

Handset-based Location Technologies: A Viable Choice for Rapid Phase II Implementation

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The Phase II Mandate

The Federal Communications Commission's (FCC) Phase II mandate, which requires the Automatic Location Identification (ALI) of wireless phones calling 9-1-1 to an accuracy of 125 meters, 67 percent of the time, by October 2001, has been a catalyst for new technology developments and trials. Vendors and carriers alike can envision a variety of new revenue-generating, location-based commercial and consumer applications to further justify the implementation of technology across 75 million wireless subscribers and 65,800-plus cell sites.

Approaches to Location Technologies

Since the FCC Phase II rulemaking, three principal approaches—network-based, handset-based, and a combination of the two—have emerged and are being proposed to the wireless carriers and Public Safety Answering Points (PSAPs).

Due to the earlier development of network-based solutions, the prevailing thought was that this technology would be the de facto answer for Phase II implementation.

The lack of any clear guidance regarding an appropriate phase-in of technology—either network or handset-based—has deterred wireless carriers and PSAPs from agreeing to a specific Phase II solution. In the past six to nine months, however, presumptions about Phase II technology have been altered, as viable options are made available to implement Phase II and to achieve—and even exceed—the FCC accuracy requirement.

Recent Developments

Through extensive field testing, handset-based location technologies—typically based on the U.S. government's Global Positioning System (GPS) technology—have recently been proven to be a viable option for Phase II implementation. Handset-based solutions use both software and a GPS antenna resident in the handset to obtain location information, prepare it for transport, and move it through the wireless and wireline network to a receiving station at a PSAP. While architectures for GPS solutions vary, the common denominator is that the intelligence resides within the phone, *under the control of the handset user*.

GPS technology is a mature system, with more than 30 years of proven service. There are numerous portable commercial products on the market that display the location to the *caller*—but which do not transmit the location (or other information, such as speed and direction) to *another party* (such as a PSAP). The issue of transporting this location data to a call taker station, as well as the size and power consumption of the onboard GPS, have been the key technological hurdles

to successful implementation of handset solutions for Phase II. These barriers are now being quickly overcome.

Four important technological and regulatory breakthroughs have occurred to make the handset-based solution a more usable and attractive option for the wireless carriers—and can make compliance with Phase II a reality on a faster timetable:

1. **Miniaturization of both the handset-based GPS processor and antenna**—coupled with considerably reduced battery drain—has been achieved to allow insertion into new handsets at a very low per-unit cost. For instance, battery packs complete with a GPS antenna and software have already been developed within the existing battery shell, and are expected to go on sale by mid-year 2000.
2. **The achievement of high accuracy**, even with the induced errors of Selective Availability (SA), is being realized far in excess of Phase II requirements (40 feet or better, depending upon the environment). Additional captured information not required by Phase II but proven essential for many PSAPs (such as altitude), make the progress in this area truly dramatic. Network assisting and differential correction techniques are being built as a key part of Phase II ALI handsets.
3. While not a Phase II requirement, a **high-accuracy selective routing to the appropriate PSAP** (e.g., state highway vs. the local sheriff) can be accomplished with the high accuracy inherently available in GPS. Agreements between selective routing manufacturers and location technology vendors are already in place to make this happen.
4. The release of **FCC Public Notice DA 98-2631 on December 24, 1998** provided wireless carriers with the opportunity to propose an alternative for Phase II implementation by October 2001. This is contingent upon the wireless carrier demonstrating that accuracy and availability exceeds the FCC's Phase II requirements and/or proposing a plan to begin transitioning the existing and future customer handset base prior to the compliance date.

These significant developments, along with the completion of extensive testing of the handset-based solution from such companies as Integrated Data Communications of Bainbridge Island, Washington, by the King County, Washington E 9-1-1 Program Office, are changing the industry's assumptions about Phase II solutions. This test has also added significant credibility to the handset being a viable option for Phase II location. Recent testing of handset-based technology conducted in Florida further strengthen the case for the handset alternative.

With the cooperation of 12 public safety, vendor, and wireless carrier organizations, the King County test drove these technological developments by striving for location requirements significantly higher than the FCC Phase II mandate (12.3 meters vs. 125 meters). Taken together, these changes demonstrate that handset-based solutions are now a clear alternative for meeting the Phase II mandate. The results of this trial have been presented to the FCC, which is now more informed as to the range of choices available.

Miniaturization

With the advent of smaller and more powerful integrated circuitry, the ability to incorporate high-quality GPS technology onto the “backplane” of a commercially-available wireless phone—or the battery pack—has become a reality. Products available today from SiRF Technology, Inc., located in Santa Clara, CA, insert into the handset with nominal impact to power consumption and Digital Signal Processor (DSP) cycles. Only months ago, this was viewed as unachievable and was considered a major barrier for handset solutions.

In 1998, SiRF Technology signed major contracts with both Nokia and Ericsson (according to Dataquest, #1 and #3 in global wireless handset sales in 1998) to support the development of GPS-capable handsets. Very small but highly sensitive multi-band antennas for both GPS and wireless signals are also being produced. Information available from the wireless handset industry indicates that, by the end of the year 2000, GPS-enabled handsets will be made available for sale. For example, a major digital handset manufacturer projects to have handsets available to wireless carriers by third-quarter 2000.

Moreover, technological advancements in low-signal environments have increased GPS coverage in buildings and other covered structures. Technology that transmits network assistance “back” to the handset in areas of limited GPS availability is also in development by several vendors.

The issue of consistency in GPS signals in buildings is a major challenge for location technologies based on GPS. However, it is important to note that PSAPs in the Washington State area, for example, indicate that the percentage of all wireless 9-1-1 calls from major roads and highways—versus within buildings—is nearly 50 percent. These environments are considerably “GPS-friendly” with “open sky” available for location fixes.

Accuracy – and More Data

GPS has been used as a highly accurate method for determining location for decades. For the FCC Phase II mandate, the challenge has been to transmit positioning information quickly in a usable form (textual or mapped) to a PSAP. Handset-based solutions have taken the accuracy of GPS, refined it, and moved the information through networks to be processed and used by the PSAP. The intelligence resides in the two ends of the equation—the handset and the PSAP—while the network is purely a transport for the location information.

Additional data such as direction, speed, and altitude can also be provided in the datastream back to the PSAP call taker station. While not required by the Phase II mandate, this information proved invaluable in the King County, Washington test and was made part of their critical requirement.

Beyond the needs of public safety, the demand for higher accuracy as part of any related commercial service is essential. A customer's willingness to pay is directly related to the achievement of consistently accurate location information. Particularly within concentrated urban settings, the savvy consumer may not pay a premium for location services with 125-meter radial accuracy (the equivalent to four square city blocks). Many applications will require this level of granularity and precision, and this can be achieved with a GPS solution in the handset.

Furthermore, with the handset solution, costs related to public safety and commercial services are clearly separated as the handset itself is the only common device between these two major users.

Routing

Accurate routing to the correct PSAP based on the caller's location is a critical need. The ability to selectively route to the appropriate public safety organization will save critical time. The accuracy available with handset-based solutions is well suited to the need of avoiding life-threatening delays.

While Phase II routing has been proven previously with network-based solutions, the increased accuracy of GPS-based solutions can offer more value to PSAPs in urban areas, interstate corridors, and jurisdictional borders. As specific cell sectors or sites can easily propagate over two or more responsible PSAPs, routing based upon Emergency Services Routing Digit (ESRD) or Emergency Service Routing Key (ESRK) alone—without the additional granular information available from GPS—can create confusion and cause life-threatening delays.

<<Insert Figure 1 here>> *Figure 1: Routing of call to local police vs. Highway Patrol*

Figure 1 shows an actual output from the King County, WA, handset-based trial, which differentiates the routing to the local police department from the State Highway patrol—even though the PSAP borders are literally feet apart. Accurate routing at this level of precision is critical to an effective, responsive public safety organization.

Public Notice 98-2631

Perhaps the most misunderstood or mischaracterized effort to quickly achieve or even exceed Phase II compliance is the FCC's "handset waiver" notice. During the initial February 1999 submission period, more than 45 filings were forwarded to the FCC. Submitting organizations took various positions on the respective options for implementing location technology.

Universally, the major wireless carriers urged the FCC to allow them to continue to review all the options—including emerging handset-based solutions—and to permit them to choose the best solution for both compliance and their respective business models. Citing handset-based successes from the King County, Florida, Colorado, and other trials, and noting reservations about the costs and timing of network-based solutions, wireless carriers as a whole acknowledged the advancements of handset-based technologies in the last 12 months.

FCC Location Technology Roundtable

In June, the FCC requested additional comments regarding Docket 94-102 and the technology issues related to handset vs. network-based solutions. With representatives from a variety of location technology providers, the FCC convened a technology roundtable on June 28 to discuss the relative strengths and weaknesses of the various options.

With wireless carriers as diverse as Nextel, Airtouch, Sprint and Aerial Communications expressing a desire to have alternatives when choosing Phase II ALI solutions, the meeting demonstrated the need for wireless carriers—and public safety organizations—to have a choice

in selecting Phase II location technology. The session also provided an opportunity for the FCC to clarify its position within Docket 94-102 on allowing technology choice.

Handset Churn at Work

With the advent of ALI-capable handsets and advances in miniaturization, accuracy, and routing, handset solutions give wireless carriers the opportunity to dramatically improve the information they provide to PSAPs. With manufacturers regularly introducing new handset models, and annual churn averaging more than 24 percent, carriers realize that there is an opportunity to eventually turn the subscriber base over to ALI-capable handsets. This churn-based transition model for ALI handsets—particularly for newer and fast growing wireless carriers—can achieve compliance for a majority of new handsets by the October 2001 deadline, and for more than 90 percent of new handsets shortly thereafter.

Figure 2 below (from the Donaldson, Lufkin & Jenrette 1999 Wireless Survey) demonstrates that this churned-based transition has economic and consumer trends in its favor.

<<Insert Figure 2>> Figure 2. Projected Handset Pricing Reductions and Replacement Handset Ratio (DL&J Wireless Survey, 1999)

During the past four years, handset prices have been reduced by more than 50 percent through competition and manufacturing productivity. In the next four years, handset prices are expected to continue to drop, by another 31 percent. As handset prices drop the survey also projects that about *two-thirds of all wireless handset purchases will be to replace existing phones* for those with updated features, improved coverage, and additional services such as web browsing. Notably, *consumers will choose to upgrade their phones in the future in even greater numbers than they have in the past*. While it is not expected that all legacy handsets will be replaced under this scenario, these trends point to marketplace forces as a driver of enabling Phase II compliance.

While there have been claims in the FCC record of approximately \$10 per handset for ALI feature capability, these expected price projected reductions—supported by historical pricing reductions *even as new features have been introduced*—demonstrate that the consumer will benefit from better handsets, at a less expensive price, in the future.

Implications for Rural Public Safety Organizations

The handset-based approach is particularly promising to the U.S.'s less-populated communities, which are typically not early adopters of technology. The handset solution does not require the cell site density of a network-based approach—and the existing base of subscribers is usually much smaller. With no requirement to modify the network, the solution can be implemented very quickly—and rural PSAPs can be at the “head of the line” for technological advancements. PSAPs can also request an analog solution to manage the 9-1-1 calls from out-of-town roamers with dual mode (digital/analog) phones.

Call to Action for Public Safety

The recent developments noted in this article provide an opportunity for public safety organizations to raise and accelerate their expectations of location technology solutions—in

terms of accuracy, cost, routing, and timeliness of implementation. Public safety organizations have the responsibility to contact their local carrier regarding the status of their approach to FCC Phase II implementation. While the FCC Phase II guidance provides a benchmark for implementation, the technology exists to implement Phase II technology sooner than the mandate requires, and to meet the more aggressive demands driven by the PSAPs throughout the United States.

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