

# GPS Phone

## An Integrated GPS /Cellular Handset

Shon Shampain, NAVSYS Corporation

### BIOGRAPHY

Shon Shampain is Technical Lead for LocatorNet, a division of NAVSYS responsible for commercial GPS products and services. Mr. Shampain has twelve years software engineering experience, and has previously worked with organizations including The Goddard Space Flight Center (NASA), The Johns Hopkins University Applied Physics Lab (JHU/APL), Booz•Allen & Hamilton and ARINC.

### ABSTRACT

This paper will introduce the NAVSYS GPS Phone. Combining its rich experience in both GPS technology, and cellular communications, NAVSYS has been able to integrate the two technologies. The integrated GPS Phone device is a portable, handheld, fully-functional cell phone with GPS capabilities. The enabling technology in this device is NAVSYS' patented TIDGET GPS sensor.

### INTRODUCTION - WHAT IS GPS PHONE?

The NAVSYS GPS Phone is an integrated handheld device combining both GPS and cellular technologies. At approximately the size of today's current crop of cellular telephones, the GPS Phone is meant to be transported in a coat pocket, brief case, or pocketbook. NAVSYS, drawing on its broad and rich experience as a leader in the GPS field, has integrated cellular technology into a single device that effortlessly exceeds the year 2002 mandate for 125 meter location accuracy in cellular devices - today.

### What does the GPS Phone do?

At its essence, the GPS Phone is a fully functional cellular telephone. Additionally, its an emergency location device. By pressing one of GPS Phone's special keys, a user can indicate a request for police, fire, or roadside assistance. The choices do not end there because the GPS Phone can be customized for special applications (for example, the keys could be customized to report different traffic conditions -

congestion here, accident here, or smooth sailing). The GPS Phone is also capable of different modes of location services. Standard mode means that the GPS Phone is reporting a location. Finder mode means that a service center is attempting to location a GPS Phone unit. Tracker mode means that the GPS Phone will continuously report locations. The bottom line is that GPS Phone can serve many communications and location needs equally well.

### How can the GPS Phone benefit me?

There are numerous benefits to the NAVSYS GPS Phone.

- ◆ Every day, 911 is dialed approximately 60,000 times on cellular telephone devices, and of these calls, a full 25% cannot describe where they are<sup>1</sup>. The NAVSYS GPS Phone can drastically change these numbers.
- ◆ The year 2002 mandate for locating cellular devices will not help you for at least 5 years. The NAVSYS GPS Phone is functional right now.
- ◆ Many cellular phone makers are addressing the year 2002 mandate via techniques that depend on the cellular network, such as using the time difference of arrival (TDOA) of your cellular signal to nearby cell towers. Conversely, the NAVSYS GPS Phone uses the mature and stable GPS system. Additionally, the GPS system is accessible in virtually all areas of the world without the necessity of providing infrastructure additions such as special transponders and/or additional cell phone towers.
- ◆ In quantity there should be no significant difference between the price points of a cellular phone, and the NAVSYS GPS Phone.
- ◆ NAVSYS Corporation prides itself on "inventive GPS solutions". This means that GPS Phone is not cast in stone; NAVSYS can provide customization for specific applications.

- ◆ The NAVSYS GPS Phone is based upon significant experience in the field of GPS and cellular integration. In fact, there are various predecessors of GPS Phone based upon hand held technology, and in-vehicle technology.

## The NAVSYS GPS Phone

### System Architecture - TIDGET

GPS functionality in the NAVSYS GPS Phone is based upon the patented TIDGET™ technology. As opposed to a GPS receiver, the TIDGET™ is a GPS sensor. The difference between a sensor and a receiver is that a receiver will calculate a position at the device, whereas the sensor will send the raw GPS data to a base station for processing. There are various reasons why a sensor makes more sense than a receiver, and a number of situations when a sensor is superior to a receiver:

- ◆ Upgrades to processing occur once at the base station, instead of either issuing a field upgrade, or being stuck with obsolete technology
- ◆ The power for processing increasing drastically via workstation based computations, as opposed to a limited microcontroller or DSP that would be found on-board a device
- ◆ Differential corrections are standard fare in the base station, as opposed to a costly upgrade, or not having them at all
- ◆ All data is archived, implying that any run can be reproduced and verified
- ◆ The TIDGET/base-station concept enables the reporting of out-of-bound conditions, such as Dilution of Precision Warnings (DOPs), RAIM alarms, etc.
- ◆ The TIDGET/base-station concept allows tracking with as few as 2 satellites
- ◆ The NAVSYS GPS Phone has the ability to dispatch services, via its interaction with the LocatorNet Processing Center
- ◆ The NAVSYS GPS Phone has the ability to receive a location computed by the LocatorNet Processing Center, and display it
- ◆ The NAVSYS GPS Phone's lower power consumption allows the integration of GPS and cellular in a consumer device

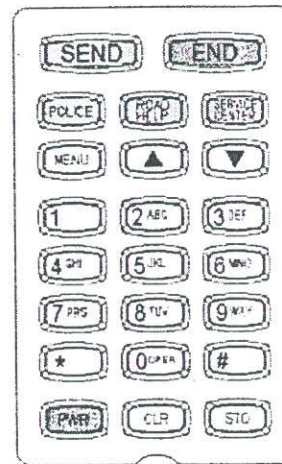
### Microprocessor

The microprocessor used for controlling the GPS Phone is based on the recently announced Phillips 8051 XA 16 bit microprocessor. This processor provides the GPS Phone with an extremely fast and powerful processing platform supporting up to two megabytes of program code and data storage, which will allow for system expansion far into the

future.

### Radio/Modem

NAVSYS has gone to great lengths to modularize the design with respect to the modem interface. Currently running a versatile serial connection, the current generation GPS Phone interfaces to the Sierra Wireless SB220 series of cellular communications devices. The NAVSYS GPS Phone also expects to achieve complete functionality with other integrated cellular phone/modem devices, such as INET, and other to be determined.



Keypad

### Keypad/Display/Speaker/Mic

The NAVSYS GPS Phone has the look and feel of a typical cellular telephone with an integrated user interface consisting of a multifunction keypad, four line LCD display and an integrated speaker and microphone.

### Cell antenna

The NAVSYS GPS Phone utilizes a typical quarter wave-type cell phone antenna.

### GPS antenna

The NAVSYS GPS Phone is equipped with a new technology, helix-type GPS antenna that provides a passive or active device in a compact package.

### Functionality as a locating device in circuit-switched mode (AMPS) - Collecting GPS data

The GPS Phone is customizable with respect to the amount of data that is requested from the TIDGET sensor. The TIDGET sensor samples the L1 GPS spectrum at 2 Mbps, and provides a 1 bit analog to digital conversion. Therefore, each millisecond of GPS data takes 250 bytes. A setup specifying 20 ms of data will provide a differentially corrected accuracy of about 50 meters (1 sigma), while 100 ms of data will provide a differentially corrected accuracy of about 10 meters (1 sigma).

### Communications link

The standard communication link for the NAVSYS GPS Phone is a circuit-switched AMPS phone connection. This medium has many benefits, including the fact that it is widely supported in the US and the rest of the world. The effective data throughput works out to approximately 240