geofence* tab offers two settings as shown in Figure 17: *Geofence Check Frequency* and *Allowed GPS Acquisition Time*.

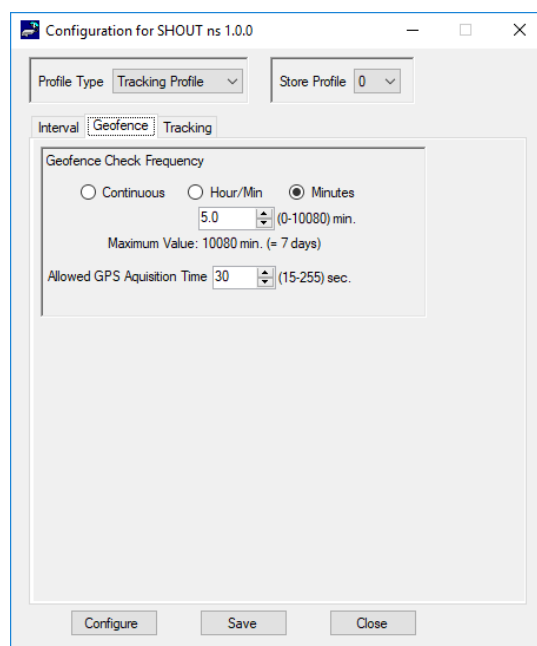


Figure 17. Tracking Profile window with Geofence Frequency tab.

6.2.2.2.2.1 Geofence Check Frequency

This parameter sets the maximum time between position updates to check if the device is in a geofence. If a valid GPS position is received before the next check, the countdown to the next check is restarted. The AT command associated with this setting is ^GFCF.

6.2.2.2.2.2 Allowed GPS Acquisition Time

This parameter sets the amount of time the geofence check attempts to acquire a GPS position. If the SHOUT ns fails to acquire a position in the time allowed, the geofence check will be aborted and will occur at the next scheduled check or the next time the GPS receiver has a valid position. The AT command associated with this setting is ^GFCF.

6.2.2.2.3 Interval Tab

The *Interval* tab offers four settings: *Use Alternate Interval for Motion*, *Time Between Reports (Standard and Motion)*, *Time To Keep Trying (Standard and Motion)*, and *Delayed First Report (Standard and Motion)* as shown in Figure 18.

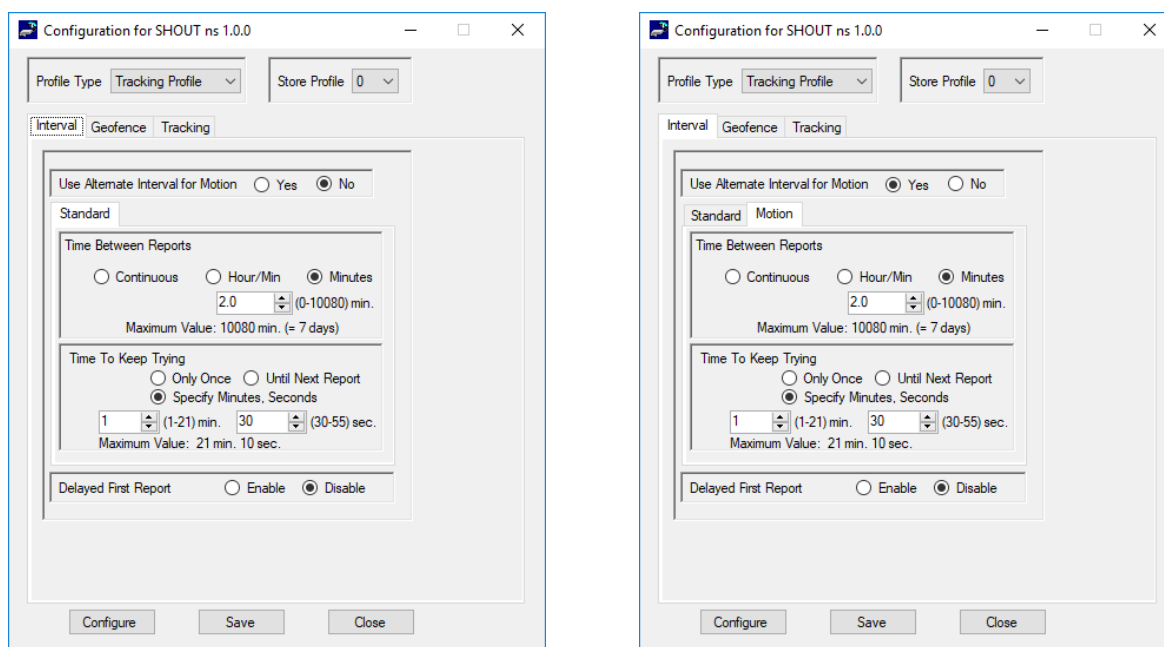


Figure 18. *Tracking Profile* window with *Interval* tab with *Standard* and *Motion* options.

6.2.2.2.3.1 Use Alternate Interval for Motion

This setting, when set to *Yes*, causes the SHOUT ns to use alternate *Time Between Reports*, *Time To Keep Trying*, and *Delayed First Report* settings while in motion. To set these

alternate settings, use the Motion tab that appears when Yes is selected. The AT command associated with this setting is ^UAMS.

6.2.2.2.3.2 Time Between Reports (Standard and Motion)

This parameter sets the interval between tracking report cycles. The interval can range from 0 and 10080 minutes in increments of 0.5 minutes (i.e., 30 seconds). The AT command associated with this setting is ^TBR (Standard) and ^TBRA (Motion).

6.2.2.2.3.3 Time To Keep Trying (Standard and Motion)

This parameter sets the duration in which the SHOUT ns attempts to retry sending a tracking report. During a report cycle, the SHOUT ns will attempt to acquire a valid GPS fix and acceptable communication link signal strength. Once the GPS fix and signal strength requirements are met, the device will send a report. If the report fails to send, the SHOUT ns will retry until the specified *Time To Keep Trying* window expires. There are two additional special values for *Time To Keep Trying* – *Only Once* and *Until Next Report*. *Only Once* will force the SHOUT ns to send only once per report cycle regardless of whether the tracking report was successfully transmitted or not. *Until Next Report* will force the SHOUT ns to retry sending a tracking report up to the next reporting cycle if there is no successful transmission. *Time To Keep Trying* is specified in 5-second increments. It has a minimum value of 1.5 minutes and a maximum value of 21 minutes and 10 seconds. The AT command associated with this setting is ^TTKT (Standard) and ^TTKTA (Motion).

6.2.2.2.3.4 Delay First Report (Standard and Motion)

When enabled, this setting prevents the transmission of the first tracking report. This applies when tracking is turned on from off or if there is a mode change. A mode change occurs when entering/leaving a geofence and when emergency is enabled/disabled. The AT command associated with this setting is ^DFR (Standard) and ^DFRA (Motion).

An example of how this parameter might be useful is to avoid unwanted transmissions which may accumulate airtime costs. If tracking mode is restarting repeatedly because of frequent power cycling, reports will be transmitted each time. Enabling *Delay First Report* would delay that first report and reduce the airtime usage.

6.2.2.3 Additional Setup Parameters

This section covers the configuration tabs associated with the Other profile settings. After the *Configure Window...* option is selected, users can go to *Profile Type* on the top left of the window and select *Other*. The *Store Profile* number has no effect for this profile type.

6.2.2.3.1 Miscellaneous Tab

The *Miscellaneous* tab shown in Figure 19 offers *Remote Update Password*, *Identifier in Reports*, and *Power-up Delay*.

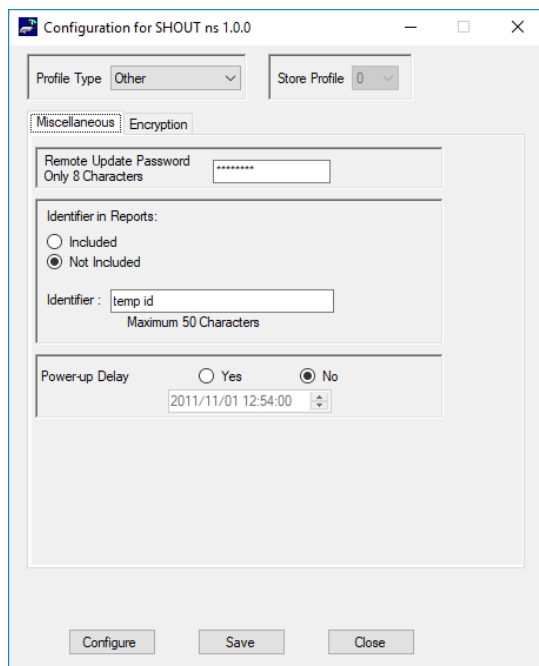


Figure 19. *Other Profile* window with *Miscellaneous* tab.

6.2.2.3.1.1 Remote Update Password

An unattended SHOUT ns can be reconfigured without requiring direct access to the device. All of the tracking profile parameters and most of the general parameters can be configured via remote updates. This parameter sets the required remote update password. The password entered must be eight characters in length. All printable characters are allowed. Factory-set default password is 12345678 and the user can keep it as-is. There is no requirement for this password to be changed. The AT command for this setting is ^RUP.

6.2.2.3.1.2 Identifier in Reports

The *Identifier in Reports* parameter sets an additional identifier of up to 50 characters which will be included in Type 3, Type 4, and Type 5 tracking reports. Users should keep the identifier short to reduce airtime cost especially when on the Iridium link. The AT command associated with this setting is ^ID.

6.2.2.3.1.3 Power-up Delay

This parameter enables the power-up delay to a specified date and time. The date and time format is as follows: YYYY/MM/DD HH:MM:SS (i.e., 2012/11/30 12:54:23). When in Tracking mode and immediately after power is applied to the SHOUT ns, the device remains in a power-saving sleep mode until the user-specified date and time. At which point, the device enters Tracking mode. The AT command for this setting is ^PUPD.

6.2.2.3.2 Encryption Tab

The SHOUT ns can send and receive data in AES 256-bit encrypted format. Figure 20 displays the SatTerm encryption setting window once the Encryption tab's "Change" button is clicked. The GUI allows the *Crypto Officer Password* to be changed, the *Encryption* to be enabled or disabled, and the *Encryption Key* or *Decryption Key* to be set.

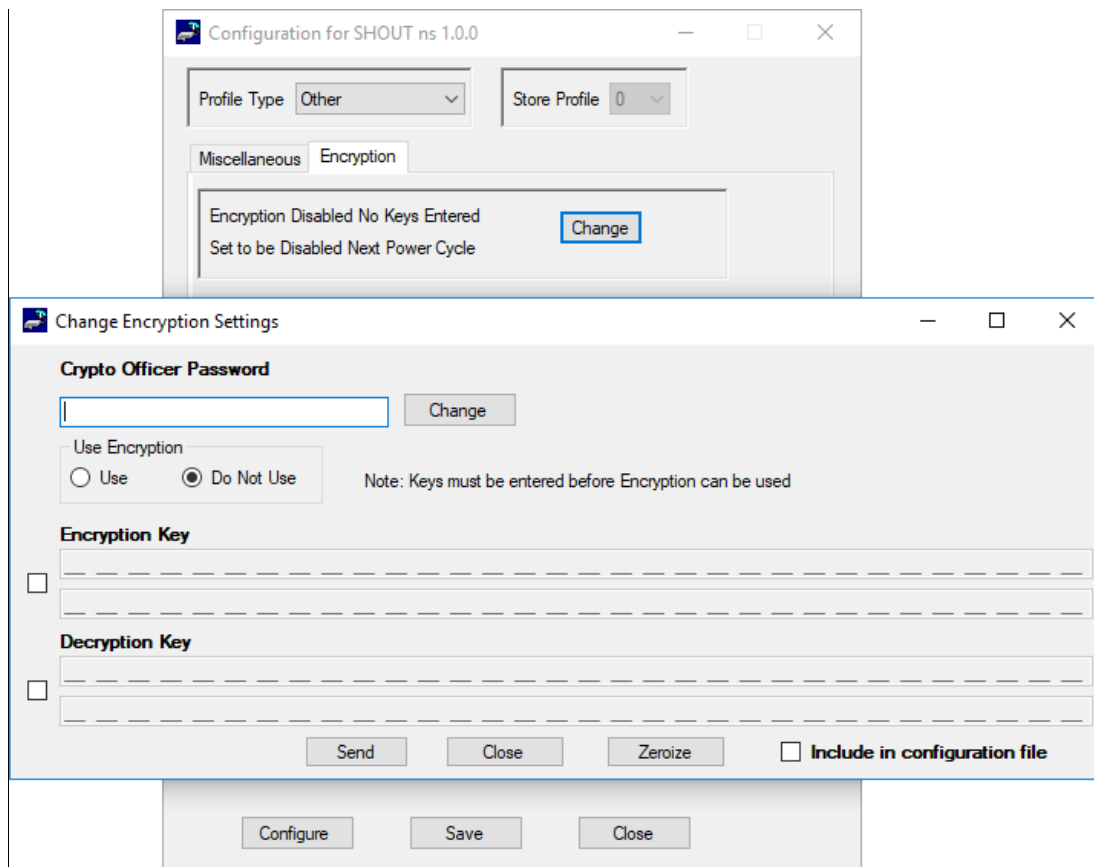


Figure 20. Other Profile window with *Encryption* tab and *Change Encryption Settings* window.

A factory-default *Crypto Officer Password* is initially set on the SHOUT ns. This default password must be changed before any encryption properties can be set. To change the default

password, click on the *Change* button to open the *Change Crypto Officer Password* window and complete the form. The default password, "temp password", should be entered in the *Old Password* field. When done, click the *Send* button. After the default *Crypto Officer Password* has been changed, encryption properties can be modified via the *Change Encryption Settings* window using the new *Crypto Officer Password*.

Once the default password has been changed, the *Encryption Key* and *Decryption Key* must be set in order to use encryption. In the *Change Encryption Settings* window, check *Use Encryption* and choose the option *Use*. Then check *Encryption Key* and enter the key twice. Next, check the *Decryption Key* and, again, enter the key twice. When done, click the *Send* button. The message *Update Made* will be displayed.

The *Encryption Key* must be set in order to use encryption for the first time. The *Decryption Key* is optional but is required to receive encrypted data. To change the *Use Encryption* option, *Encryption Key*, and *Decryption Key*, check the box next to the settings you wish to change. The encryption and decryption keys must be entered twice. When done, click the *Send* button. The message box *Update Made* will be displayed to confirm successful configuration of the selected settings.

The encryption settings will be included in the configuration file (see Section 6.2.2.4 *Configure Settings*) when the *Save to file* checkbox is selected. The *Zeroize* button erases the encryption/decryption keys on the SHOUT ns.

Configuration can also be accomplished by using AT commands. The following five AT commands are used to configure the SHOUT ns device's cryptographic options: *Change Crypto Officer Password* (^CCOP), *Key for Decryption* (^KD), *Key for Encryption* (^KE), *Use Encryption* (^UE), and *Key Zeroization* (^KZ).

6.2.2.4 Configure Settings

To configure the SHOUT ns with the current Configuration Window settings, click the *Configure* button at the bottom of the Configuration Window (see Figure 9). When the settings have been programmed and saved into the SHOUT ns, SatTerm will display the confirmation message shown in Figure 21.

The current Configuration Window settings can be saved to a file, by clicking the "Save" button at the bottom of the Configuration Window.

The SHOUT ns can also be configured from an existing *.ncf configuration file. To load an existing *.ncf configuration file into the SHOUT ns, select **Options > Configure from File...** from the SatTerm Main window. This will pop up a file browsing window prompting you to

select a file. Locate the configuration file you wish to use and click the *Open* button. SatTerm will proceed to configure the SHOUT ns with the settings contained in the selected configuration file. When this has completed, the "Update Made" dialog window appears (See Figure 21).

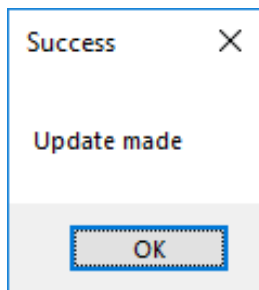


Figure 21. Successful Update Made window.

6.2.3 Geofencing

The SHOUT ns can utilize location information from its GPS receiver to determine whether it has entered or exited the bounds of pre-configured geofences. A geofence is a set of connected latitude and longitude coordinates that defines a region or zone. A SHOUT ns can be configured to send a report when entering or exiting a geofence, and to use a different tracking profile. This gives user the ability to change the behavior of the SHOUT ns based on its location.

Geofences can be configured two ways: using the AT commands and using SatTerm. If latitude and longitude coordinates are known, geofences configuration can be done using the following AT commands: Start Geofence (^GFS), Add Geofence Point (^GFAP), Finish Adding Geofence Points (^GFF). Geofence maintenance and modification can be accomplished using the following AT commands: Geofence Check Frequency (^GFCF), Modify Geofence (^GFM), Delete Geofence (^GFD), Erase Geofence (^GFE), and Read Geofence Points (^GFR).

A geofence forms-based GUI configuration tool is available using SatTerm. To configure geofences with SatTerm, select **Options > Geofences...** (see Figure 8) and the Geofences window shown in Figure 22 will appear. Note that the visual map-based geofence options *Create Geofence* and *Edit Geofence* utilizes Google Maps so an Internet connection is required for a map to show up.

There are two lists in the *Geofences* window. The one on the left shows a list of geofences and the one on the right shows a list of coordinates corresponding to the selected geofence. To the far right are settings for the selected geofence. The list of geofences contains three

columns, which reflect values set in the settings section on the right. The *ID* column indicates the identifier assigned to the geofence. This identifier is used to reference the geofence when the SHOUT ns sends arrive and depart notices and when updating geofence parameters via AT commands or remote updates. The *Options* column shows a combined bit field value of the options parameters (000 (0) – 111 (7), with each digit corresponding to *Enable*, *Arrive notice*, *Depart notice*). The *Profile* column indicates the tracking profile assigned to the geofence.

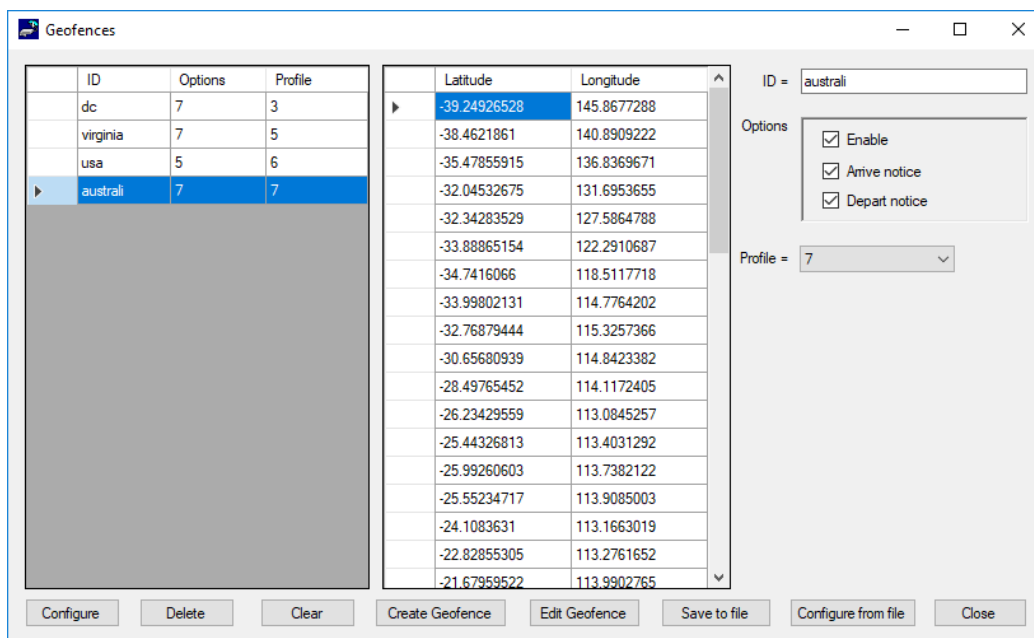


Figure 22. Geofences window.

Descriptions of the geofence settings listed on the right of the window are as follows.

ID	Defaults to an incremented integer value. It can be set to any 8-character string to identify the geofence (e.g., "USA", "BASE", and "DANGERZN").
Enable	Enables this specific geofence.
Arrive notice	Sends a NAL format GPS version 6 tracking report with short code 18 (GPS Report Version 6 Format [2]) when entering this specific geofence.
Depart notice	Sends a GPS version 6 tracking report with short code 19 when exiting this specific geofence.
Profile	Sets a tracking profile to be used while inside this specific geofence.

At the bottom of the *Geofences* window are a set of buttons. Descriptions of the buttons are as follows:

Configure	Selecting the <i>Configure</i> button saves the list of geofences on the SHOUT ns.
Delete	Deletes the selected geofence.
Clear	Deletes all configured geofences.

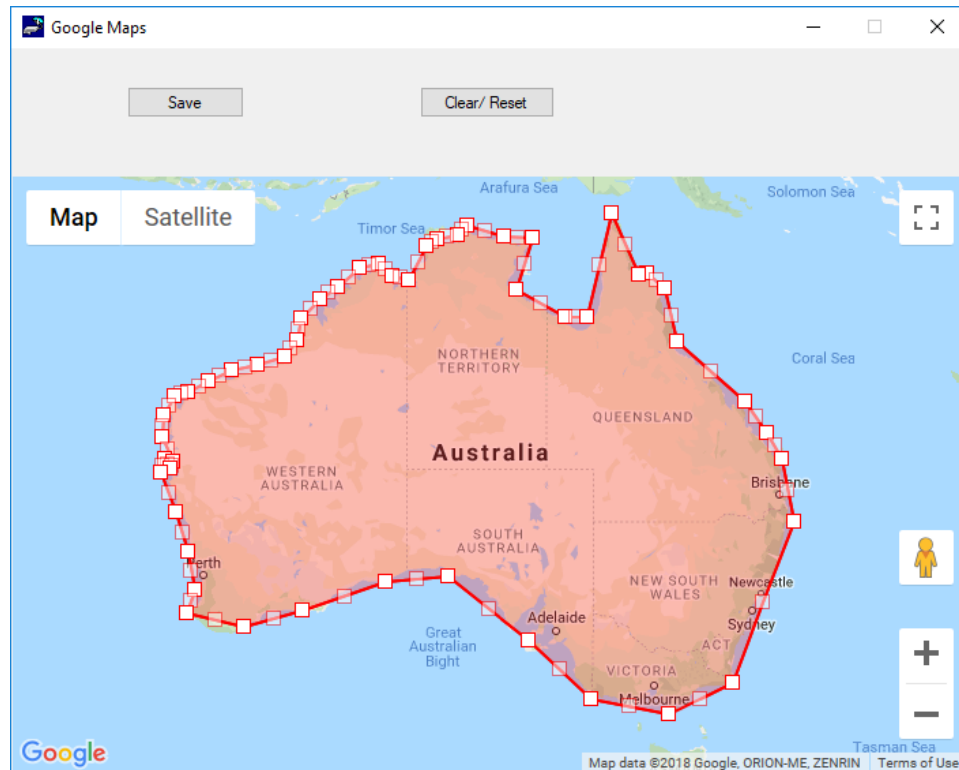


Figure 23. Create/Edit *Geofence* window.

Create Geofence Opens a window to create a geofence by adding points on a map. The window is shown in Figure 23. Clicking anywhere on the map will add a point to the geofence. Each point is connected to its previous point. Clicking an existing point will delete it from the geofence. Dragging an existing point will move that point to where it is dragged. A geofence is complete when the start point is clicked. The *Save Points* button transfers the marked points to the coordinates list and closes the map. The *Clear/Reset* button is used to clear all points on the map. The minimum number of points in a geofence is 3 and maximum number of points is 50.

NOTE: The *Create Geofence* option utilizes Google Maps. An Internet connection is required for the map to show up.

Edit Geofence	Opens a window to edit the coordinates of the selected geofence. The window is the same as <i>Create Geofence</i> with the same functionality, but it opens pre-populated with coordinates as shown in Figure 22.
Save to file	Saves the list of geofences to a Comma Separated Values (.CSV) file.
Load from file	Loads geofences from a Comma Separated Values (.CSV) file.
Close	Closes the <i>Geo Fencing Information</i> window.

6.2.4 Call Out

In addition to normal tracking reports sent at a predefined interval, the SHOUT ns can also send daily tracking reports at specific UTC times. These daily reports are called Call Outs. Call Outs can be configured two ways: using AT commands and using SatTerm.

Call Outs configuration can be done using the following AT command: Add Call Out (^COA). Call Outs maintenance and modification can be accomplished using the following AT commands: Delete Call Out" (^COD), Erase Call Out (^COE), and Read Call Out (^COR).

To configure Call Outs with SatTerm, select **Options > Call Out...** (see Figure 8) and the *Callout Form* window shown in Figure 24 will appear. As long as there is at least one enabled entry in the list, the Call Out feature will be enabled.

The main portion of the *Callout Form* window has a list of existing Call Outs. The list shows three columns: *Index* is the position of the Call Out in the list, *UTC Time* is the time a Call Out is to be made (In HH:MM:SS format), and *State* indicates whether the Call Out is enabled (1) or disabled (0). Below the Call Out list is a set of buttons. Descriptions of the buttons are as follows:

Add	Adds a Call Out to the list.
Delete	Deletes the selected Call Out.
Clear	Deletes all configured Call Outs.
Close	Closes the <i>Callout Form</i> window.

Call Outs

	Index	UTC Time	State
▶	0	12:15:00	1
	1	12:50:00	0

Add Delete Clear Close

UTC Time: 15:35:00

State: ☒ Enabled ☐ Disabled

OK Cancel

Figure 24. *Callout Form* window.

7.0 NAL SHOUT ANDROID APP OVERVIEW

The SHOUT ns can communicate with an Android smartphone running the SHOUT Android app, available from NAL Research via Google Play App Store, using the SHOUT ns Bluetooth interface. This Android application provides all the capabilities of the display screens on other NAL Research tracking devices such as the SHOUT nano and SHOUT ts. These capabilities include device status, text messaging, managing tracking parameters such as reporting rate, reporting format, and geofencing, diagnostic utilities, and configuring the SHOUT ns. This section provides a brief overview of the SHOUT App. More details regarding the SHOUT App can be found in the SHOUT App User Guide [4] document.

7.1 Pairing the SHOUT ns with a Smartphone

After the Android app has been downloaded to the desired device, the user can proceed to pair the device with the SHOUT ns. To pair a Bluetooth enabled device such as a smartphone or tablet with the SHOUT ns, a connection of a PC to the USB interface is required to use the SatTerm PC based Terminal Emulation application (see Section 6.2 Using SatTerm). Section 4.6 Device Bluetooth pairing with the SHOUT Android App has detailed steps to pair the SHOUT ns with an Android device.

7.2 SHOUT App Screen Overview

Once the devices have been paired, the user can launch the SHOUT app on the smartphone or tablet. Figure 25 depicts the SHOUT ns Android App display. This window has four segments which provide status and menu selections for the user. The top segment is called the Title Bar and provides the name of the selected menu item displayed in the Menu Area as well as Forward / Back icons to assist in navigating the app screens. The next segment is the Status Bar which provides an overview of the SHOUT ns status (Iridium network connection, GPS signal strength, battery life / charging status, Text message status, etc.) as well as an array of icons for the various SHOUT app functions. The third segment is the Menu / Function Area which provides the menu icons for the function selected in the Bottom Dock segment and various data entry windows. The last segment is the Bottom Dock. Like an Android smart phone, this menu area is always present on every screen and allows a quick change to a new menu area when desired.

7.2.1 Title Bar

The SHOUT app Title Bar provides the name of the selected menu item displayed in the Menu / Function Area as well as Forward / Back icons to assist in navigating the app screens. The top level menus (Texting, Tracking, Utilities, and Settings) do not have Forward / Back

icons as they are top level menus and the Bottom Dock segment is used to switch between menus.

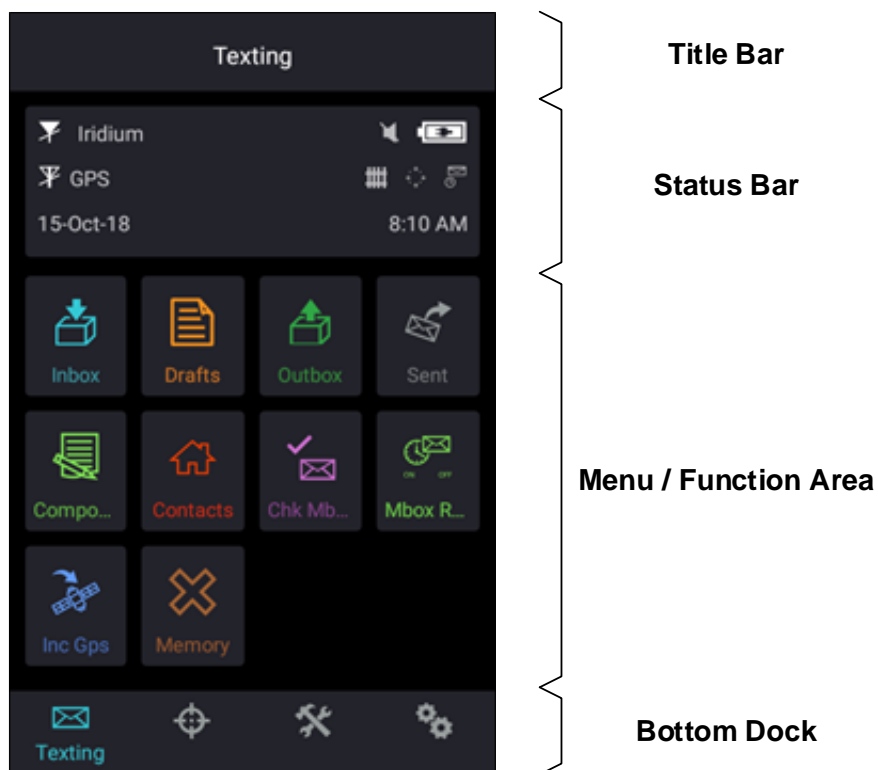
















Figure 25. SHOUT ns Android App main window.

7.2.2 Status Bar

The next segment of the SHOUT app display is the status bar located between the Title bar and the Menu / Function area. Below is a list of status icons and their meanings:

	Denotes the Iridium transceiver is off. To preserve battery life, the Iridium transceiver will only be turned on when transmitting a message or position report and, thus, a diagonal line is drawn over the symbol when off.
	Denotes either: (1) the Iridium transceiver is on with real-time signal strength represented by the number of vertical bars or (2) SBD message transmission is in progress. The signal strength can range from the lowest of zero to the highest of five bars. During transmission the antenna must have a clear view of the sky. Due to variable signal attenuation for different structures, the device cannot reliably send messages or reports from inside a building.

	Denotes the GPS receiver is off. The GPS receiver is always kept off to preserve battery life until time, date or position information is needed.
	Denotes the GPS receiver is on with real-time satellite acquisition status represented by the number of vertical bars. One bar represents valid time and date fix, two bars represent 2-D fix or dead reckoning, three bars represent 3-D fix with HDOP higher than 2.0 and four bars represent 3-D fix with HDOP less than 2.0. Although the GPS receiver can often obtain a location fix when the antenna is partially blocked (near buildings, in a room next to a window, etc.), it is recommended that the antenna must have a clear view of the sky to minimize acquisition time and better position accuracy.
	Battery charge indicator.
	Denotes the battery is being charged by an external power source.
	Denotes all audio is off.
	Denotes audio is on.
	Denotes unread message(s) is in the Inbox.
	Denotes message(s) is(are) in the Outbox ready to be sent or message(s) in queue failed to send.
	Denotes Geofences is on when the symbol is bright white. The symbol turns dimmed gray when geofence tracking is off. The geofence symbol will not appear when there are no fences saved into the device.
	Denotes Call Out is on when the symbol is bright white. The symbol turns dimmed gray when Call Out is off. The Call Out symbol will not appear when there are no Call Out times saved into the device.
	Denotes Mailbox Check is on when the symbol is bright white. The symbol turns dimmed gray when Mbox Check is off.
	Denotes Tracking (standard tracking, geofence tracking, etc.) is on when the symbol is bright white. When standard tracking is on, a countdown timer to the next report will appear beside the tracking symbol. The symbol turns dimmed gray when tracking is off.

7.2.3 Menu Functional Area

At the top menu level, the Menu / Functional Area contains the sub menu icons for the functions provided by that menu and the functional screens for each of those menus such as the Inbox for the Texting Menu or the Reporting Rate selections for the Tracking Menu.

7.2.4 Bottom Dock

The bottom Dock contains the menu icons for the four main menus; Texting, Tracking, Utilities, and Settings. This segment is always visible and allows the user to switch between top level menus quickly.

7.3 Texting Menu

The Texting menu, depicted in Figure 26, allows the user to compose, save, view, send canned or free-text messages, check mailbox for incoming messages and setup an automatically mailbox check frequency. This menu has the following sub-menu items:

Inbox	Drafts	Outbox	Sent
Compose	Contacts	Check Mailbox	Mailbox Check Rate
Include GPS	Memory		

7.4 Tracking Menu

The Tracking menu for the SHOUT app is shown in Figure 27. There are a variety of different menus used to interact with the tracking function. Some menus, such as Geofences and Call Out, require the user to use SatTerm to configure parameters beforehand. For these options, user is referred to Section 6.2 Using SatTerm for more details. This menu has the following sub-menu items:

Report Rate	Format	Link (Iridium)	Geofences
Brevity	Block Report	Call Out	Queue Report
911 Activate	Data Log	Stats	Cancel 911

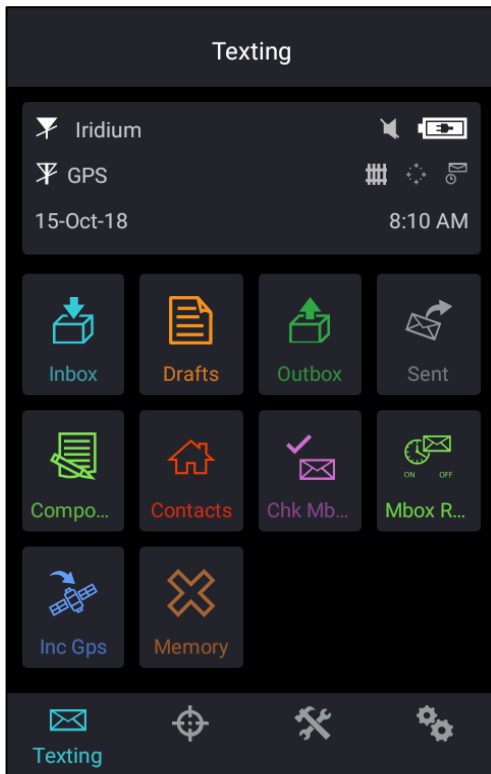


Figure 26. Texting Menu Screen.

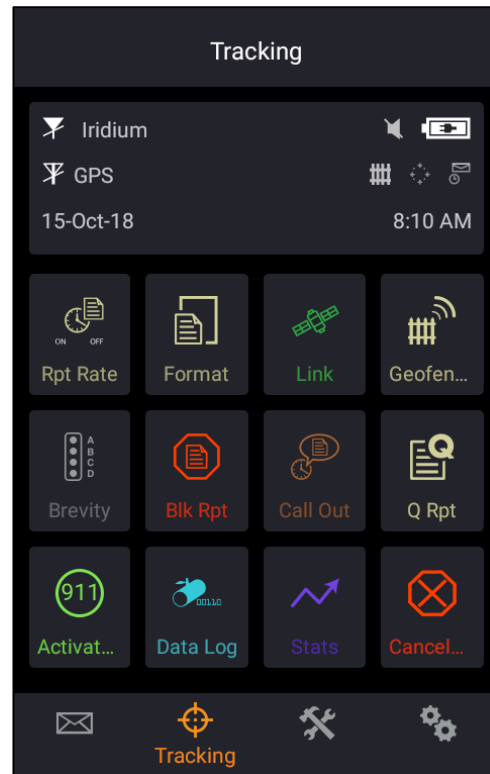


Figure 27. Tracking Menu Screen.

7.5 Utilities Menu

The Utilities menu is shown in Figure 28 and provides five options used mainly to check for proper hardware operation and network setup. These utilities can be useful when trying to troubleshoot certain problems with the device. This menu has the following sub-menu items:

Check GPS	Check Iridium	Test Report	Check-In
Waypoints			

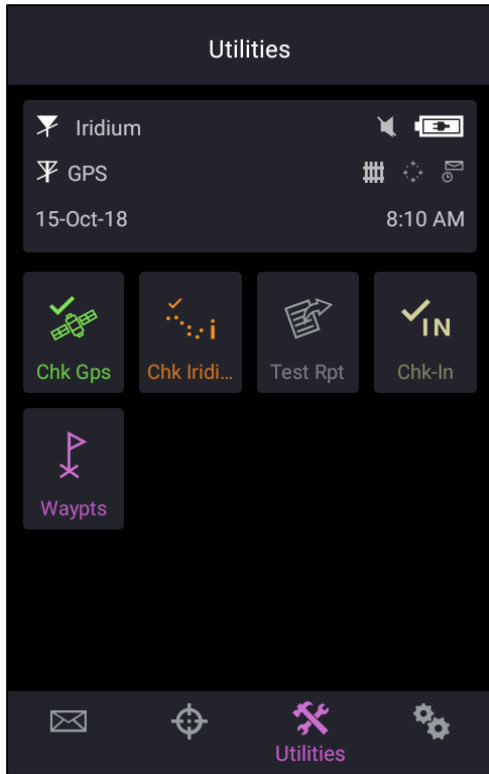


Figure 28. Utilities Menu Screen.

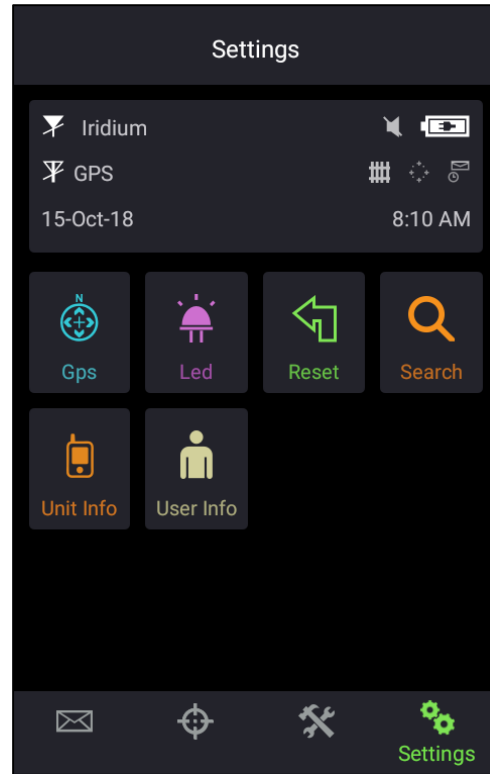


Figure 29. Settings Menu Screen.

7.6 Settings Menu

The Settings menu allows user to view and customize the hardware settings and is shown in Figure 29. The settings menu also gives the user an easier way to view device information, and allows for resetting the device to default tracking settings. This menu has the following sub-menu items:

GPS	LED	Reset	Search
Unit Info	User Info		

8.0 SHOUT NS USE WITH THE NAL VUE MANAGEMENT TOOL

8.1 Overview

NAL Vue is a web-based locating, tracking and communication management system that provides your team with situational awareness and control to make timely and effective mission decisions. NAL Vue is an integrated system bringing satellite, GSM and other data together into a single and simple-to-manage display and control platform. NAL Vue tracks your assets by location and movement (position, speed, altitude and heading) in real-time via GPS updates from your NAL Research devices and other compatible tracking devices.

The flexibility of the NAL Vue Asset Management System offers awareness of position over your global inventory of trackable assets such as the SHOUT ns. Whether you are tracking personnel, vehicles, shipping containers, etc., your designated system administrator will maintain control and have the ability to communicate with any number of assets simultaneously. Conversely, NAL Vue does not allow others to see the location or movement of your assets unless you authorize it. For more details, see the NAL Research NAL Vue Users Guide [5] document.

8.2 NAL Vue User Interface

8.2.1 Six Core Tabs

NAL Vue's features and capabilities all roll up into one of six main functional groups, making the navigation panel simple and direct for new users: *Assets, Alerts, Reports, Settings, Preferences, and Users*. This navigational hierarchy comes from an understanding that users entering the tracking portal have a very clear intent, and the six top-level categories make it very clear how to get directly to that interface.



Figure 30. NAL Vue home Map / Asset window.

8.2.2 Assets Tab

Full create, read, update, and delete functionality for assets allows administrators and users the ability to gather data in near real time and, under most circumstances, act upon that data without needing to leave the portal. Views of the data can be customized to show both live and historic data transmission, and users can group assets in a number of ways within NAL Vue to meet their needs. Configuration of field triggers and geofencing capabilities further expand the management of assets in the field. The Assets Tab The assets tab window has two data areas, the Assets Panel and the Map.

8.2.2.1 Assets Panel

The Asset panel to the left of the interface allows users to interact with their assets directly from the home map page, which makes it easier to locate them, as well as perform any tasks like configuration, messaging, or status checks. The panel itself allows users to create and collapse groups of assets in order to maintain order of large ecosystems from a single interface. Each asset's details can be viewed by selecting it from the left panel or by clicking/tapping the asset on the map.

8.2.2.2 Map View

The default tracking view for the system is a map, shown in Figure 30, which can be zoomed in or out to display the entire region, continent, or world. Assets, groups, geofences, location history, and travel paths appear on the map, which can be as much or as little as the

user wants to see. Additionally, the user can toggle between enabling and disabling various map layers on the view.

Layers on the map are ways for specific organizations to get more value out of the interface, particularly maritime industries, which has its own map layer available by default. Other layers include weather radars, traffic maps, satellite network maps, oil, and other API-based maps that can be configured by the user.

8.2.2.3 Adding Assets

Adding assets such as the SHOUT ns to NAL Vue is a simple process that also allows for very specific pieces of information to be included in an asset profile. Managers can color-code their assets, use provided iconography or their own iconography to differentiate it, and configure a number of different settings from the add/edit interface. For assets with operators (such as vehicles), those operators can be added as “drivers” who will be able to log into the device when they are actively engaged with it for more accountability. See Figure 31 for the NAL Vue Add Asset window.

The screenshot shows the 'Add Asset' window in the NAL Vue application. The window has a title bar with the text 'Add Asset' and a close button. Below the title bar is a tabbed interface with the following tabs: Main, Groups, Users, Extra, Settings, I/O, Driver, Alerts, Garmin, and Assets. The 'Main' tab is currently selected. The main content area of the 'Main' tab contains the following fields and options:

- Name:** A text input field.
- Device:** A dropdown menu with 'NAL SHOUT ts' selected.
- IMEI/Unit #/Device ID:** A text input field.
- Sensitivity:** A slider control set to 50.
- Icon:** A row of icons with radio buttons. The first icon (a blue circle) is selected. Other icons include a person, a car, a truck, a plane, a boat, and a lighthouse.
- or**: A separator line.
- Upload Icon: (PNG, 18x18 pixels)**: A text input field with a 'Browse...' button.
- Color:** A grid of color options with radio buttons. The 'Blue' option is selected. Other colors include Turquoise, Dark Blue, Green, Dark Green, Red, Dark Red, Orange, Dark Orange, Pink, Magenta, Purple, Yellow, White, Grey, Dark Grey, and Brown.

At the bottom right of the window are two buttons: 'Save config' and 'Cancel'.

Figure 31. NAL Vue Add Asset window.

While adding assets, managers can also associate the asset with any number of groups or users so that the asset will be visible and sorted within those groups immediately after it has been added to the system. There are a number of complex settings that can also be configured

by the asset manager, including how to display it on the map. For advanced users, there is even an option to change the spatial reference system to a regionally supported or mandated standard system.

8.2.2.4 Asset Configuration

Once added to the system, asset details can be configured or updated at any time by their managers using the same intuitive interface that was used to create it. This functionality can be used, as well, by managers to sort assets into groups, modify drivers, and change permissions for which users can and cannot interact with that asset through NAL Vue.

8.2.2.5 Grouping Assets

Grouping allows users greater ability to manage their assets when there is a large number of different types of devices loaded into a single portal. This can also be used to set up local, regional, or team-based grouping so that access to manage assets and personnel can be delegated directly to the leaders of that corresponding group more efficiently.

This feature can be geared towards helping fleet managers with a thousand or more active assets or scaled down to smaller organizations that simply need to perform batch actions on a given set of assets.

8.2.2.6 Track and Monitor Assets

Each asset viewable on the left panel is also viewable on the map. Users can access the portal and immediately view any asset's last-reported position data, and they can open the asset menu to access interactive functionality. These functions include following an asset, routing the asset remotely from the NAL Vue system, and setting or sending waypoints along an intended route, which can be used to trigger alerts and estimate arrival times for more complex tracking operations.

While it is connected to NAL Vue, each asset creates a log of all its interaction with the system. Including position reports, messages sent or received, waypoint and geofence activity, and any other information reported by hardware connected to the tracking device. These logs can be accessed by managers at any time on NAL Vue, and don't require a special server pull.

8.2.3 Alerts

NAL Vue can help asset managers keep track of everything including service reminders and maintenance requirements for each of the assets in the system. Whether these alerts are set to occur by intervals (i.e. a certain amount of time or usage), or by specific milestones.

NAL Vue can use any of its collected data points to alert managers if one of its assets is in need of attention. Triggered alerts can be tied to intervals as mentioned above, but are also more often tied to events, activity, or geofence criteria. Alerts related to geofences can help managers keep assets out of dangerous situations or locations, and can also help managers identify potential theft if their assets deviate too far from the intended path. Because of the potential for hardware to be able to track and monitor personnel and their vital signs as well, NAL Vue can alert the system when a given unit is under siege, or if a particular field agent, operative, or member of a team is under duress or worse. This kind of real-time monitoring and alerting system allows managers to respond more quickly and with better information.

Alerts encompass a wide range of mostly trigger-based activity and behavioral monitoring. NAL Vue can also be used to automate certain “checking” and “reminder” activities and processes associated with hardware assets. Beyond that, manual alerts can be transmitted between NAL Vue and any device in the primary user portal that is part of the connected ecosystem. Alerts can be triggered by a number of events and data points within the NAL Vue ecosystem, but will most commonly be associated with motion activity, geofence activity, and meter readings. The asset’s hardware and sensory devices will be the primary means of determining the extent of the alert activity a manager is capable of establishing. Some alerts will require the contact to acknowledge receipt of the notification, and these alerts will be resent from the portal until the contact has acknowledged it. The interval and number of retries can be configured by the user setting up the alert, and the course of action for unanswered alerts can include sending an alert to a secondary contact.

8.2.4 Reports

Reports from the NAL Vue system range from generic to high level and high level activity reports to fully customized and specifically detailed reports. Visual reports from the NAL Vue dashboard are also readily available, and can be customized by the user in order to help them aggregate the data they need to make decisions and act upon insights produced within their data ecosystem. NAL Vue offers a host of report types ranging from activity reports which are a detailed list of all information gained from an asset to more specific reports like geofence dwell reports which identify how long an asset has been within a specific area. In addition to asset-related reports, administrators can also generate reports for NAL Vue users so that they can track the OP address, activity log, and session data for all activity in the system within a given time frame. For the majority of reporting needs, the reports that are already part of NAL Vue are those that are preconfigured to display the most pertinent information with regard to telematics. These reports can be customized by the user.

Reports can be pulled on demand, or they can be configured to automatically send on a given date or time schedule. The NAL Vue reporting feature is very similar to almost any other data-driven platform's reporting system in that it allows the user to configure a report from a set of pre-existing criteria driven by the types of data available in the system, define parameters and limitations on that information, and generate reports once or at regular intervals.

All reports can be viewed directly in the NAL Vue system, and can be pulled on demand or scheduled to be sent at predefined intervals. Regardless of whether they are recurring or single pulls, all reports can also be exported from the system in the form of a .PDF, .CSV, or .XLS file that the user can download and/or send from the system to any recipient.

8.2.5 Settings and Preferences

As with any account and user based software system, NAL Vue affords its administrators and users the ability to configure their own settings and preferences while they are using the application using two tabs; the Settings tab and the Preferences tab. Within the Settings tab, users can configure address books, canned messages, driver settings and updates, addition of custom map layers, and a number of other behavioral considerations. The Preferences tab manages the more standard account-level settings like regional considerations (i.e. time zone, metric or imperial measurements) and default views for each panel. More complex customization of the interface and functionality is available in the Settings tab.

8.2.5.1 Map Layers

NAL Vue offers users the ability to control how a viewer sees the information presented from assets. The clearest visual example of this is the ability to toggle the various map layers and map views on the Assets tab. Most of the map layers are provided by the National Oceanic and Atmospheric Association (NOAA), but clients also have the capability to add their own. The map views are provided by third party service called Mapbox®. It is important to note that the tile images by Mapbox in some cases can be improved upon, and more detailed visuals or more recent visuals of a given area can be obtained for a fee. Users may also import their own map layers on the Settings tab under Map Layers and clicking Add Map Layer. Keyhole Markup Language (KML), GeoJSON, GPS Exchange Format (GPX), and image overlay are the supported formats for custom map layers. From the Map Layers page, users can also select or deselect which map layers are enabled for viewing in the Assets tab.

8.2.5.2 Messaging Capabilities

Users in the field with devices that have a graphical user interface can use their device to communicate with a system manager anywhere in the world by sending messages to the NAL Vue system from the device. This same functionality also permits devices to communicate with one another, regardless of manufacturer. Those devices will also allow the same operator to receive important messages from a command hub, or instructions related to performing certain tasks or field work. This feature set can be critically important in emergency scenarios, as well as everyday operational needs for certain types of organizations.

Messages can be routed between devices, including those that do not normally have the means to communicate with one another. NAL Vue accomplishes this by assigning a message routing ID to each device. For example, Device Alpha (ID 13) can send a message to Device Bravo (ID 44) by sending a text message "44:Hello, Device Bravo." The ID on the front of the text message tells the network to route the message to Device Bravo. This limits the need for additional address books to be developed, for as long as two operators are utilizing devices connected to NAL Vue, they can communicate with one another using this switchboard ability.

For managers or standard users of NAL Vue, this process is even easier, as they can push the messages to the devices directly from the system's user interface (UI). This can be taken a step further when engaging the messaging functionality utilizing geofences. Instead of communicating to only one device, dispatchers can quickly draw a geofence around an area and begin messaging everyone in the designated zone. This process allows managers to quickly and efficiently direct personnel in the field on how to deal with situations.

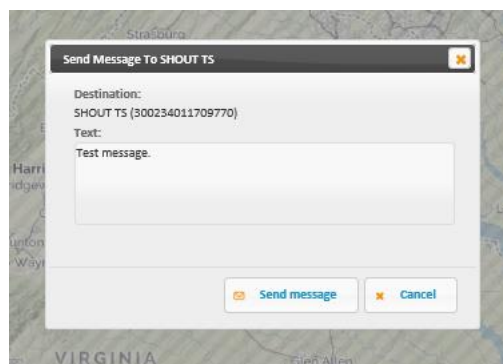


Figure 32. NAL Vue Messaging window.

For emergency services, this can be employed to make persons aware of how to respond to threats or natural disasters, and for fleet managers, messages could include important information about expected delays, route guidance, modifications to the existing plan, or

additional waypoints. The ability to communicate with any device across any network in a simple fashion allows users of NAL Vue to do more than simply observe telemetry and logistics data but also be able to react to it in a meaningful and productive way.

8.2.6 Users

As a web based interface, NAL Vue has three user profiles tailored to fit different user needs; Administrator, Standard, and Anonymous. The administrator user profile has the ability to change all configurable aspects of the platform as well as the ability to change anything at the other user levels, including permissions, assets, or settings/preferences. This user profile type is typically assigned to a dispatcher for a fleet management operation, a high-level engineer for asset management, or a central command officer for remote ground personnel operations. The standard user profile will be the most common profile within an organization, and is perhaps the most flexible type, allowing for full control of each individual's permissions, capabilities, and usage as permitted by the Administrator. Access to the assets, places, geofences, alerts, and other aspects of NAL Vue can be configured by the administrator to be as open or restricted as desired with this user type based on their roles and responsibilities. The Anonymous User is not technically a user on NAL Vue. This user profile gives organizations the ability to make NAL Vue data (i.e. the location and behavior of an asset or asset group) available to people outside of the organization through a URL link.

For more details regarding NAL Vue, see the NAL document "NAL Vue Users Guide" [5].

9.0 TECHNICAL SUPPORT

FOR TECHNICAL SUPPORT, PLEASE CONTACT US AT

Phone: 703-392-1136, x203

FAX: 703-392-6795

E-mail: contact@nalresearch.com

Technical documents are also available to download on NAL Research's website

www.nalresearch.com

APPENDIX A: STANDARDS COMPLIANCE

The 9603 transceiver inside the SHOUT ns is designed to meet the regulatory requirements for approval for FCC, Canada, and CE assuming an antenna with a gain of ~3 dBiC and adequate shielding. The 9603 transceiver is tested to the regulatory and technical certifications shown in table below.

Regulatory Approvals	Radio Tests	EMC Tests	Mechanical/ Electrical Tests
CE	ETSI EN 301 441 V1.1.1 (2000-05)	ETSI EN 301 489-1 V1.8.1 (2008-04) ETSI EN 301 489-20 V1.2.1 (2002-11)	EN60950-1:2006 Part 1
FCC	FCC CFR47 Parts 2, 15, and 25	EN61000-4-2: 1995/A2: 2001 Part 4.2 EN61000-4-3: 2002 Part 4.3 EN61000-4-4: 2004 EN61000-4-6: 1996/A1: 2001 Part 4.6	
Industry Canada	Industry Canada RSS170 Issue 1, Rev 1, November 6, 1999	EN55022: 2006	

APPENDIX B: EXPORT COMPLIANCE INFORMATION

The SHOUT ns is controlled by the export laws and regulations of the United States of America (U.S.). It is the policy of NAL Research to fully comply with all U.S. export and economic sanction laws and regulations. The export of NAL Research products, services, hardware, software and technology must be made only in accordance with the laws, regulations and licensing requirements of the U.S. Government. NAL Research customers must also comply with these laws and regulations. Failure to comply can result in the imposition of fines and penalties, the loss of export privileges, and termination of your contractual agreements with NAL Research.

The export and re-export of NAL Research products and services are subject to regulation by the Export Administration Regulations (15 CFR 730-744), as administered by the U.S. Department of Commerce, Bureau of Industry and Security (BIS). See: <http://www.bxa.doc.gov> for further information on BIS and the Export Administration Regulations (EAR). Additional export restrictions are administered by the U.S. Department of the Treasury's Office of Foreign Asset Controls (OFAC). See: <http://www.ustreas.gov/ofac> for further information on OFAC and its requirements.

APPENDIX C: DESCRIPTION OF THE IRIDIUM NETWORK

C.1 Description of the Iridium Network

The Iridium satellite network is owned and operated by Iridium Satellite LLC (ISLLC). It is constructed as a constellation of 66 satellites in low-earth orbit (LEO), terrestrial gateways and Iridium subscriber units (ISU). An ISU can either be an Iridium satellite phone or various types of modems. The satellites are placed in an approximate polar orbit at an altitude of 780 km. There are 6 polar planes populated with 11 satellites per orbit constituting the 66 satellite constellation. The near polar orbits of the Iridium constellation provide truly real-time and global coverage from pole-to-pole.

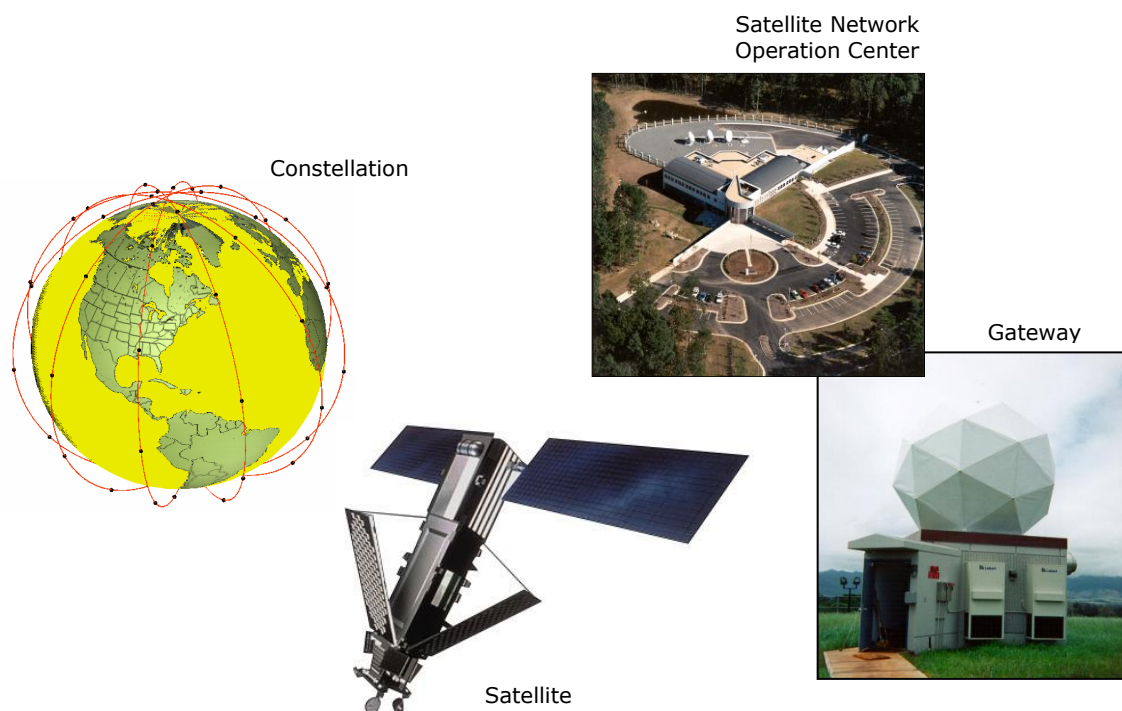


Figure C1. Iridium Network Major Components

The Iridium is designed to operate in the band of 1616.0 to 1626.5 MHz although the exact frequencies used depend on the local regulating authorities and issued licenses in any particular region. Each satellite projects 48 beams on the surface of earth, which may be viewed as providing coverage cells on the ground similar to terrestrial systems. Each beam is approximately 600 km in diameter. The 66-satellite constellation has the potential to support a total of 3,168 spot beams; however, as the satellite orbits converge at the poles, overlapping beams are shut down. The satellite footprint is ~4,700 km in diameter. Under each footprint, a satellite is power limited to ~1,100 simultaneous circuits.

The Iridium network uses a time domain duplex (TDD) method and transmits and receives in an allotted time window within the frame structure. Since the system is TDD, the ISU transmit and receive in the same frequency band. The access technology is a FDMA/TDMA (frequency division multiple access/time division multiple access) method whereby an ISU is assigned a channel composed of a frequency and time slot in any particular beam. Channel assignments may be changed across cell/beam boundaries and is controlled by the satellite. The system will provide an average link margin of 13.1 dB.

Although there are multiple gateways, a user is registered to a single gateway. The gateways perform call connection setup and administrative duties such as billing and resource management. The satellite constellation provides connectivity between users, from a user to the Iridium system gateway, and between gateways. Within the Iridium network architecture, the satellites are cross-linked which allows ISU to ISU communication independent of gateway intervention once the call connection is established.

There are currently two commercial Iridium gateways located in Arizona, United States and Fucino, Italy. The U.S. Government owns and operates an Iridium gateway located in Hawaii, United States. Each gateway generates and controls all user information pertaining to its registered users, such as user identity, geo-location and billing items. The gateway also provides connectivity from the Iridium system to the terrestrial based networks such as the public switched telephone network (PSTN) or the Internet.

C.2 Description of the Iridium Network Data Capabilities

For data communications, the Iridium network supports five different modes of operation as shown in Figure C2: dial-up data service, direct Internet connection, short-burst data (SBD), short-messaging service (SMS) and router-based unrestricted digital internetworking connectivity solution (RUDICS).

C.2.1 Dial-Up Data Service

Dial-up data service provides connectivity through the Iridium satellite network to another Iridium modem, to the public switch telephone network (PSTN), to the Defense Switch Network (DSN), to a remote LAN (e.g., a corporate network) or to an Internet Service Provider (ISP) at a nominal data rate of 2.4 kilobits per second (kbps). The connection time involving user authentication and handshaking (or modem training) can range from 15 to 30 seconds. For an Iridium-to-Iridium call, dial-up data service offers an additional option known as Data-After-Voice or DAV. Similar to a voice call, a DAV call is routed directly from one Iridium modem to another Iridium modem without going through the gateway.

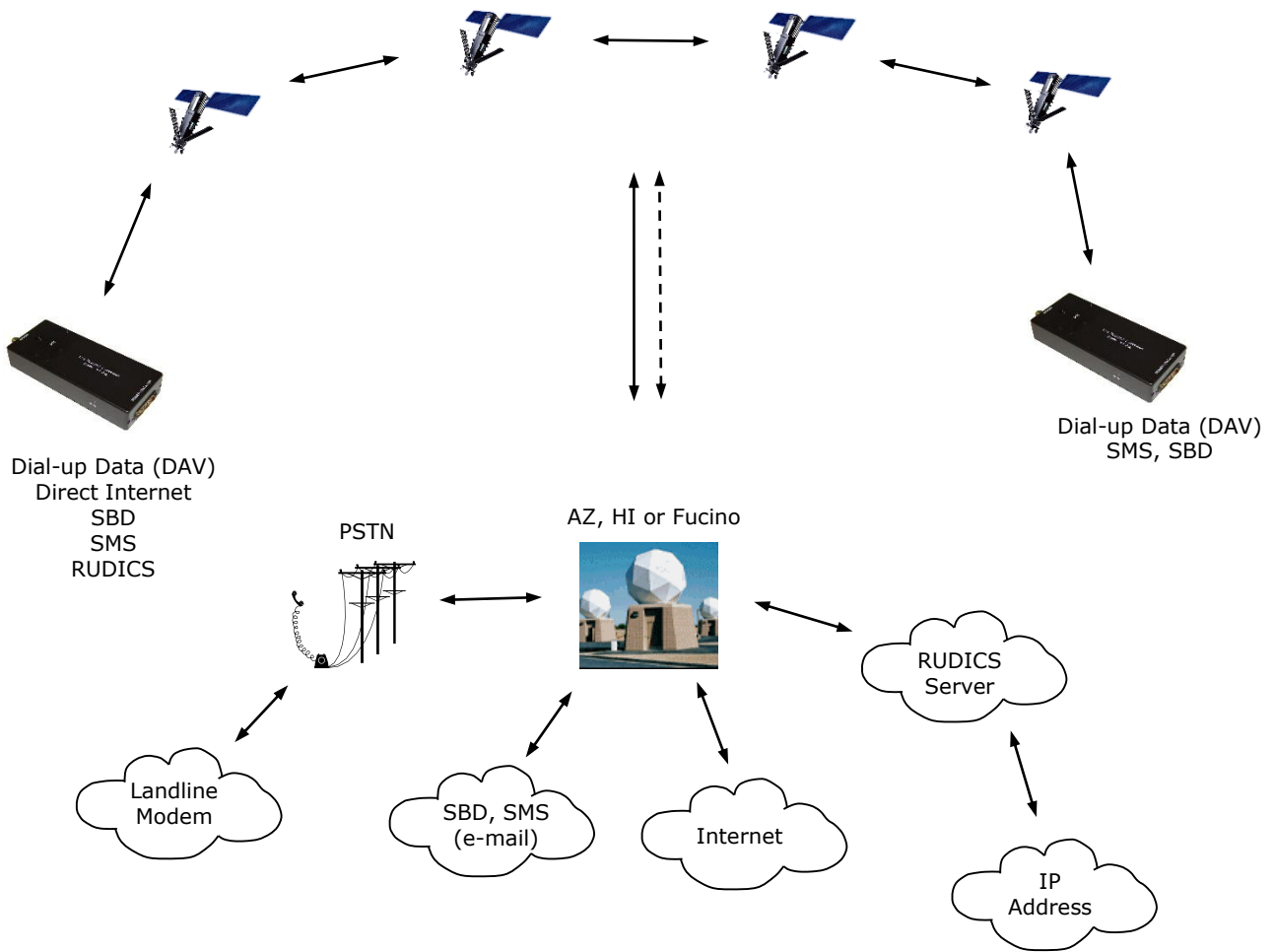


Figure C2. Iridium Network Data Capabilities.

The Iridium dial-up data service, as shown in Figure C3, functions in much the same way as the PSTN dial-up connectivity. From the perspective of a computer, the Iridium modem is just another external modem. The only difference is that the dialed telephone number must conform to the international dialing pattern used by Iridium. When a data call is placed, the Iridium modem actually dials and initiates a connection with the Iridium gateway through the Iridium satellite constellation. Since the Iridium modem is requesting to establish a data connection, the switch at the gateway routes the call through another modem. The modem at the Iridium gateway then dials into and connects to another modem at the other end. Figure C3 illustrates how an Iridium dial-up data service call is routed. The handshaking and protocols established between the modems independent of the Iridium network.

For those ISU-to-ISU dial-up calls where data transmission delay is critical such as the application of TCP/IP protocol, DAV should be considered in the design. This option eliminates

the Iridium gateway once authentication and registration is completed allowing ISU-to-ISU communication without the gateway in the loop.

C.2.2 Direct Internet Connection

The Iridium Direct Internet service allows users to connect to the Internet via the Iridium gateway without having to sign up with an Internet service provider. This service utilizes a dedicated Apollo Server at the Iridium gateway, which provides high-speed connectivity to the Internet and optimizes server-to-Iridium modem communications. The dial-up networking setup is similar to the dial-up networking setup for a landline telephone. The only difference is that the dialed telephone number is an international number provided by Iridium. Figure C3 illustrates how Iridium Internet (NIPRNet) call is routed.

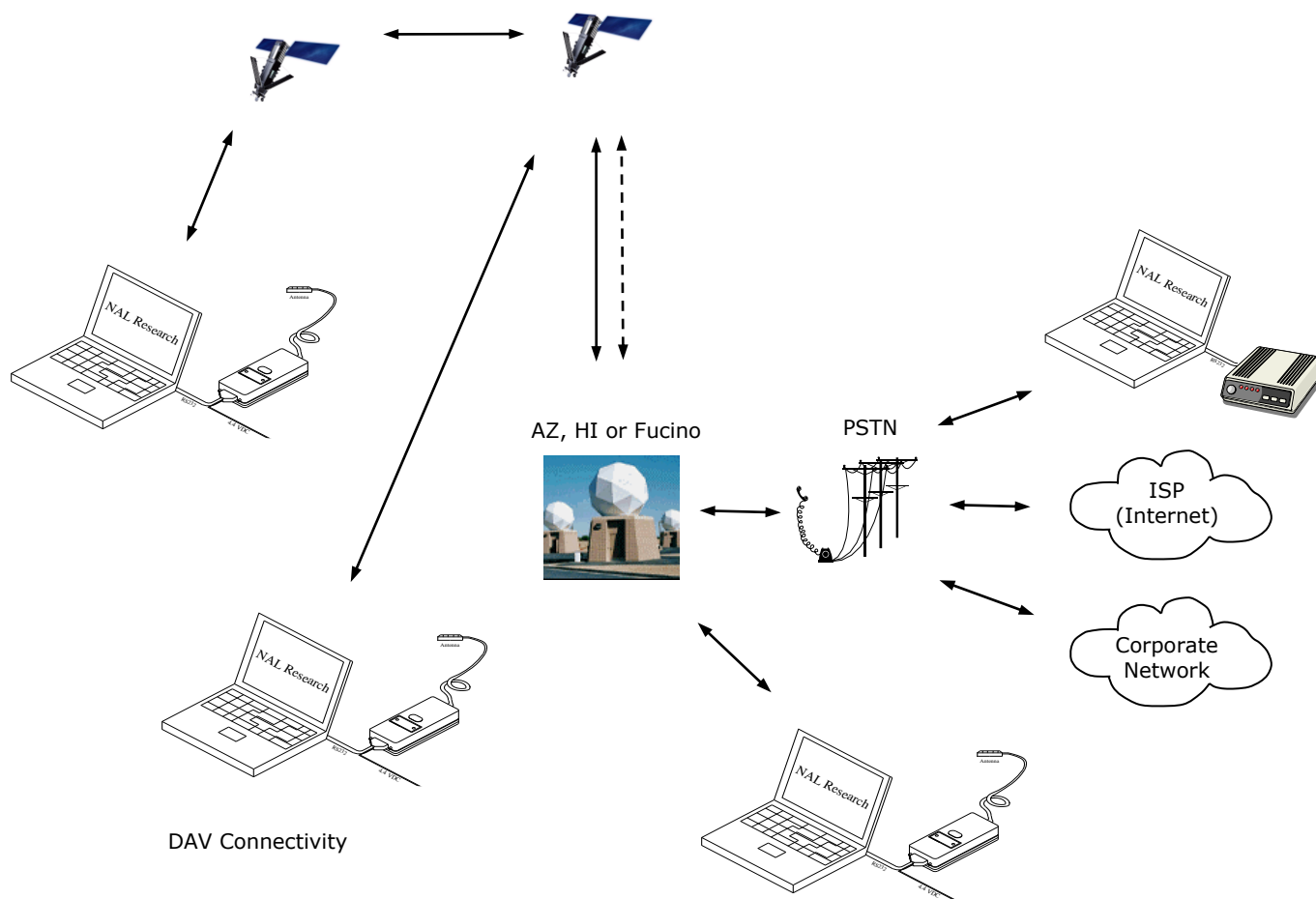


Figure C3. Iridium Dial-Up Data Service.

Direct Internet service can be enhanced using Windows-based emulated point-to-point protocol (PPP) called the Apollo Emulator. With the use of the Apollo Emulator software instead of Microsoft Windows® dial-up networking, Direct Internet service can reduce connection time

and improve data throughput. In addition, the Apollo Emulator offers a feature called Smart Connect™, which manages airtime by seamlessly connecting and disconnecting a user through the Iridium system. Airtime charges accumulate only while the call is connected. Improved effective data throughput is achieved through the use of user-transparent data compression. The channel rate is still 2.4 kbps. However, 10 kbps effective throughput can be achieved depending on content (graphics and images will result in lower effective throughput).

C.2.3 Router-based Unrestricted Digital Internetworking Connectivity Solution (RUDICS)

RUDICS is an enhanced gateway termination and origination capability for circuit switched data calls across the Iridium satellite network. When an Iridium modem places a call to the RUDICS Server located at the Iridium Gateway, the RUDICS Server connects the call to a pre-defined IP address allowing an end-to-end IP connection between the Host Application and the Iridium modem. There are three key benefits of using RUDICS over the conventional PSTN circuit switched data connectivity or mobile-to-mobile data solutions: (1) elimination of analog modem training time, (2) increased call connection quality, reliability, and maximized throughput and (3) protocol independence.

C.2.4 Short-Burst Data (SBD)

SBD is a simple and efficient bi-directional transport capability used to transfer messages with sizes ranging from zero (a mailbox check) to 1960 bytes. SBD takes advantage of signals within the existing air interface but without using the dedicated traffic channels. As a result, small amounts of data can be transferred more efficiently than those associated with circuit-switched data calls. Messages that originate from an Iridium modem can be delivered to a variety of destinations. Commonly, data are delivered across terrestrial communications networks (NIPRnet and Internet) to servers and applications that process data from one or multiple fielded Iridium modems. SBD service also supports the transfer of messages to Iridium modems, where messages may originate from terrestrial sources. Delivery methods and options are initially configured when the Iridium modem is first purchased and may be easily modified via web pages at a later time.

C.2.5 Short Messaging Service (SMS)

SMS is a mechanism to deliver short data messages over the Iridium satellite network to the NIPRNet/Internet. Iridium SMS incorporates a subset of the GSM SMS features. Each SMS message can be up to 160 text characters (7-bit coded) in length. The text characters are

based on a 7-bit alphabet, which is encoded and transmitted as 8-bit data, hence the 140 octet (byte) maximum message size.

SMS is a store and forward method of transmitting messages to and from an Iridium modem. The short message from the modem is stored in a central Short Message Service Center (SMSC) which then forwards it to the destination. In the case that the recipient is not available, the SMSC will attempt to deliver the SMS message until it is delivered or the validity period expires. SMS supports a limited confirmation of message delivery. The sender of the short message can request to receive a return message notifying them whether the short message has been delivered or not. With this option, the originator gets a confirmation that the message was delivered to the SMSC. Unlike standard GSM, the Iridium SMS can only acknowledge that the message was delivered to the SMSC and not the end-destination.

SMS messages can be sent and received simultaneously while a voice call is in progress. This is possible because SMS messages travel over and above the radio channel using the signaling path, whereas the voice call uses a dedicated "traffic" radio channel for the duration of the call.

C.3 Iridium Geo-Location

The Iridium network makes calculations of the geographical location (geo-location) of an ISU each time a call is placed. The technique employed to determine the geo-location of an ISU is based on measurements of the ISU and satellite propagation delay and Doppler frequency shift. These measurements are used to estimate cosines of spherical angles that identify the ISU's location relative to the satellite by the gateway.

The Iridium network can locate an ISU to within 10 km only about 78% of the time. The so-called error ellipse can have a large eccentricity with the major axis oriented in the azimuth dimension and the minor axis oriented in the radial dimension. The position of the ISU in the radial dimension relative to the satellite can almost always be determined to within 10 km with just one measurement. Errors in the azimuth dimension relative to the satellite are largest along the satellite's ground path and tend to increase with distance from the satellite. Geo-location errors in the east-west dimension, therefore, are sometimes more than 100 times greater than in the north-south dimension.

MECHANICAL DRAWING

