Wireless Location Services™: A commercial Market Perspective of Potential Technology Usage
By Mark H. Flolid

Introduction
The United States Federal Communications Commission's (FCC) phase II mandate to accurately locate wireless 9-1-1 callers to within 125 meters has acted as a catalyst for an emerging industry that is focused on developing location determination technologies. As a result, many approaches to location determination have been introduced and successful live wireless 9-1-1 network trials have proven the capabilities of the technology. The promise of location determination technology, however, extends beyond its important role for wireless 9-1-1. It has now gained attention as a potential enabler of many commercial applications that can be enhanced by location.

An important shift is beginning to occur. Network operators are transitioning for a focus on how to determine the geographic location of a wireless network for end-user consumption. The application of location has caught the attention of wireless operators who are under increasing pressure to offer new services that will differentiate their network service offering. Whether location offers network operators the new "killer service" or not, it is clear that the investigation of how to exploit the potential of location for commercial applications s under way. This paper will address some of the fundamental market issues that will be critical to the future of commercial location services.

- The market for location service
- Potential commercial applications of location services
- Deployment strategies for location services
- The Market for Wireless Location Services
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The market for commercial location services is global. Today, the population of North America is approximately 5 percent of the world's population of 6 billion. The size of the North American market in terms of contracted cellular and PCS customers is 25 percent of the world's 280 million customers. By the year 2005 it is projected that the rest of the world will grow to be five times the size of the market in North America.

Forecasters predict the U.S. market to achieve 100 million subscribers by year-end 2000 and 146 million subscribers by year-end 2005. Or, put another way, approximately 32 percent of the U.S. population will be wireless customers by the turn of the century and in six years it will be approaching half of the population. In the rest of the world, growth rates are significantly higher. Forecasters predict 322 million subscribers by year-end 2000 and 600 million subscribers by year-end 2005, with an annualized growth rate of 19 percent per year.

As the market continues to grow, what does this mean for location services? From a global perspective, the size of the market for location services is forecast to exceed $10 billion for year-end 2005 as shown in Table 1 on page 18. North America accounts for a little over 30 percent of the total revenues with the safety (emergency road services, E9-1-1, etc.) and information related (traffic, 4-1-1, navigation, etc.) location services contributing equally. For the rest of the world, information-related location services

dominate. Tracking (fleet, car, etc.) services revenues are forecast to be relatively low, contributing a little over 10 percent of the total in both North America and the rest of the world.

The FCC 9-1-1 mandate has been the primary driver of location services in the US. For the rest of the world the market is driven by commercial forces such as service differentiation, customer retention and gains to market share that add new incremental revenue to the bottom line. In both North America and the rest of the world, market dynamics will drive significant market opportunity for commercial location services from a standpoint of both market dynamics and sheer size.

Potential Commercial Applications of Wireless Location Services™
For discussion purposes the range of location applications can be grouped into five convenient categories. The categories in Table 2 below show groupings for Safety, Tracking, Information and Billing.

Safety applications extend beyond E9-1-1 to include many personal safety applications. Emergency road service is an excellent example of an existing service widely used today, which would greatly benefit used today, which would greatly benefit from knowing the location of the wireless caller. As with wireless 9-1-1, knowing the location of the caller allows the ERS call center for efficient call handling and customer service assignment. By dialing a special feature code # ERS "send," the ERS member's called number can be interpreted by the mobile switch and routed with location in formation and callback number to the closest and correct ERS call centers. Other location enhanced Safety applications include Early Warning Evacuation allows a network operator to direct a message service or recorded voice circumstances that occur with storm conditions, fires, or other disasters.

Tracking applications are focused on monitoring the location of assets, objects and persons. There are many examples of dedicated network tracking applications on the market today. Location services allow these applications to be deployed within the wireless network, using unmodified handsets, offered at a fraction of the price. Fleet management is a prime example. Deployed as a network-based location service, the location of fleet vehicles can be tracked based upon the mobile subscriber's registration, call origination or call termination. As the mobile moves geographically its location is updated and sent to a central dispatch station that monitors location, status and pending calls for service assignments. Other examples of location tracking are based upon placing special low-cost wireless data devices that register with the network as do mobile hand on demand. Stolen vehicles and valuable shipments are prime markets for the applications with specialized location devices.

Information applications are focused on directing information to subscribers relative to their current or anticipated location. Information-oriented location applications such as 4-1-1 directory assistance and area number calling applications provide personalized and localized information to the subscriber. These applications are triggered by a subscriber dialing a special feature code that routes the caller to the closest service provider or voice response service that delivers information on selected services that are in proximity to the subscriber. Another location information service, Smart Message Service, is messages that are sent to the subscriber at the right place at the right time, such as with selective advertising or special event information.

Billing applications allow different billing and service availability plans to be varied depending upon a subscriber's location when making or receiving a call. Location based billing services are focused on replacing wireline minutes with wireless. If there is a "killer service" this may be the one. The potential market impact for location billing is high, because it will allow operators to target billing plans for all segments of the telecommunications market and begin to capture wireline minutes. For example, it is

forecasted that 24 percent of the population will use cellular or PCS service by year-end 1998. Yet surprisingly, this market only telecommunication minutes of use. Clearly, wireless is still primarily for mobile communications and is still used as a complement to wireline communications.

The demand for location services will continue to grow as more consumers choose wireless communications to serve their business and personal lifestyles. This will require wireless network operators to offer a more complete communication service the combines the capabilities of wireline services with which their customers are familiar. This includes services that address flexible rate programs or programs that make wireless communications attractive for personal communications, public safety, and worker mobility.

Deployment Strategies for Wireless Location Services™
To date there are two primary approaches to the deployment of location services, point-to-point and network-based solutions. Both approaches offer the fundamental network elements necessary to deliver a location service. These elements include geographically location information back to a central server and applying the location information to a context in which to deliver a service.

Historically, the location services have been deployed as point-to point solutions. Point-to-point solutions are offered as high-end vehicle options that offer navigation assistance and specialized information support from customer care call centers. Point-to-point solutions make use of the wireless infrastructure only as a conduit to deliver location information back to the call center as shown in Figure 1 above.

Examples of point-to-point location services that have been deployed worldwide and in the US include: vehicle tracking, tracking information, and fleet. Location services were first introduced into the market in the 1970's and were primarily focused on the transport-oriented mobile location market. As indicated in her table below, the worldwide penetrations for location services are low.
There are several factors that explain the limited consumer acceptance of these solutions, including:

- The high initial cost of deployment
- Lack of a compelling suite of services
- Product and services strategies target the high-end automobile market
- Point-to-point technologies are costly and difficult to scale

Network-based solutions on the other hand are designed to leverage the inherent capabilities of the wireless network to derive location and deliver services to the market. Many location technologies are capable of being used in the network, including cell/sector, angle of arrival and time difference of arrival. These approaches to location capabilities to derive subscriber location from several points in the network which include the subscriber handset, base station equipment and switching infrastructure as shown in Figure 2.

In addition to the requirement for network-based location determination, location services must provide a network-based location determination, location services must provide a network-based method of hosting and delivering service information to the subscriber. An important technological trend in the wireless industry is the adoption of Wireless Intelligent Network (WIN) systems for the delivery of new advanced network services like location services. Network services offerings have traditionally been part of the wireless switch function. But the costs of switching infrastructure, capacity limitations, maintenance costs, and the market demands to rapidly deploy new services have led the infrastructure providers to create the new off-switch computers known as Service Control Points (SCP), that are

interfaced to switches through standards-based messaging. The advantages of the Wireless Intelligent Network approach to deploying location services are:

- Direct interaction with network call processing model for call routing
- Integrated with operator billing systems
- Services scalability for network deployments
- Standards based for rapid service deployment across different networks
- Single point of OA&M
- Supports the predominant Non-call Associated Signaling (NCAS) approach to the deployment of location services for Wireless 9-1-1 Phase I and II.

The Wireless Intelligent Network offers an ideal environment for the delivery and provisioning of a multitude of value-added network services.

Summary
In summary, the growth of the wireless communications market and consumers' willingness to pay for not only greater personal safety, but also increase communication convenience will drive the demand for location services. Network operations seeking to differentiate their networks in an increasingly competitive market will offer many new and compelling location-based services to attract customers beyond wireless 9-1-1. Critical to the success of location services will be how they are deployed. Since wireless network operations are the most likely provides of a truly broad-based offering of these services it will be important that the technology solution leverage their existing network capabilities.

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