




WhereNet
WhereTrack - WNC

User's Guide

Document Number D1312r??

Model Number: WTK-5000

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FCC Requirements

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

See FCC registration label, located on the bottom of the equipment for the FCC, registration.

This equipment has been tested and found to comply with the limits for Class A devices, pursuant to Part 15 of the FCC Rules.

This ISM device complies with Canadian ICES-001.
Cet appareil ISM est conforme à la norme NMB-001 du Canada.

Agency Approvals

Emission – FCC Part 15 Class A
Radio – FCC Part 15.247
IC RSS 210
EMC EN 301489-1/-17
Radio – EN 300328
Electrical Safety IEC 60950-1
Electrical Safety EN 60950-1

Note: IEEE 802.11 functionality will only support b/g (not “a” version).

RF Notice

Any changes or modifications to WhereNet Corp. equipment not expressly approved by WhereNet Corp. could void the user’s authority to operate the equipment.

FCC Radiation Exposure Statement

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20cm between the radiator and your body. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.



There are no user-serviceable parts inside. Do not attempt to open the unit for repair.

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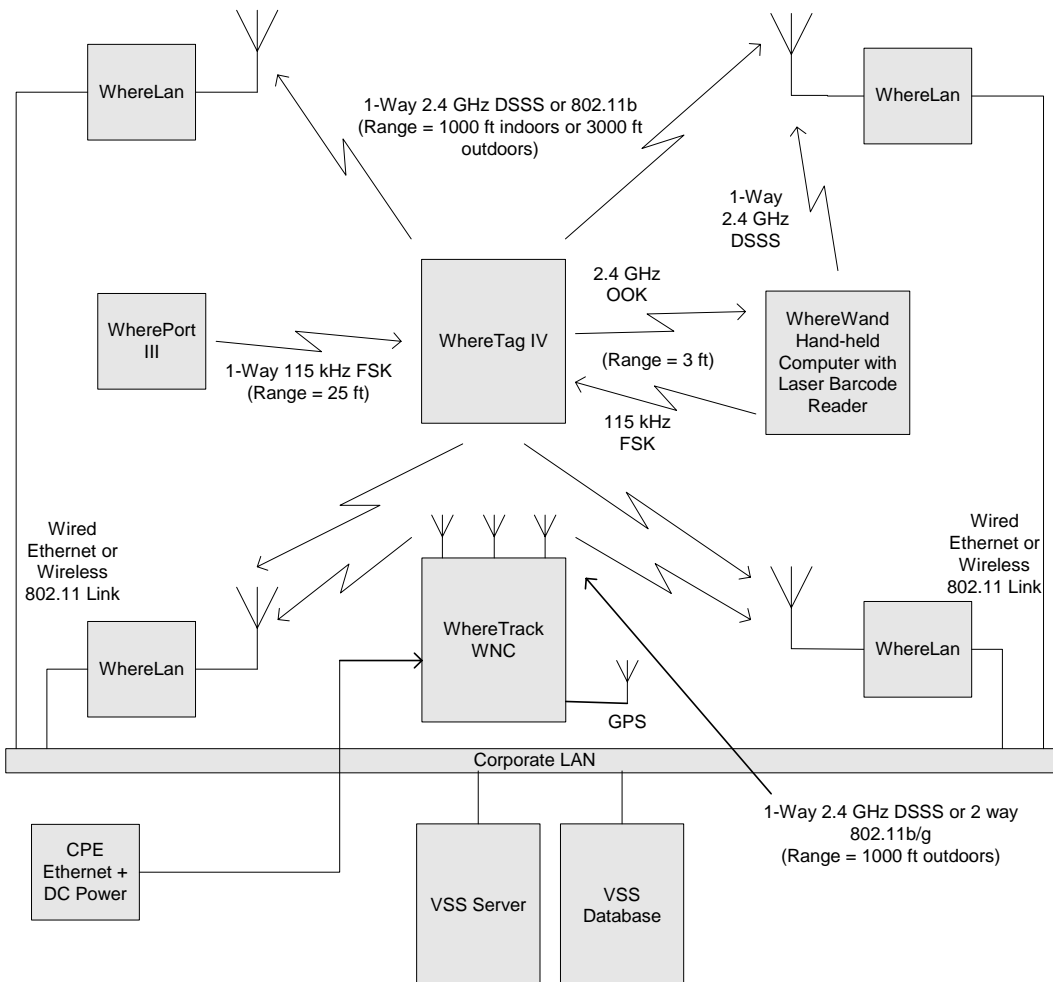
Introduction

System overview

The WhereNet Real Time Locating System (RTLS) is designed to permit users to determine the position of tagged assets in both indoor and outdoor facilities such as factories and freight yards. The system locates tagged assets by a process involving redundant triangulation. Each tag autonomously emits a 2.4 GHz direct sequence spread spectrum (DSSS) radio signal at predetermined blink rate. Each tag's blink rate is randomized around its predetermined value to minimize the number of collisions between transmissions made by different tags. The signal emitted by the tag is received by a minimum of four Location Antennas. A typical transmission contains a preamble which is used to synchronize the receiver, the tag's serial number which identifies the tag, a status word which monitors various tag functions, data stored in the tag's memory and finally a CRC used to assure that the tag's message is correct as received.

A WhereTrack or WNC unit may be utilized as part of the RTLS to locate yard vehicles, back haul GPS and telemetry information from the CPE and also offers WiFi communication capability.

Figure 1: WhereNet Real Time Locating System Block Diagram



WhereTrack WNC Unit



The WhereTrack is a custom WhereNet product that supports 802.11b/g WiFi, GPS, and the WhereNet Real Time Locating System (RTLS). It is a medium sized device that can be attached to a variety of CPE such as UTRs, RTGs, FELs, STs and SGs. A PACECO PTIU is generally, but not always, also installed on the CPE. If the CPE has a PTIU, the WNC connects to the PTIU via Ethernet and forwards the PTIU telemetry information to the RTLS through tag transmissions and provides WiFi back haul connectivity. Some CPEs, such as Quay Cranes, may not require a PTIU, but may still require a WNC unit. In this case, the WNC provides the function of periodic GPS and RTLS location reporting.

The PTIU is a custom Paceco product that supports a number of digital and analog ports. The PTIU is installed on a variety of CHE. It's primary function is to detect the state of sensors, to determine container transition events, and to report these to the WhereNet MTS SW stack. The PTIU generally connects to sensor signals already available on the CHE as well as a variety of new sensors installed on the CHE. In some cases, the PTIU also connects to the CHE PLC in order to obtain the sensor data it requires.

The WNC contains the functionality of 4 internal STHO WhereTags that can be set to "blink" an RF transmission at pre-programmed rates ranging from 0.5 seconds to one hour between blinks. The WhereNet RTLS infrastructure receives these blinks and use sophisticated Differential Time of Arrival, (DTOA), algorithms to determine the location of the tag. Accuracy of this determined location can be as low as 2 meters and is nominally within 3 meters in most installations. The tag blink data field can also include the GPS locate information as well as other telemetry information that is connected to the WNC from the CPE. The WNC is also assigned an individual MAC address.



The WhereTrack complies with the ISO 24730-2 RTLS standard and IEEE 802.11b/g standards. It operates in the globally accepted 2.4GHz frequency band and transmits spread spectrum and WLAN signals in accordance with these standards. The use of direct sequence spread spectrum technology provides extremely long range; in excess of 1,000 meter locate range outdoors, and 300 meter locate range indoors.

The WhereTrack device is powered by a 12 to 24V DC input at 12W maximum via a customer supplied input cable (or cables) which may also supply telemetry or programming information.

Designed to operate in a wide range of outdoor applications, the WNC is fully sealed and rated to IP67 to handle harsh weather environments. The unit's construction is also resistant to oils, solvents and hydraulic fluids.

WhereLan Location Sensor (LOS) and Location Access Point (LAP)

The Location Sensor and Locating Access Point receive the tag transmissions and forwards the information to the WhereNet Visibility Server Software which performs locations calculations, database functions and systems management. The Location Sensors and Locating Access Points communicate with each other and the Visibility Server Software via standard wired Ethernet cables or an 802.11b-compliant wireless LAN. Utilizing sophisticated DSP technology, the LOS and LAP are able to track large populations of WhereTags including those from a WhereTrack unit simultaneously. They can be installed in a grid configuration to provide ubiquitous coverage over large areas comprised of many cells. The Locating Access Point combines multiple functions: an RTLS Location Sensor and a Wi-Fi certified access point for wireless LAN clients and applications

Visibility Server Software (VSS)

WhereNet's Visibility Server Software (VSS) is an integrated software package that provides all the tools required to effectively manage assets and resources as well as the WhereNet Real-Time Locating System (RTLS). Visibility provides all core software components to allow efficient resource management. Key among those software components is WhereSoft Locate, which is a distributed Windows Service. When WhereSoft Locate is combined with Visibility and any of the many applications available from WhereNet, it is possible to locate assets, know their status, and react to any number of user configurable alert conditions. Visibility also provides the tools required to control and monitor the Real-Time Location System (RTLS). It includes configuration tools, diagnostics, system alerts, an interface manager and installation tools.

Laptop Computer

A laptop computer can be used to monitor and configure the WNC settings. This can be accomplished with a serial connection from a WNC data cable to the computer. A Hyper terminal session can be used to see that the WNC unit boots correctly and to access the WNC main menu. From the main menu, configuration settings can be set, diagnostic checks can be made, and internal tag commands can be utilized.

WhereTrack Installation and Operation

WNC units are shipped with all radio emitters deactivated. After installing a WNC to a vehicle to be tracked, the unit must be activated. This is done using the Ethernet cable serial connection from a computer to the WNC unit along with DC power. A computer can be used to configure and activate the internal tag functionality, 802.11b/g transceiver, and verify the GPS receiver function. A WhereNet LAP can be utilized to verify the functionality of the internal tag transmissions and 802.11b/g communications.

WhereTrack Configuration Diagram

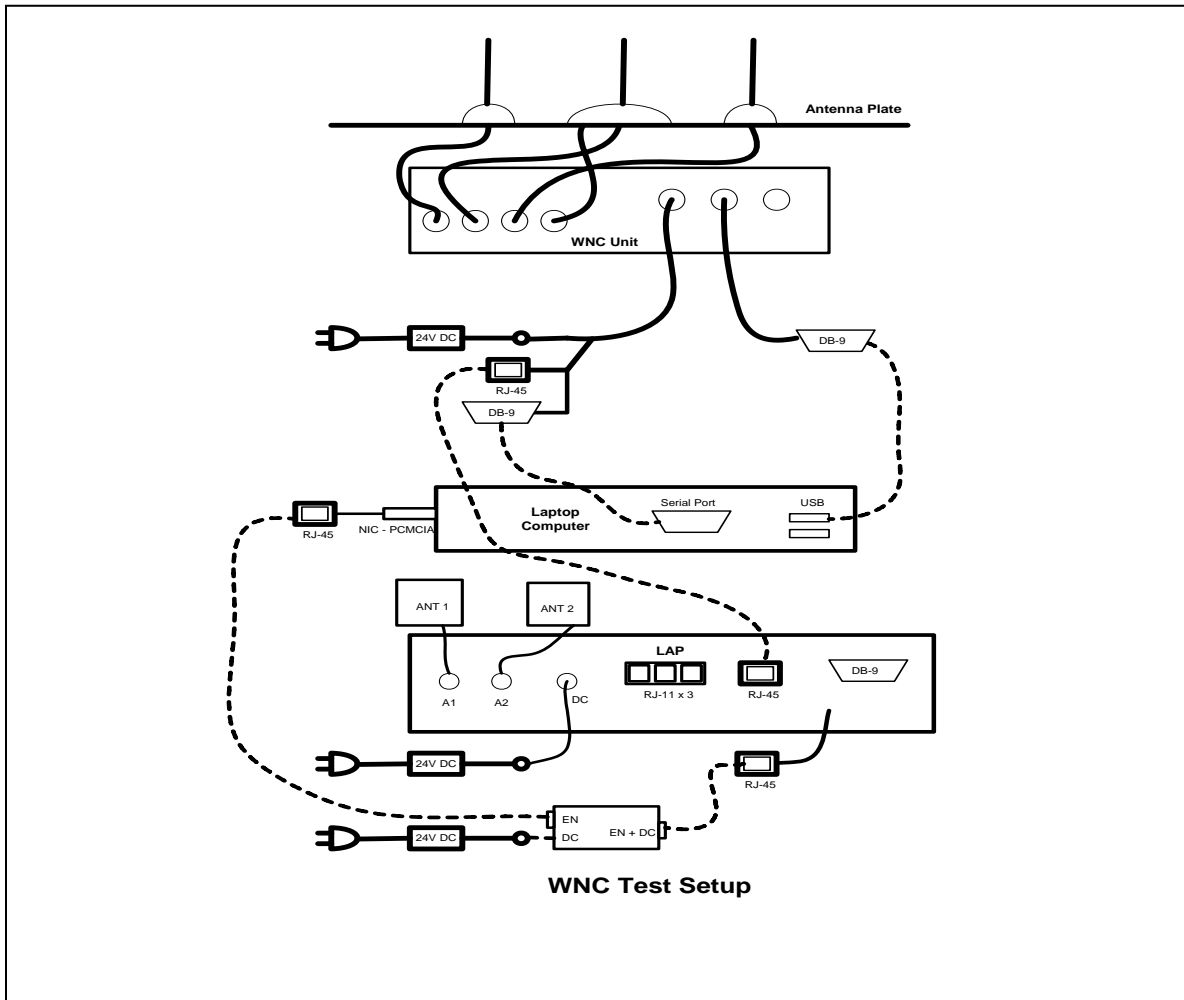
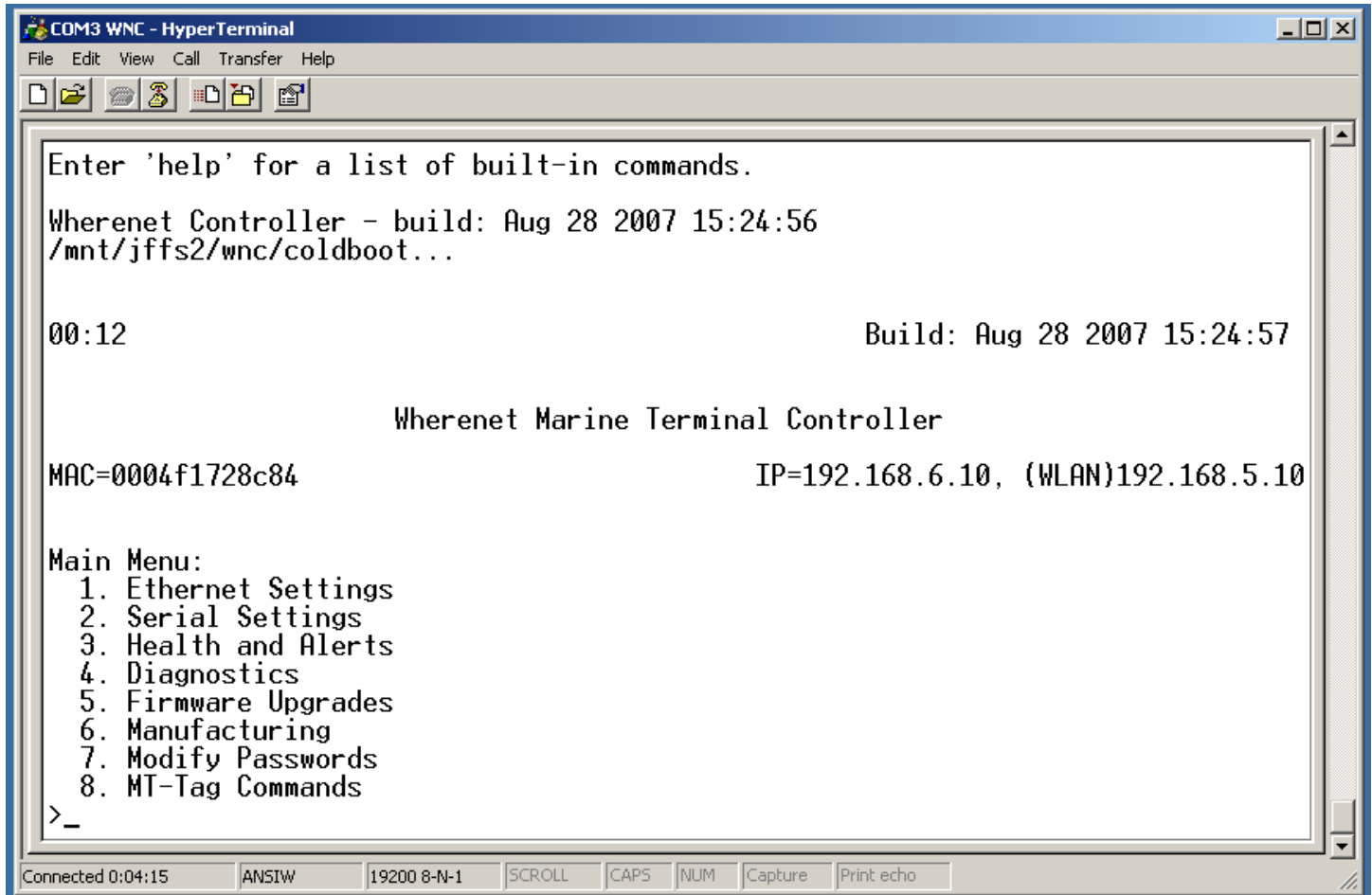


Figure 2

WNC Software Configuration

The WNC unit can be configured by using a hyperterminal window on a laptop computer's serial connection. Once DC power is applied to the WNC unit, it executes a software boot sequence which ends at the WNC main menu screen.



```
COM3 WNC - HyperTerminal
File Edit View Call Transfer Help
[Icons]
Enter 'help' for a list of built-in commands.
Wherenet Controller - build: Aug 28 2007 15:24:56
/mnt/jffs2/wnc/coldboot...

00:12                                     Build: Aug 28 2007 15:24:57

                Wherenet Marine Terminal Controller

MAC=0004f1728c84                         IP=192.168.6.10, (WLAN)192.168.5.10

Main Menu:
 1. Ethernet Settings
 2. Serial Settings
 3. Health and Alerts
 4. Diagnostics
 5. Firmware Upgrades
 6. Manufacturing
 7. Modify Passwords
 8. MT-Tag Commands
>_

Connected 0:04:15  ANSIW  19200 8-N-1  SCROLL  CAPS  NUM  Capture  Print echo
```

From this menu, the WNC can change Ethernet or Serial settings, set health alerts, access diagnostics, upgrade the WNC firmware, and also control the embedded tag settings.

GPS Master Station

The vast majority of new units will require WhereNet to provide DGPS for the CHE location reporting. This will be accomplished by the use of a GPS reference receiver or “master station”, whose function is to provide GPS correction data. The baseline architecture will be inverse DGPS, but the system will be able to support forward DGPS as well.

The GPS Master Station is installed on-site at a location that presents a clear view of the sky for optimum reception of the GPS satellites. It is envisioned that this will generally be possible by placing the GPS Master Station on the roof-top of a building in the facility.

The GPS Master Station is critical to the operation of the GPS solution. It will consist of a pair of GPS units and will require the customer to provide DC power derived from redundant DC power supplies whose AC input is backed up by UPS.

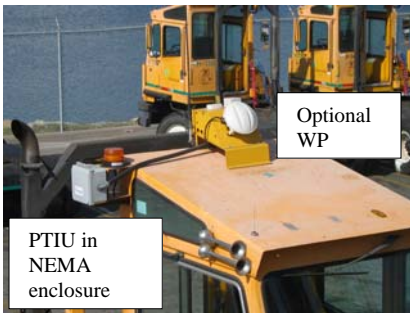
WhereNet has completed preliminary testing of the quality of UTR GPS locates in a Marine Terminal environment. While not conclusive, the tests indicate that the GPS will be the predominant source of locates over a large area of the sites, with RTLS locates being used primarily to augment GPS as necessary, such as along the Berth.

WNC CHE Installations

This section highlights how the WhereTrack WNC and PTIU are integrated onto the various CHE.

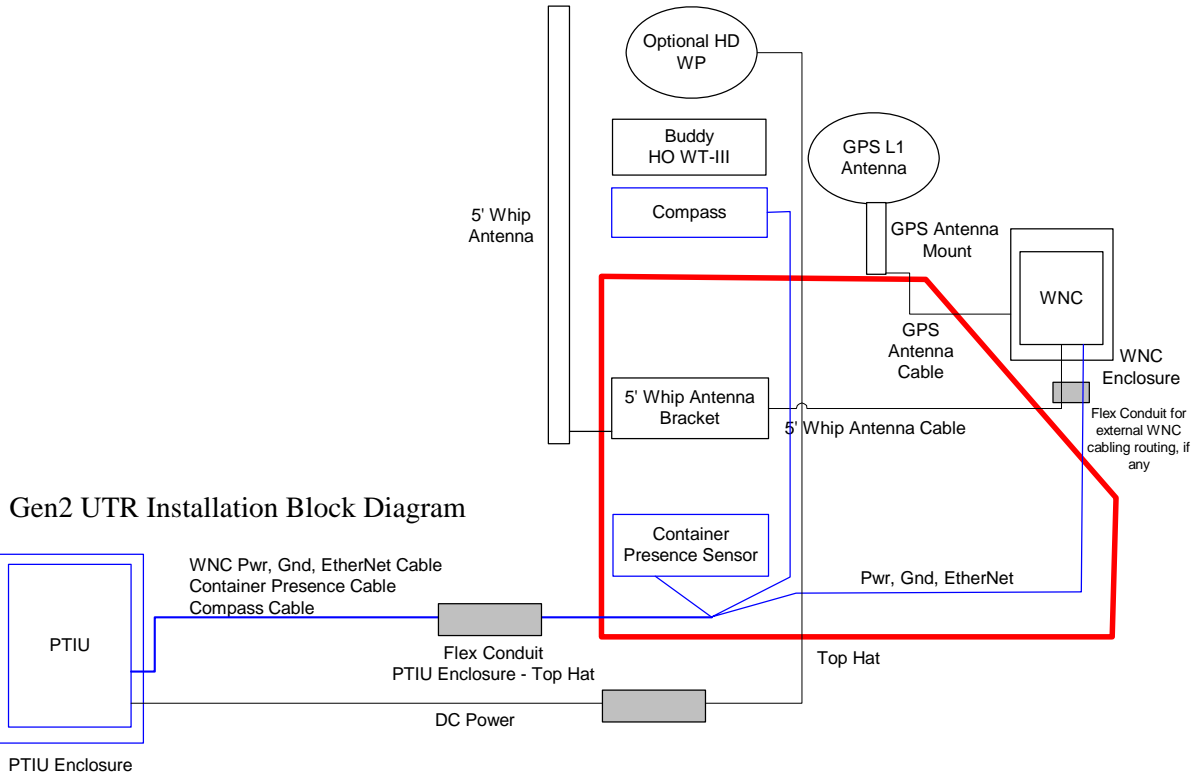
UTR

A UTR is a 'utility tractor' or 'yard truck' designed to connect or 'latch' onto chassis or bomb carts. Containers are placed and removed from these chassis or bomb carts. A sample UTR is shown in the adjacent photo. Two UTR manufacturers, Capacity and Ottawa (owned by Kalmar) capture the majority of the US UTR market. Variations among manufacturers and specific models exist and their impact on the specific installation of the WNC, PTIU, and sensors are the responsibility of the customer. The PTIU is housed inside a NEMA enclosure that is installed on the back side of the unit. The UTR configuration almost universally includes the use of so called 'Top Hat' that is installed over the roof of the UTR. The top hat houses an ultra sonic sensor, a compass, an STHO WhereTag with an external 5' whip antenna, and an optional WherePort. It is shown in the following photos.



In a new Gen2 installation, a UTR will no longer have a separate STHO WhereTag, as its function will be performed by the WNC. In addition, PACECO and WhereNet will investigate the use of alternate sensors on the UTR, including the current ultra sonic sensor and compass. The ultra sonic sensor may be replaced by a different type of sensor, or a different model of ultra sonic sensor, or it may be kept intact. The compass will be replaced by a similar unit but less expensive unit.

A block diagram of the components and connectivity of the Gen2 hardware is shown below.



Note: No cable needed for WNC RS422 debug port. Accessible at UTR roof top.

- Provided by PACECO
- Provided by WhereNet
- Provided by Customer

RTG/Transtainer

An RTG is a large CHE that can create large container stacks and deliver and receive container to and from UTRs and over-the-road trucks. RTGs vary from 50' to 100' in overall height, depending upon the make/model. Sample RTGs are shown in the following photos.

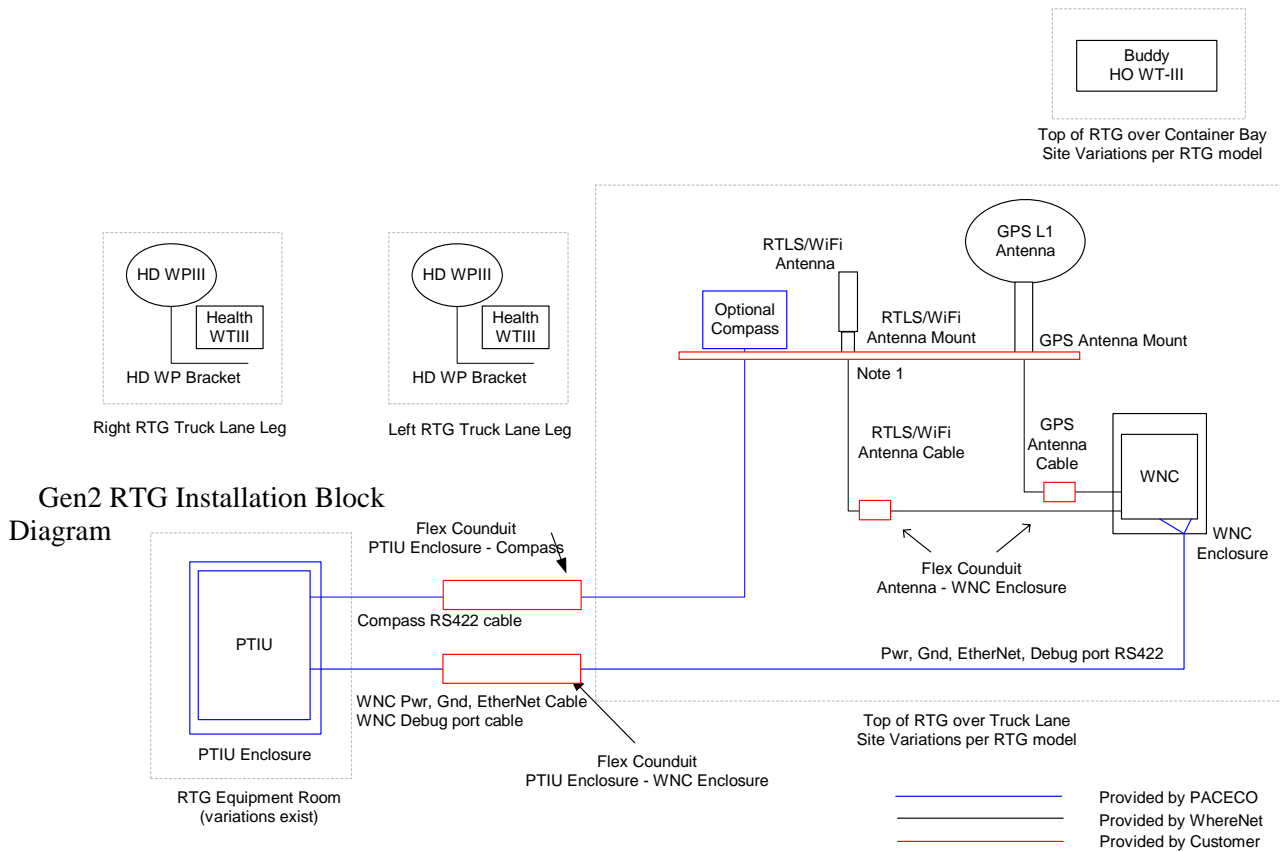


Variations among RTG manufacturers and specific models exist and their impact on the specific installation of the WNC, PTIU, and sensors are the responsibility of the customer.

The PTIU is housed inside a NEMA enclosure that is usually installed in the equipment room of the RTG. The PTIU generally connects to the RTG PLC in order to obtain the necessary telemetry data. In some cases, PACECO has installed sensors in lieu of the PLC interface. The Gen1 WhereNet products on an RTG are: one STHO WhereTag, one buddy WTIII, two hardened WPs, two rugged WP mounts, and two WP health tags. In a Gen2 configuration, the STHO WhereTag is deleted and a WNC is added. In addition, a compass is also added if the site has no RTLS coverage along RTG runs.



A block diagram of the components and connectivity of the Gen2 hardware is shown below.



Note 1: CFE antenna attachment (brackets, unistruts, etc) needed to elevate antennas above metallic obstructions at the top of RTG
 Note 2: PTIU-RTG PLC EtherNet connection via WNC not recommended. Use hub in equipment room.

FEL

A FEL is a large CHE that can create large container stacks and deliver and receive container to and from UTRs and over-the-road trucks. FELs vary greatly in design, depending upon the make/model. Some FELs are designed to pick up empty containers ('Side Handlers'), and some are designed to pick up loaded containers ("Top Handlers"). Sample FELs are limited to stacks of containers up to 5-high, whereas others can work with 6-high and 7-high container stacks. Sample FELs are shown below.

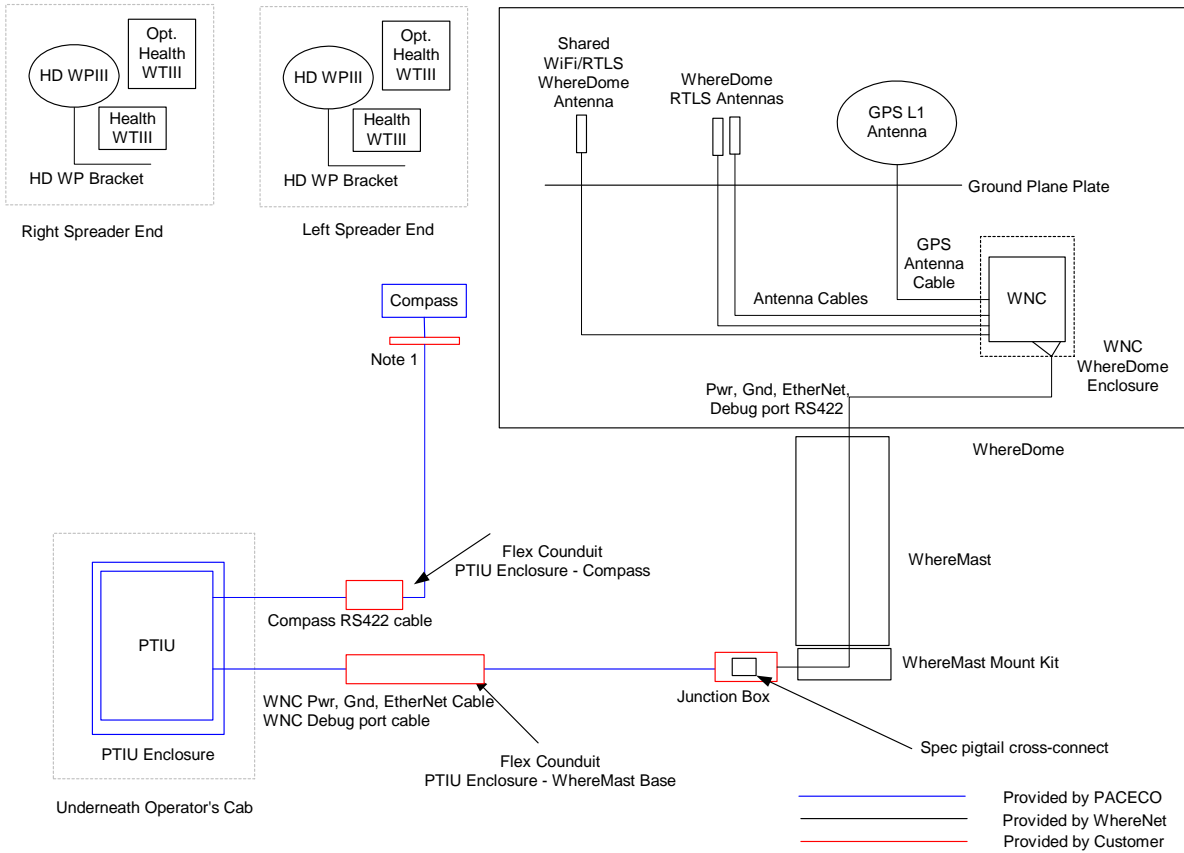


Variations among FEL manufacturers and specific models exist and their impact on the specific installation of the WNC, PTIU, and sensors are the responsibility of the customer.

The PTIU is housed inside a NEMA enclosure that is usually installed in the space underneath the FEL operator's cab. To date, the PTIU generally does not connect to the FEL (Top Handler) PLC in order to obtain the necessary telemetry data. Generally, the PTIU 'taps' onto existing sensor or new sensors are installed in lieu of a direct PLC interface. The Gen1 WhereNet products on an FEL are: one WhereMast and mount, one WhereDome with cabling, two hardened WPs, two rugged WP mounts, and two WP health tags. In a Gen2 configuration, the individual STHOs housed inside the WhereDome obsoleted. The WhereDome instead houses the WNC, GPS antenna, and RTLS/WiFi antennas. It is anticipated that the WNC will be housed in an enclosure different from the use used one UTRs/RTGs/etc due to the specific constraints of the WhereMast/WhereDome dimensions.

In the Gen1 solution, the WhereDome also houses the digital compass, which is provided by PACECO. For the Gen2 solution, PACECO and WhereNet will determine whether the compass can instead be installed elsewhere on the FEL, such as on the rooftop of the operator's cab.

A block diagram of the components and connectivity of the Gen2 hardware is shown below. For planning purposes, the FEL compass is shown as being installed outside the WhereDome/WhereMast.



Note 1: Compass may be mounted on roof top of FEL cab pending performance test results.

Gen2 FEL Installation Block Diagram

SC and ST

SCs and STs are CHE used by so called ‘straddle’ operators. Straddle container stacks are different than FEL/RTG stacks in that containers are not placed immediately adjacent to one another. They are stacked from 2-high or 3-high creating long rows of containers separated from each other by about 7’. An SC and an ST are shown in the following photo.



SC

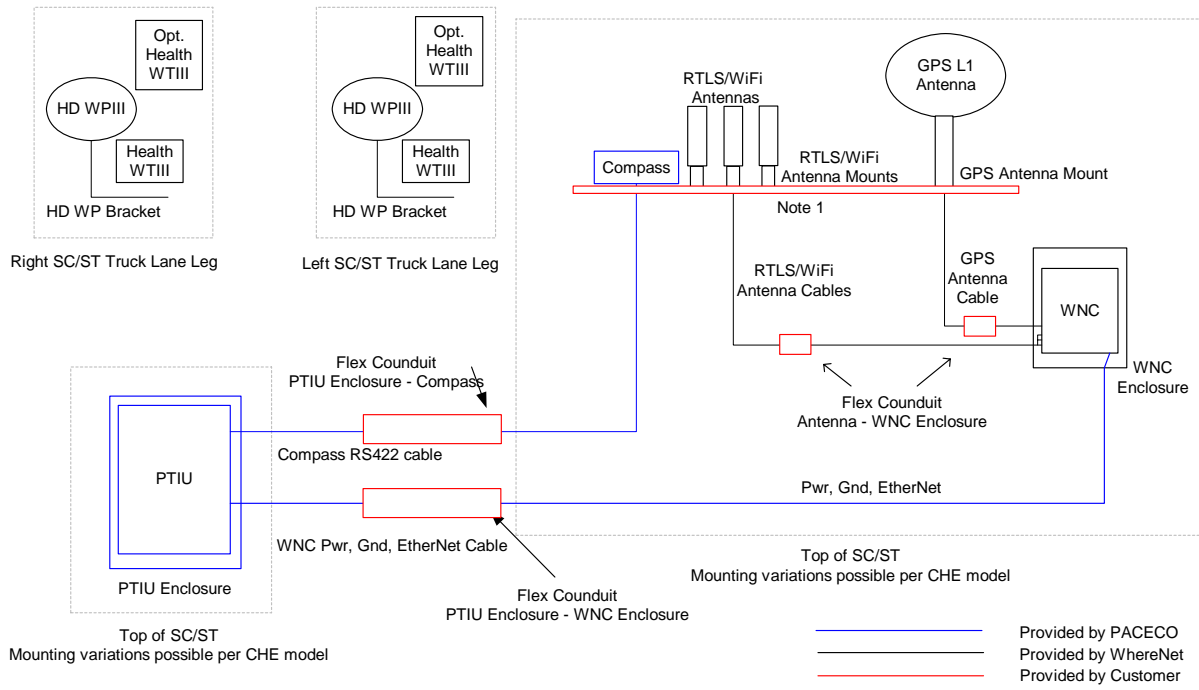


ST

Neither WhereNet nor PACECO have installed any equipment (yet) on an SC/ST. The installation, however, is expected to be straightforward. The PTIU and WNC will be installed at the top of the SC/ST. It will most likely be necessary to raise the WNC’s GPS antenna, WiFi/RTLS antennas, and compass relative to the possible point of installation of the WNC enclosure. As in the case of the RTG, the necessary brackets to do this will be the responsibility of the customer.

A block diagram of the components and connectivity of the Gen2 hardware is shown below.

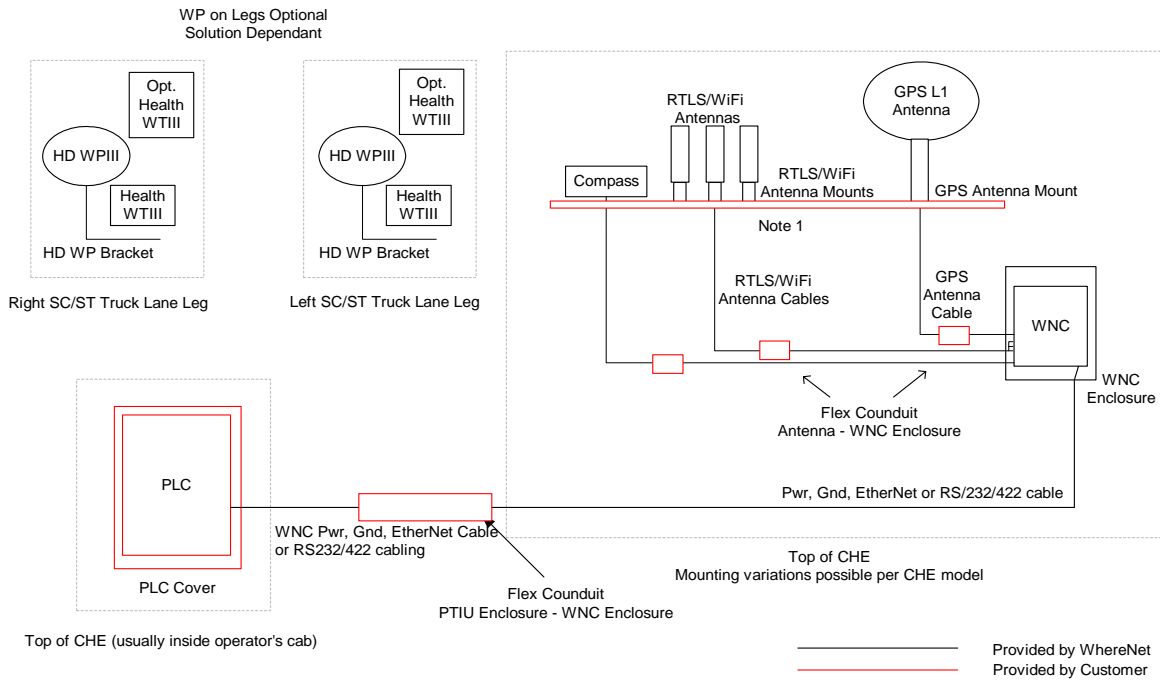
WP on Legs Optional
Solution Dependant



- Note 1: CFE antenna attachment (brackets, unistruts, etc) needed to elevate antennas above metallic obstructions at the top of CHE
- Note 2: CFE compass attachment (flat surface!) needed at TBD compass mounting location at top of CHE.
- Note 3: PTIU-RTG EtherNet connection via WNC makes viable. CHE PLC is housed in vehicle cab near top of CHE.

Gen2 SC/ST Installation Block Diagram, PTIU

WhereNet is currently looking to establish an OEM or partnership agreements with one or more CHE manufacturers. These discussions are at their earliest stages. However, it is anticipated that it may be possible to connect the WNC directly to the SC/ST PLC, instead of the PTIU. For planning purposes, the following block diagram shows the corresponding components and connectivity. It should be noted that, in this configuration, the WNC will likely need to interface to a compass.

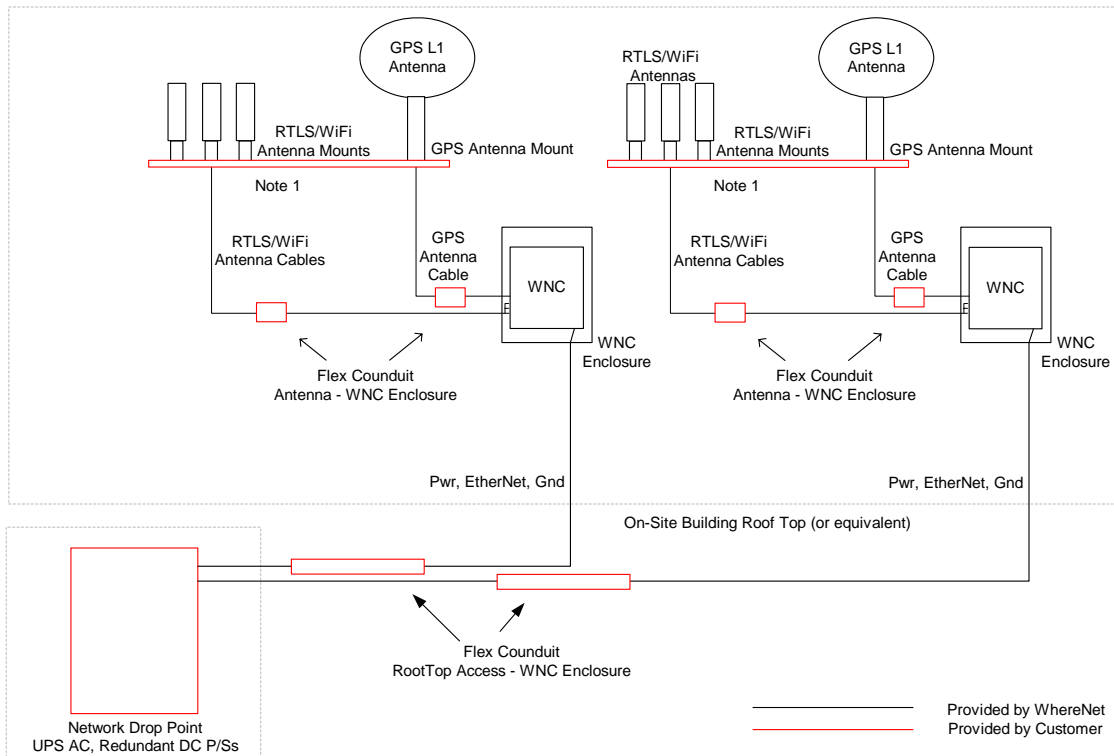


Note 1: CFE antenna attachment (brackets, unistruts, etc) needed to elevate antennas above metallic obstructions at the top of CHE
 Note 2: CFE compass attachment (flat surface!) needed at TBD compass mounting location at top of CHE.
 Note 3: WhereNet is attempting to establish OEM relationships with various CHE manufacturers. The plan would be to connect directly to the CHE PLC. The connection details are NOT known. It is expected that the connection would be RS232/422 serial or over EtherNet. Protocol/messaging is 100% TBD.

Gen2 SC/ST Installation Block Diagram, PLC Connect

GPS Master Station

The following diagram shows the components and connectivity of the Master Station installation.

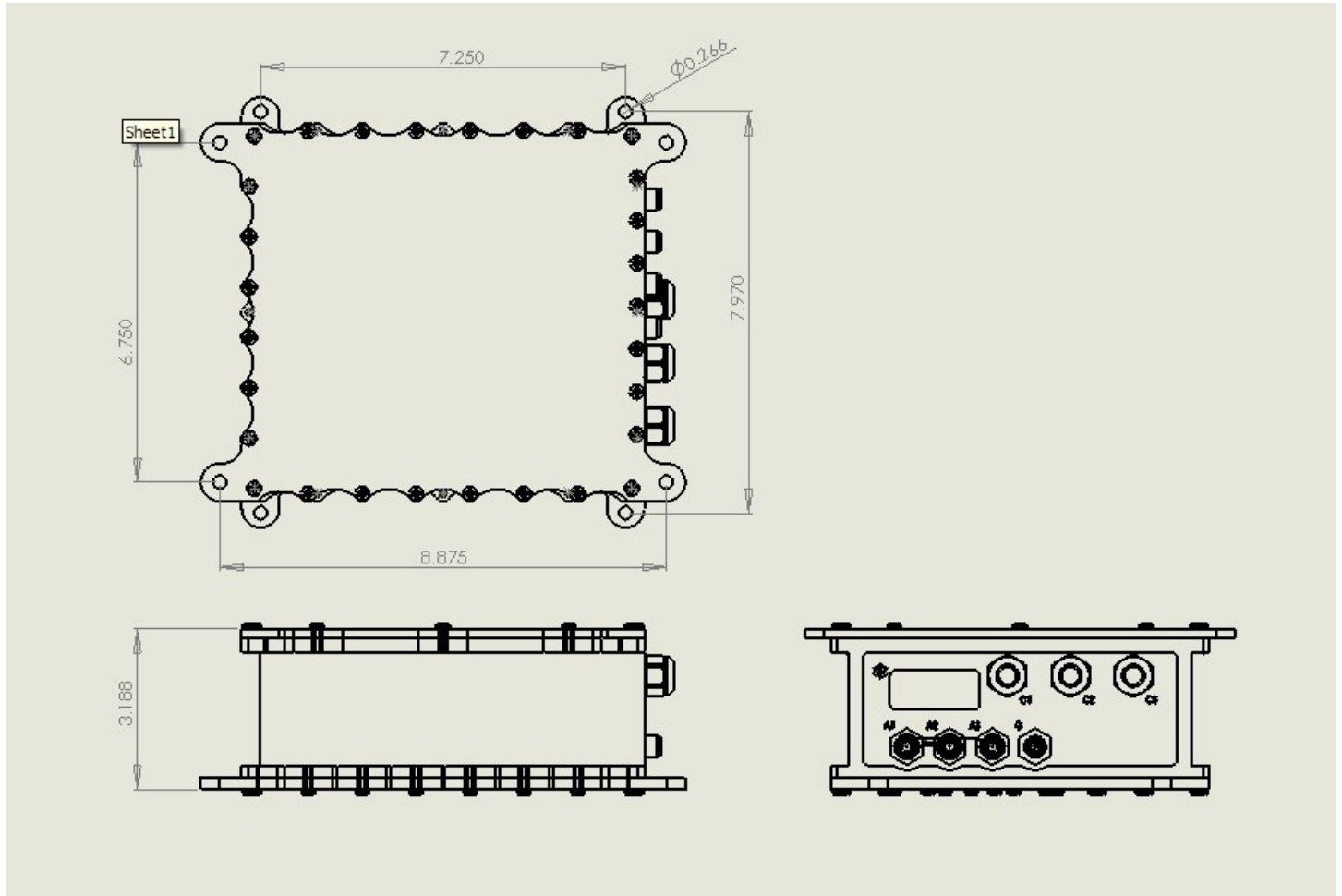


Note 1: CFE antenna attachment (brackets, unistruts, etc) needed to elevate antennas above metallic obstructions at installation point.

Gen2 GPS Master Station Installation Block Diagram

WNC Mounting Options

The mounting of the WNC unit will depend on the specific application for the WNC. Please refer to the installation instructions for each particular application for specific instructions. Below is an outline drawing of the WNC that details the mounting hole locations.





Specifications (Subject to change without notice)

WhereTrack (Model #: WTK-5000-00AA)

CAPABILITIES

Frequency Range 2.4 to 2.4972 GHz
 Typical Locate/Data Range..... 1,000 m (3200 ft)
 Typical 802.11b/g Range 1,000 m (3200 ft)
 User Configurable Blink Rate..... 0.5 sec to 5 days
 GPS Locate Accuracy..... TBD

WNC MOUNTING OPTONS

Mounting method varies depending on application
 - FEL mounting plate
 - Top Hat box

ELECTRICAL

Power 12V to 24V DC at 1A max.
 Data Input.....EtherNet (CAT-5): RS232, RS485, 10/100BT

ENVIRONMENTAL / PHYSICAL

Operating Temperature Range -40° C to +60° C (-40° F to +140° F)
 Storage Temperature Range..... -40° C to +85° C (-40° F to +185° F)
 Durability TBD drop to concrete
 Height, without antenna plate 8.2 cm (3.2 in)
 Length, including mounting tabs 24.2 cm (9.5 in)
 Width, including mounting tabs..... 21.6 cm (8.5 in)
 Weight..... TBD
 Environmental Sealing..... IP67 (dust tight, immersible)
 Case Material Aluminum Housing

REGULATORY APPROVALS

FCC Part 15 Class B, FCC Part 15.247, IC RS210, Electrical Safety IEC 60950-1, EMC EN301489-1/-17, EN 3000328, Electrical Safety EN 60950-1