gpsOne Overview

Position location capabilities have become increasingly important to wireless handset manufacturers and carriers as they look for ways to offer new revenue-generating products and services to their customers. Location-based applications encompass a broad range of markets, including entertainment, fleet management, commerce, safety and systems applications. In all cases, maximizing position location accuracy and availability is the predominant requirement.

Ensuring that high-accuracy position location technology is widely available benefits manufacturers, carriers, infrastructure providers and content developers by creating new markets and increasing revenues — for example, KDDI of Japan reports that average revenue per user (ARPU) has increased since the introduction of their gpsOne™-based eznavigation service in December 2001. High-accuracy, high-availability position location technology also benefits consumers by providing a panoply of exciting new products and services.

QUALCOMM’s gpsOne technology is the only commercially proven GPS-based positioning solution for third generation wireless (3G). It is also the lowest-cost integrated wireless GPS solution in the world.

As of February 2003, there are over ten million gpsOne terminals on the market, the highest rate of wireless GPS sales in the world. In Japan, Korea and the U.S., 30 handset models from
multiple vendors are available with gpsOne, and over ten carriers are currently deployed or in deployment to provide gpsOne-based services.

**Wireless Geolocation Systems**

Traditionally, there have been two methods for providing wireless position location information: network-based solutions and handset-based solutions.

Network-based solutions rely on the signal transmitted from the wireless handset and received at multiple fixed base stations, using Angle of Arrival (AOA) and Time of Arrival (TOA) to determine position. Network-based solutions face a number of difficulties, including multipath propagation, diffraction, weak signal conditions, base station availability and expensive upgrades.

Handset-based solutions make use of the Global Positioning System (GPS), a worldwide system of 24 satellites and their ground stations. By accurately measuring the distance from three satellites, the receiver triangulates its position anywhere on earth. Handset-based solutions also face a number of challenges, including the GPS receiver state (in a cold-start, for example, it could take the receiver up to 10 minutes to aquire the first fix), and inability of the handset to acquire satellites due to physical obstructions such as buildings, foliage and topography.

**QUALCOMM gpsOne solution**

Although individually inadequate in providing a real-world commercial position location solution, network and GPS solutions complement one another. For example, in rural and suburban areas, not many base stations can “hear” the handset, but a GPS receiver can often
“see” four or more satellites. Conversely, in dense urban areas and inside buildings, GPS receivers do not detect enough satellites, but the wireless handset can see two or more base stations.

QUALCOMM developed the gpsOne solution for CDMA networks to address the need for accurate commercial-grade, high-availability position location technology. Using a hybrid wireless Assisted Global Positioning System™ (A-GPS) solution from SnapTrack, a QUALCOMM subsidiary, the gpsOne solution offers a position location system that provides high accuracy and works across all terrains, including indoors and in dense urban areas that are usually hostile to unassisted-GPS implementations.

GpsOne is the first GPS-based solution to work reliably indoors. It is also the first integrated wireless baseband with GPS capability and the first integrated wireless RF with GPS capability. A gpsOne-enabled Mobile Station Modem (MSM™) chipset made possible the first integrated CDMA-based tracking service module (SECOM Co. Ltd.’s CoCo SECOM).

**How gpsOne Works**

QUALCOMM’s hybrid approach merges GPS and network solutions by collecting measurements from the GPS constellation and cellular/PCS network, then sending the information to SnapTrack’s Position Determination Entity (PDE), located in the network, where the measurements are combined to produce an accurate 3-D position.

Locating a wireless handset involves two functions: signal measurement and position calculation. The gpsOne solution is flexible enough to allow the location functionality to be built in a variety
of configurations using different radio-location technologies. Signal measurement can be performed at the handset or the base station, or both. Placing the PDE at the base station:

- Allows the PDE to take full advantage of any future air interface enhancements
- Facilitates mobile-assisted location determination
- Reduces A interface signaling (the interface between the base station and mobile switching center)
- Improves time to first fix
- Allows coordination of base station call control tasks
- Supports all radio-location technologies, thus reducing concern over raw data formatting between the base station and mobile switching center
- Supports availability of location information after call setup
- Reduces impact on backhaul network capacity (in some network architectures)

The gpsOne solution is integrated in selected QUALCOMM MSM chipsets, which reduces the cost of implementing a position location system for handsets. Also, instead of requiring modifications at each base station as in most network-based solutions, the gpsOne solution requires that a database be constructed that contains the precise location of each base station in the network (typically, that data already largely exists), so that it may be used in the hybrid solution. In addition, a wide-area reference network must be deployed. This involves connecting the GPS receivers to the PDE via a data pipe. The wide-area reference network allows the PDE to provide assistance information for handsets in any segment of the coverage area. The minimal infrastructure changes required make the gpsOne solution a system that is cost effective to deploy.
Value-Added Position Location Applications

Wireless access to high-availability position location information opens up far-reaching application-development and revenue-generation opportunities for the telecommunications industry. Of course, the ability to provide services must be balanced by a user’s desire for privacy. With gpsOne technology, the user retains the ability to disable positioning services or limit information access through user-selected controls located on the handset.

Recent successful launches and planned launches of gpsOne position location applications include:

- SECOM Co., Ltd., the leading provider of security services in Japan, launched CoCo SECOM nationwide in April 2001. The safety and security service enables asset tracking and stolen property recovery as well as the locating of individuals. CoCo SECOM service represents the world’s first commercial deployment of a QUALCOMM gpsOne-enabled MSM chipset, which incorporates both position location technology and state-of-the-art CDMA wireless telephony capabilities.

- KDDI Corporation of Japan launched eznavigation service in December 2001. The service currently offers 105 applications, including friend finder, personal navigation, stolen property recovery, mapping, restaurant guides, train schedules, town guides and weather information. Since eznavigation service began, KDDI has sold over four million handsets since the service began. They offer handsets from a variety of companies, including Toshiba, Hitachi, Sanyo, Casio, Panasonic and Kyocera.

- In January 2002, KDDI and mobile ad agency a1adnet Corp. began a trial service directed at users of gpsOne-enabled phones. The user’s phone displays the menu and map data of the nearest McDonald’s restaurant.
- SK Telecom of Korea announced plans to offer commercial gpsOne service on July 1\textsuperscript{st}, 2001, and has since launched their NATE GPS service.

**Conclusion**

Both network and standalone GPS location technologies have inherent weaknesses, resulting in reduced accuracy, decreased availability and higher implementation costs. QUALCOMM’s hybrid solution utilizes the complementary nature of both approaches to overcome situational weaknesses experienced by either network or GPS approaches working alone. The benefits of the hybrid solution include maximum availability, increased sensitivity, industry-leading accuracy, reduced handset cost and complexity, reduced PC board real estate, minimized external components for carriers and a rapid time-to-first-fix. QUALCOMM’s gpsOne solution is the only position location solution currently available that offers these real-world benefits.

More information on QUALCOMM’s gpsOne solution, as well as the company’s other CDMA products and services, can be found at [www.cdmatech.com](http://www.cdmatech.com).

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