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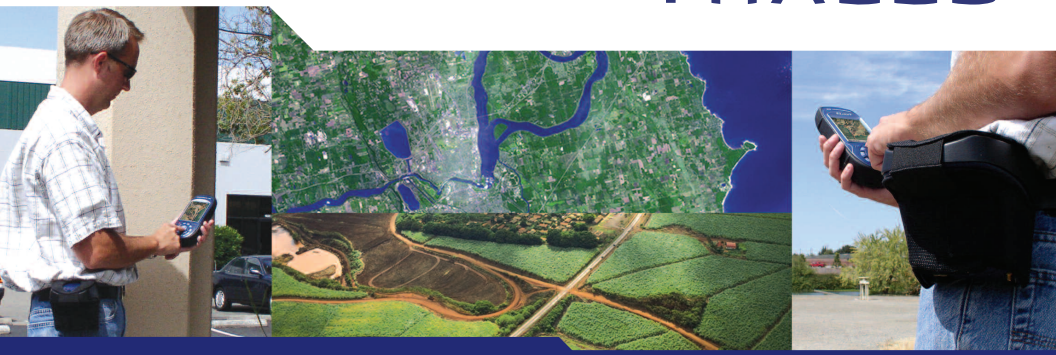

MobileMapper™ Beacon

USER MANUAL

FCC Notice

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.

CE

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Preface

Welcome to the Thales MobileMapper™ Beacon User Manual and thank you for buying this high-performance, belt-mounted DGPS system. This product is an accessory to the MobileMapper and MobileMapper CE handheld GPS/GIS data collection systems. The purpose of the MobileMapper Beacon system is to receive accuracy-enhancing corrections from Coast Guard beacon networks.

Coast Guard differential GPS beacons have been installed throughout many locations in the world, and send GPS corrections to users in order to improve GPS accuracy and integrity, using a medium frequency signal. This service facilitates the Coast Guard requirements to provide a safe navigation and position service to its users. Over the last many years, Coast Guard beacons have been used to great success by terrestrial users. In fact, a program is currently in place to provide dual redundant coverage of beacons throughout the continental United States for a variety of land-based uses.

GPS corrections received by the MobileMapper Beacon are transmitted to the GPS data collection system using Bluetooth® (1) wireless technology.

(1) The Bluetooth® trademark and logos are owned by Bluetooth SIG, Inc. and any use of such marks by Thales is under license. Other trademarks and trade names are those of their respective owners.

The MobileMapper Beacon may also be used with 3rd-party GPS systems that accept RTCM SC-104 corrections via a Bluetooth or traditional hard-wired serial connection.

The following figure shows the MobileMapper Beacon system.

We have written this document to assist you with learning how to use the MobileMapper Beacon system, how it operates with GPS equipment, and provide some general information on Coast Guard beacon technology.

Key Features

- Fully integrated Coast Guard beacon receiver and antenna
- All-day battery life using either four alkaline, 1.5-V Lithium or NiMH rechargeable AA-type batteries
- Integrated Bluetooth wireless technology for communications with the MobileMapper CE
- Convenient belt-mounted carrying system
- User interface includes a power button and status lights
- Conventional hard-wired serial port for communication with other GPS equipment via a cable with standard DB9 connector.

Introduction

Note - Though the MobileMapper Beacon is primarily intended for use with our MobileMapper and MobileMapper CE GPS/ GIS data collections systems, it may be used with any GPS system that support RTCM-based real-time differential corrections. In order to connect to other devices, you will need to ensure the GPS supports either Bluetooth wireless technology or an RS-232 serial port.

The Thales MobileMapper Beacon system is an accessory to the Thales MobileMapper CE GPS data collection system. The MobileMapper Beacon is a self-contained, Coast Guard beacon receiver system. It features an internal beacon receiver and magnetic field beacon antenna, wireless communications, and a compartment for 4 AA batteries.

The following figure illustrates the use of the MobileMapper Beacon.

Receiving Your Shipment

If you find that any of the items are damaged due to shipment, please contact the freight carrier immediately for assistance. If you find that the system is incomplete for some reason, please contact your point of sale for assistance.

MobileMapper Beacon System

Each MobileMapper Beacon system is composed of:

- MobileMapper Beacon Coast Guard beacon receiver unit
- 4 AA Batteries
- Belt-mounted carrying system
- 1 battery clip for easy loading of batteries
- Warranty card
- User Manual
- A PC-interface cable for serial communications.

Using the MobileMapper Beacon

User Interface

The MobileMapper Beacon user interface is located on the top of the unit. This interface consists of a power button and three lights. A red light next to the power button indicates the unit is on. A green light comes on once the unit has locked onto a DGPS transmitter with a signal-to-noise ratio greater than seven and is sending the corrections to the GPS receiver. A blue light next to the Bluetooth symbol is illuminated when the unit is sending the corrections to the GPS receiver via the Bluetooth connection.

The following picture shows the status lights and power button located on the top surface of the product. Please note the power button and indicator lights are visible through a cut-out located on the top of the pouch, supplied with the system.

The following table provides detail regarding the status lights.

LED	Color	Function
	Red	Power indicator - when the MobileMapper Beacon is powered, this LED will solidly illuminate. Note: This LED does not have a label, but is connected to the Power Button to indicate what it is for.
	Blue	Bluetooth indicator - this LED will illuminate when there is a Bluetooth connection between the MobileMapper Beacon and a Bluetooth compatible device and off when there is no Bluetooth connection.
	Green	Beacon lock indicator - this indicator will illuminate continuously when the MobileMapper Beacon has achieved a solid beacon lock with an SNR (signal to noise ratio) of greater than 7.

Powering the MobileMapper Beacon

This product is intended for use with regular 1.5-V, rechargeable and non-rechargeable, AA batteries. Do NOT use higher voltage batteries (including 3.6V Li-SOCl2 AA cells) as these will cause damage to the unit.

The MobileMapper Beacon system includes four AA alkaline batteries for power. You may alternatively use four 1.5-V Lithium batteries (such as the Energizer® e² Lithium) or four NiMH (nickel metal hydride) rechargeable batteries, as long as you do not mix battery types.

NiMH batteries, being rechargeable, offer economy but if you are going to work in cold weather, you should be aware that the charge capacity of NiMH technology decreases with falling temperatures.

Please also keep in mind that if you use NiMH batteries, they need to be freshly charged before use if they are been stored for a long period of time.

Although you may load individual batteries into the MobileMapper Beacon, the system includes two battery clips to ease battery loading. You may insert four AA batteries into each of the clips, drop one clip into the battery compartment and store the spare clip in the mesh pouch on the side of the belt-mounted carrying system.

The easiest way to insert batteries into a clip is by sliding them up from under the clip. There are some moulded stops designed for the proper alignment of the batteries in the clip. This ensures that the battery terminals make the proper contact when the compartment door is fastened to the unit.

It is important to insert the batteries into the clip with alternating polarity. A fully loaded clip is shown below.

As shown on this photo, the polarity of the batteries is positive, negative, positive, negative. You can easily slide the batteries up and into the clip.

The battery clips are also marked with plus and minus signs to indicate the polarity of the batteries. If you use batteries without polarity markings, just remember that the flat end is negative and the end with the raised knob is positive.

It is not necessary to remove the MobileMapper Beacon from the belt-mounted carrying system in order to open the battery compartment. Just unscrew the knurled silver knob until you feel the compartment door come loose and pull the door away from the unit.

You will find that the fastener disengages and 'pops' toward you. You can then use the fastener to open the door.

At this point, you may load either four individual batteries into the MobileMapper Beacon, or load the batteries into the clip and insert the clip assembly into the battery compartment. The battery clip easily inserts into the compartment.

To secure the battery compartment door, slide it into place.

Now gently push the door down until the gasket engages.

Pressing the door down, screw the knurled knob into the unit assuring a good seal.

Warning *- Please use only batteries of the same type. Do not mix alkaline batteries with 1.5-V Lithium or NiMH batteries. Please do not mix batteries of different charge levels. This can cause the batteries to fail, causing damage to you or the MobileMapper Beacon.*

Powering the MobileMapper Beacon

To turn on the MobileMapper Beacon, press the black, recessed power button on the top of the unit as seen in the photographs below. When powered, the red LED light turns on.

When the MobileMapper Beacon is turned off, it still draws a small amount of current from the batteries. If you will not use the receiver for a number of weeks, you may wish to remove the batteries so they do not lose their charge. You may place the batteries in the belt-mounted carrying system so you know to place them back in the receiver prior to use.

Belt-mounting

The MobileMapper Beacon is designed to mount easily onto a belt using the included carrying system. You may alternatively carry the Beacon in a backpack or mount it on a range pole in some fashion. Wherever you carry the MobileMapper Beacon, please be sure to separate it from your GPS receiver or any other electronic device (cell phone, PDA, etc.) by at least 75 centimeters (30 inches) to prevent radio interference. You should also keep the top of the Beacon horizontal to optimize signal reception. This is easy to do if you place the Beacon on your belt on the hip opposite to the hand you use to carry your MobileMapper or MobileMapper CE receiver. For example, if you will carry the GPS receiver in your left hand, place the MobileMapper Beacon on your right hip. Doing this keeps the Beacon away from the GPS receiver, it keeps the top horizontal and it allows you to check reception status by looking at the LEDs on the top of the unit.

The belt-mounted carrying system has an open bottom so you can easily access the battery compartment, use an external beacon antenna or attach a serial data cable to the unit without having to remove it from the carrying system.

Bluetooth Wireless Communications with MobileMapper CE

You can also use a serial data cable to communicate with the MobileMapper CE. The original (non-CE) MobileMapper receiver is not Bluetooth-enabled, and so you must use a cable link. This is available as an option.

The MobileMapper Beacon's primary method of communicating coast guard beacon corrections to the MobileMapper CE system is via an internal Bluetooth wireless communications module. This module is a license-free transceiver that may be used in majority of countries throughout the world, and operates at 2.4 GHz.

Bluetooth wireless communications is a convenient method to communicate between electronic devices, eliminating the need for you to connect a cable between the MobileMapper Beacon and the MobileMapper CE.

The MobileMapper Beacon contains a Power Class 1 Bluetooth enabled device that is capable of a maximum range of 100 m with another class 1 device. If you are communicating with another device that is a Power Class 2, your range will be limited to a maximum of 10 m.

As Bluetooth transmits and receives at 2.4 GHz, it is a line of sight system. This means that the MobileMapper Beacon and the receiving device require a line of sight between them in order to communicate. This is critical if you are using the two devices toward their maximum operating rate from each other. For example, you may use the MobileMapper CE away from a vehicle, with the MobileMapper Beacon sitting on the roof instead of wearing it. In this case, both devices must be able to 'see' each other and be within the range limit.

However, when operating the MobileMapper Beacon near the other device, such as the MobileMapper CE, you do not need a line of sight between the two products. In this case, reflected signals can be tracked off the ground with success.

Establishing a Bluetooth Connection

For details regarding the process of connecting to the MobileMapper Beacon system with the MobileMapper CE, consult the section below, "MobileMapper CE Bluetooth Manager."

When the MobileMapper CE has established a Bluetooth connection to the MobileMapper Beacon system, a blue LED will illuminate on the top of the MobileMapper Beacon. This blue LED is identified with the Bluetooth logo as shown in the following figure. A successful Bluetooth connection between these devices will be present as long as the blue LED light on the MobileMapper Beacon is on.

Note - The Bluetooth port will not be used for firmware updates; it is recommended you use the serial port for any software updates.

If you are using the MobileMapper Beacon system with an alternate GPS system that uses Bluetooth communications, please follow the instructions for that system on how to perform a Bluetooth discovery and make a connection to the MobileMapper Beacon system.

Serial Communications

The second method of communicating with the MobileMapper Beacon is through a traditional RS-232 serial port. When using a serial cable, you will not see the *Bluetooth* light illuminate; however, serial data will be downloading into the GPS system.

A PC-interface cable is supplied with the MobileMapper Beacon system for serial communications. This cable will be used for any firmware upgrade, if required, and for interconnection to GPS systems that do not support *Bluetooth* wireless communications.

On the bottom of the MobileMapper Beacon system, you will notice that beside the battery door, there is a rubber boot that covers a data socket. Written on this rubber boot is the word 'Data'. The round 7-pin connector of the PC-interface cable plugs into this socket. There is a white dot on both the socket and the 7-pin plug of the cable. To mate these connectors, align the two dots together and simply push the connector onto the socket. To remove the connector, you will need to squeeze the two locking clips on either side of the 7-pin connector of the cable.

When not using serial communications, please ensure that the rubber boot is pushed onto the data socket at all times. This will protect the connector from water and dust.

To attach the serial cable to the MobileMapper Beacon, line up the white dots on both connectors.

To remove the cable, squeeze the tabs on either side of the cable and gently pull it out.

In the event that you are connecting the MobileMapper Beacon to a non-Thales-branded GPS receiver, you may need to plug a gender changer and null modem adapter into the DB9 end of the Beacon's serial cable.

Using the optional serial cable (P/N 980816), it is easy to connect Thales MobileMapper to MobileMapper Beacon.

Serial Port Parameters

If you wish to use the MobileMapper Beacon with non-Thales GPS equipment without Bluetooth wireless technology, you may need to use conventional serial communications between the two systems. In this case, you will need to know the port settings of the MobileMapper Beacon, which follow:

- Baud Rate: 4800
- Data bits: 8
- Stop bits: 1
- Parity: None

Beacon Lock

When a signal from a coast guard beacon station has been acquired, the green lock indicator light will illuminate as shown below. If you are operating in a weak signal environment, or with sufficient environmental noise to cause interference with the signal, this light will either be intermittently illuminated or may not come on at all. We recommend that you trouble-shoot a no-lock condition by using the Differential GPS configuration tool supplied in the GPS Utilities folder of the MobileMapper CE or the standalone MobileMapper Beacon configuration utility that can be downloaded from ftp.thalesnavigation.com.

Using this tool, you can tune the Beacon to specific frequencies and coast guard beacon stations and monitor the current frequency or station being used and the resulting reception performance.

Knowing What Beacon Station To Use

Thales publishes a beacon listing that provides beacon station details around the world. Often, beacon site details change or new stations are added, so please check with your local Thales Navigation office for updates.

MobileMapper CE Bluetooth Manager

In order to use corrections from the MobileMapper Beacon, the MobileMapper CE's Bluetooth Manager must first be used to discover the Beacon product, and then establish a connection.

To access the *Bluetooth* Manager:

- Tap the Windows butterfly icon in the lower left of the MobileMapper CE screen with the stylus.
- Then access **Settings>Control Panel>BTManager**. The *Bluetooth* icon will appear in the system tray.

To turn the *Bluetooth* function on or off, you will need to tap on the *Bluetooth* icon. A window will pop up. From here, you will be able to turn this communications feature on or off. Ensure that your MobileMapper Beacon system is nearby and powered. When turned on, the *Bluetooth* Manager will proceed to initiate a discovery of nearby *Bluetooth*-capable systems. The results of this process are displayed below the on and off buttons.

To make sure that your MobileMapper CE handheld will automatically connect to the same MobileMapper Beacon device each time you turn on the system, in the context-sensitive menu tied to the chosen Bluetooth Serial Port, check **Auto Connect**.

When the discovery is complete, you should see the MobileMapper Beacon system displayed as 'MMBEACON xxxxx', where 'xxxxx' is the last five digits of the multimedia access code (MAC) address, indicated on the serial label of the MobileMapper Beacon system.

If you press the 'plus (+)' box beside the 'MMBEACON xxxxx' device, you will notice that the supported service is 'BLUETOOTHSERIAL'. Using the stylus, tap and hold on the service name. A menu will pop up and choose 'connect'.

In a few moments, you should see the *Bluetooth* indicator light on the MobileMapper Beacon illuminate. The MobileMapper CE will also indicate a *Bluetooth* connection.

Windows CE Configuration Utility

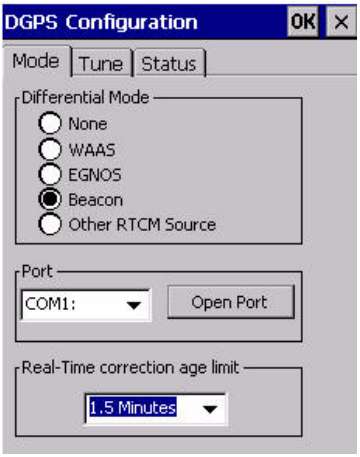
A standalone MobileMapper Beacon Configuration Utility is also available at ftp.thalesnavigation.com. *This tool allows you to tune the receiver and monitor the reception in Windows XP/2000 or Windows Mobile 2003 environment.*

As part of our MobileMapper CE GPS Utilities, we have a utility that allows you to modify the correction source used by the GPS. Within this interface, you will also have access to communicate with the MobileMapper Beacon system. This utility allows you to tune the receiver to a specific beacon by frequency or station name, and monitor the reception performance of the system as measured by the Signal to Noise Ratio (SNR).

Differential Mode

The following figure illustrates the differential GPS mode of operation. There are three choices from which you may choose. The first choice is to not use any corrections. The second, and default, is to use corrections from the internal WAAS / EGNOS demodulator.

To use the MobileMapper Beacon with the CE system, you must choose the **Beacon** option. This will instruct the MobileMapper CE system to 'look' for correction data incoming from a certain port. To use the beacon corrections, you must first establish a Bluetooth connection using the Bluetooth Manager discussed earlier.



Tuning the Beacon Frequency

There are two methods that you can use to tune the beacon receiver inside the MobileMapper Beacon. The first method is the default mode, which is automatic operation. The second mode is manual operation where you specify the frequency to which you want the receiver to tune.

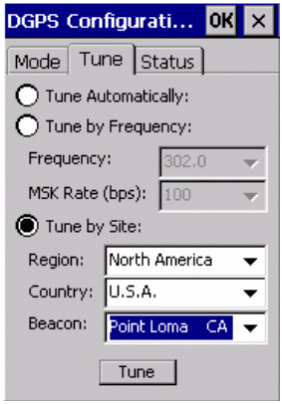
We recommend that you use automatic tuning when operating in an area where you are unsure of the stations available or their frequency details. If you know the station name or frequency, we recommend you tune the receiver manually. This way, you know for certain which station that is being used. Further, we recommend that you consistently use the same station for all your work in a particular region. This will ensure the best consistency of differentially-corrected position data. As you may know, errors seen at a GPS base station may not be the same as seen by your GPS receiver. Due to the difference between these errors, a bias can creep into the positioning solution. This is the nature of local area differential GPS. Using the same beacon station helps to ensure that your data is as consistent as possible.

If, for some reason, the beacon to which you want to tune is not operating, you will obviously need to use another station, if available. Beacon stations are reliable, but sometimes need to be maintained, or may be hit by lightning. Most beacon stations are designed so that most parts that could fail for one reason or another, are backed up by an identical, redundant piece of equipment. It's not often that a beacon will fail, and remain down, without redundant equipment taking over. You should follow up with your service provider (most often a Coast Guard, but sometimes a Port Authority) for details on a particular station.

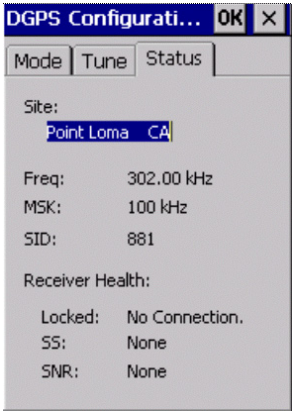
Our Configuration utility allows you to change the way that your beacon system is tuned. The following discussion describes how you may tune your system using this software tool.

Within the DGPS Configuration window, tap the 'Tune' tab at the top of the window. The following figure displays the content of the associated tab.

You will see that you're free to either tune by the frequency and MSK (data) rate of the station, or by station name, chosen by region, country, and beacon name.



The following window displays the content of the 'Status' tab. You will see in this window the current tuning settings, including the station name, frequency, but rate, and station ID. Below this information is the lock condition, signal strength (SS) measured in dBµV, and signal to noise ratio (SNR) measured in dB.



The following section provides guidance on evaluating reception quality, given a particular SNR.

Monitoring Reception Performance

Beacon reception performance is described by a signal to noise ratio (SNR) number. Essentially what this number indicates is how much the signal 'peaks' above the noise floor. A taller signal would mean better reception performance than a shorter signal above the noise floor. The SNR is measured in decibels (dB).

The following table describes reception performance based on the SNR indicator.

SNR	Receiver Description	Approximate Data Throughput
>25	Excellent	100% data throughput
20 to 25	Very Good	100% data throughput
15 to 20	Good	Good data throughput up to 100%
10 to 15	Moderate	Moderate to good data throughput
7 to 10	Intermittent	Low data throughput
<7	No Lock	No data throughput

Beacon Interference

The signals transmitted from Coast Guard beacon stations are very weak and can be jammed by noise emitted from electronics. All electronics emit some type of radio noise. Depending on the amplitude and frequency bands that they emit, it has the potential to interfere with beacon reception. There are other sources of noise, such as power lines, engine electronics of vehicles, power transformers, and the like.

The MobileMapper Beacon system is able to provide diagnostic information to the DGPS Configuration application that you can run on your PC or on the MobileMapper CE system. This utility can allow you to monitor the current reception performance of the MobileMapper Beacon system. This will tell you how well it's receiving the signal compared to the amount of noise present in the environment.

To ensure that you provide the MobileMapper Beacon with the best chance to receive a relatively noise-free signal, here are some precautions that you should be aware of:

- If you use a belt-worn pager or mobile phone, ensure that you wear it on the opposite side of your body so that it's away from the MobileMapper Beacon.
- Wear the MobileMapper Beacon on the same side of your body as write with a pen. For instance, if you are right-handed, wear the beacon system on your right hip.
- If, for some reason, you have a notebook or tablet computer nearby, ensure that it's a few feet away from the MobileMapper Beacon system.

We have found that personal digital assistants (PDA's) emit noise that can mask the beacon signal, but they often do not emit as much noise as a full computer system. You may find that there's little interference from such a system within one or two feet.

Troubleshooting Reception

The first thing to confirm when troubleshooting beacon reception problems is to monitor the lock LED indicator. If it's on, the receiver is locked. If you find that it's on most of the time, chances are that there's sufficient data being passed to the GPS system to allow differential correction to happen. If you find that the light is most often off, or always off, this would be an indication of reception problems.

Reception problems can be confirmed using the Configuration Utility described previously, by monitoring the SNR value. If you find the SNR is very low, you should confirm that the frequency or station to which the receiver is tuned, is the correct one. If it is not, re-tune the receiver to the correct station or frequency.

If you find that the receiver is tuned to the right station, you need to determine if the problem is associated with too much noise in your area, use of the product in a region of very weak signal, a service-side failure, or a failure of the receiver system itself.

Note - If you see '-100' at any point in the SNR or SS fields, this just means that the receiver is changing frequency or data rate of the signal automatically. This will not happen in when the system has been tuned in manual mode by selecting the frequency or station name.

If you are able to communicate with the receiver with the Configuration Utility, you know the receiver is functioning in some capacity. The next step is to monitor the signal strength. If you find that the signal strength is very close to zero or negative, this indicates the possibility of an antenna failure.

If you find the signal strength is higher than approximately 10 dB, the antenna should be functioning correctly. The next step is to determine what is causing reception problems. It will either be environmental noise or weak signal. If it's a noise problem, the signal strength will likely be high. For example, if you see an SS value of say 50 dB, and an SNR of 5, you can be assured that the environment is jamming the reception of the signal. There's not much that can be done in a situation like this unless you can identify the source of noise. Sometimes this takes a bit of looking around your environment to determine.

Coast Guard DGPS Service

The MobileMapper Beacon receives differential correction data transmitted by coast guard stations located in many regions throughout the world.

This chapter aims to provide you with practical knowledge of this coast guard service, to empower your use of this product.

Radiobeacon Range

The broadcasting range of a 300 kHz beacon is dependent upon a number of factors including transmission power, free space loss, ionospheric state, surface conductivity, ambient noise, and atmospheric losses.

The strength of a signal decreases with distance from the transmitting station, due in large part to spreading loss. This loss is a result of the signal's power being distributed over an increasing surface area as the signal radiates away from the transmitting antenna.

The expected range of a broadcast also depends upon the conductivity of the surface over which it travels. A signal will propagate further over a surface with high conductivity than over a surface with low conductivity. Lower conductivity surfaces such as dry, infertile soil, absorb the power of the transmission more than higher conductivity surfaces, such as sea water or arable land.

A radiobeacon transmission has three components: a direct line of sight wave, a ground wave, and a sky wave. The line of sight wave is not significant beyond visual range of the transmitting tower, and does not have a substantial impact upon signal reception.

The ground wave portion of the signal propagates along the surface of the earth, losing strength due to spreading loss, atmospheric refraction and diffraction, and attenuation by the surface over which it travels (dependent upon conductivity).

The portion of the beacon signal broadcast skywards is known as the sky wave. Depending on its reflectance, the sky wave may bounce off the ionosphere and back to Earth causing reception of the ground wave to fade. Fading occurs when the ground and sky waves interfere with each other. The effect of fading is that reception may fade in and out. However, this problem usually occurs in the evening when the ionosphere becomes more reflective and usually on the edge of coverage areas. Fading is not usually an issue with overlapping coverage areas of beacons and their large overall range.

Atmospheric attenuation plays a minor part in signal transmission range, as it absorbs and scatters the signal. This type of loss is the least significant of those described.

Radiobeacon Reception

Various sources of noise affect beacon reception, and include:

- Engine noise
- Alternator noise
- Noise from Power lines
- DC to AC inverting equipment
- Electric devices such as PDA's, cellular phones, CRT's, electric motors, fans, and solenoids

Noise generated by this type of equipment can mask the beacon signal, reducing or impairing reception, depending on its magnitude and proximity. Weak sources of noise can still jab reception of a beacon signal. Under this type of condition, however, removal of the noise source by a number of inches is often sufficient to improve reception.

Your MobileMapper CE system (and some 3rd-party GPS equipment) allow you to set the maximum differential age. Setting the age to a higher value allows any reception disturbances to be buffered by the increased age. If you find that you're operating in an area of high noise, you may find that if you allow the beacon receiver to lock in a quieter area, that you have sufficient time before the differential time-out to conduct the work that you require.

Spatial Decorrelation

Depending on the range from yourself to the beacon, the environmental conditions may differ between the base station site and your location. This difference will show up as an additional error in positioning, and is referred to as spatial decorrelation.

Note - Due to effects of spatial decorrelation, we recommend that you consistently use a specific beacon station as much as possible. If, for some reason this station is not available, you will need to determine if a secondary station is available.

The additional degradation will depend on the difference in observed orbit and ionospheric errors between the reference station and your GPS system. A general rule of thumb would be a 1 m error for every 100 miles of distance to the beacon station. This error is often seen as a bias in positioning, resulting in a position offset. The scatter of the receiver is likely to remain close to constant.

Coast Guard Beacon vs WAAS/EGNOS

Coast Guard beacon DGPS has certain strengths in comparison to WAAS and vice versa, which are important to know when deciding what correction source to use. Both services are provided without user fees, so your choice of which system to use must be made according to different criteria.

Benefits of Coast Guard Beacon

- Low Frequency - the low frequency of beacon is a significant strength when working in areas where a line of sight is blocked to WAAS or EGNOS, such as under canopy or in urban canyon. The frequency of beacon is located below AM radio stations. As you've likely experienced of AM radio stations, compared to higher frequency FM stations, AM radio is more robust, and diffracts well around obstacles, such as buildings, highway overpasses, etc. With often only two WAAS or EGNOS satellites available, and sometimes only one, it's possible that GPS can still be tracked effectively under tree canopy. Being low frequency, the beacon signal is able to penetrate trees very well, while a WAAS/EGNOS lock cannot be attained reliably.

- The low frequency has benefit in penetrating tree-cover, but it is also susceptible to man-made sources of noise from various electronics or electrically driven equipment. This susceptibility shows up in reduced SNR, which could lead to less reliable reception.
- ·Local Area Service - beacon is a local area service where only one station is providing correction data to the user-base. This is a strength such that it provides good quality corrections when near the beacon site. Spatial Decorrelation does enter the picture as you operate away from the station. However, it's possible that Coast Guard beacon DGPS could handle large ionospheric disturbances better than WAAS/EGNOS, although a rare condition.

Benefits of WAAS/EGNOS

- High Frequency - WAAS / EGNOS transmit with a pseudo-GPS signal at L1 frequency. This signal will be available anywhere the GPS receiver's antenna can 'see' the satellite. This provides a very wide operating area, with the exception of behind certain large objects that can mask the signal.
- Robust Reception - Being line of sight, and being transmitted on L1 frequency, the WAAS/EGNOS signal is typically easy to acquire. Interference with GPS is typically rare, which provides you with a robust service, when the satellite(s) can be viewed.
- Wide Area Service - WAAS and EGNOS use a wide area format for their service. A network of reference stations compute corrections for the specific errors in the GPS service (ionosphere, satellite orbit, and clock corrections). It's possible that the reference stations in the network are not of sufficient density, and they cannot pick up subtle changes in the ionosphere.

This could result in a similar error as spatial decorrelation in Coast Guard beacon, however, this is likely to be less significant. More significant is that the ionospheric map is downloaded to users only every 5 minutes. Recent past has shown that the ionosphere, during peak solar activity, can change more quickly than this update rate, causing a significant source of error.

This is a very rare condition. Solar activity can be monitored by consulting various Web sites, such as www.spaceweather.com

Radiobeacon DGPS

Radiobeacons conforming to the standards of the International Association of Lighthouse Authorities broadcast a limited selection of RTCM SC-104 messages, including message types 1, 2, 3, 5, 6, 7, 9, and 16.

- A DGPS beacon will broadcast either Type 1 or Type 9 messages, both of which contain similar information. These two messages contain pseudorange corrections and range rate corrections to each GPS satellite.
- The Type 2 message contains delta differential corrections that are used when the remote receiver is using a different satellite navigation message than used by the base station.
- The Type 3 message contains the position of the beacon's reference station, often accurate to within centimeters with respect to the WGS-84 reference datum.
- The Type 5 message contains GPS constellation health information used for improving tracking performance of a GPS receiver
- The Type 6 message contains null information, and is broadcast so that a beacon receiver demodulating the data from the broadcast does not lose lock when the beacon station has no new data to transmit.

- The Type 7 message contains the radiobeacon almanac information composed of location, frequency, service range, and health information of sister stations for the currently tuned beacon.
- The Type 16 message provides users with a 90 character text string that may contain information regarding the status of the system, weather warnings, etc.

Radiobeacon DGPS is often referred to as a local-area service, as the data broadcast is appropriate for use within the coverage range of the station.

Radiobeacon Coverage

The following figure shows the approximate radiobeacon coverage throughout the world. In this figure, light shaded regions note current coverage, with beacon stations symbolized as white dots. Please note that the extent of coverage shown is approximate. To get the most up to date information on Coast Guard DGPS beacon services, we recommend that you contact your local Coast Guard or Port Authority.

World Radiobeacon Coverage - April 2004

MobileMapper Beacon

User Manual

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