

Location-enhanced Call Center and IVR Services

Technical Insights about Your Calling Customer's Location

Executive Summary

Enterprise operations can save money and increase profits by enhancing service to their incoming callers by automatically locating the caller. This is currently being done for wireline callers using the ubiquitous caller ID, but has only recently become available for wireless callers. There are important differences between street address derived from wireline caller ID and the information available about the location of a mobile caller. This information can be hugely valuable, such as for a call from a person broken down on a long stretch of highway. In fact, in this case there is simply no address that could be provided. At the same time, limitations of wireless location technologies make it difficult to identify that a call is coming from a specific apartment number. This white paper provides background to readers not completely familiar with wireless location technologies, their relative accuracies, and the implications to caller assistance and other contact center solutions.

Introduction

Enterprises and individuals have become accustomed to knowing “who” is calling by virtue of ubiquitous caller ID that accompanies wireline and wireless phone calls. Similar insight about “where” a caller is located is also now available for call center and IVR applications. This information can be used to improve dispatched services, automate call routing to the nearest service point, or help the caller “find the nearest”. Any dialog with the customer that includes “Where are you?” can find cost savings, operating efficiencies and enhanced customer service by automating the answer to this question. Some caller location automation solutions have used telephone area code and prefix effectively for years. Others ask the user for their location with prompts such as, “Please enter your zip code.”

Why is more needed? Simply put – because phones and callers are no longer fixed to geography and mobile phones in the U.S. now outnumber wireline phones! For mobile telephones, fixed addresses are only relevant for billing purposes. When asked, mobile users often complain, “I don’t know the zip code here.” Telephony now encompasses far more than traditional plain old telephone service (POTS) and systems that rely on fixed line logic fail to serve an ever growing percentage of callers.

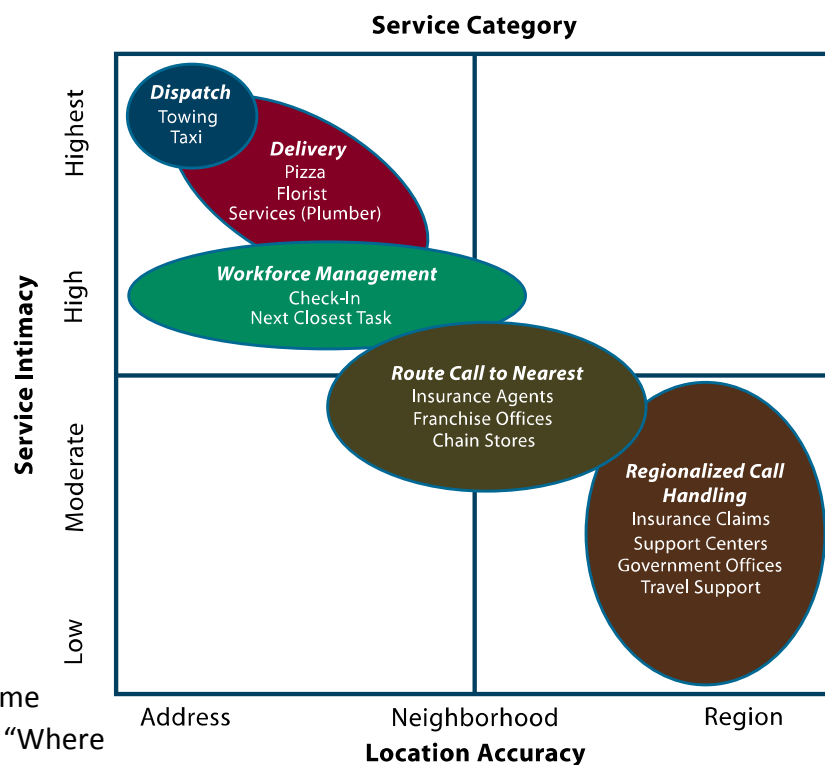
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Across the range of available telephony services, the technologies available to determine caller location range from very accurate, as with the registered address of a home phone or the global positioning system (GPS) location of a mobile caller; to less precise zip code or prefix-based location that might yield the caller's neighborhood; or simply an unknown location. Optimizing the caller experience requires IVR logic and operator-assisted work flows designed with a thorough understanding of the range and availability of location information. A good design that leverages the value from caller location and handles the exceptions effectively can yield substantial enterprise and customer benefits. The sections that follow describe in more detail the benefits of mobile caller location as well as some practical considerations for its effective application.

Location Enhanced Call Center and IVR Overview

The concept of the "location enhanced" call center and IVR is simple – customer services use the knowledge of caller's location to improve the services delivered, resulting in a faster, more economical, and better customer experience. Examples include:

- Helping callers even when they don't know where they are to reduce costly dispatch mistakes and to substantially reduce the costs of operator time by reducing service call duration.
- Automatically routing calls made to a central number to the local point of sale to leverage the personal service from local stores and franchises to close sales.
- Reducing the hassle and time in answering the question "Where are you?" to realize operator cost savings and improve customer satisfaction.



Given the range of location technologies in use, caller location accuracy can vary from as precise as a few meters to as coarse as a few thousand meters. As illustrated in the figure above, the corresponding benefit to call centers and IVR applications can therefore range from being very substantial to quite limited depending on the needs of particular location enhanced services.

Source of Location According to Call Origin

The call center or IVR system can obtain the caller's location through one of three mechanisms:

1. **Manual Entry by Caller (Wireline or Wireless)** – someone, either the caller or the operator, provides all the details of the caller's location. This may be semi-automated at the IVR with speech-to-text, menu selection, or a fully manual process of the caller speaking the address to the operator to in turn be typed into the service application. In all cases, the caller engages in a “manual” process of providing his/her location.
2. **Database Look-Up** – the caller location is accessed by using the caller ID or a caller-provided user ID from an enterprise, telephone carrier, or other database. Database lookup requires a source of stored locations for fixed callers, so this method is not applicable to the mobile caller.
3. **Computed Wireless Location**– geometric computations of caller location using wireless signal measurements such as those received from GPS satellites or wireless network base stations. In some cases the resulting location may be limited to a predetermined area such as that defined by the signal coverage of a cell site or sector.

Manual Entry – Wireline or Wireless

Manual entry of caller location can be very precise, since the caller can state any location they desire, where they are now (“I’m calling from home”) or an address required for service elsewhere (“My car is in the shop located at ...”). However, address capture can be inaccurate if mistakes are made by the caller, operator or speech-to-text system, or if the caller simply doesn't know his/her address. Sometimes no address is available, such as on a road between towns.

Speak Your Address: Today's most common user input for a precise location is answering the question “Where are you?” to a live operator or speech recognition system and providing a full street address, city, and state. Errors in spelling, data entry, or simply misunderstanding may introduce errors. The process can be time consuming and may not be applicable to the mobile user.

Enter Your ZIP Code: A commonly used method of entry on web pages and voice input is asking for the caller's zip code to ascertain coarse location such as city, town or neighborhood. This can be less time consuming and less susceptible to entry errors than manually entering or speaking a full address and can be very useful for calls originating from one's home or office. However, this is often found to be useless and aggravating to the mobile or traveling user who doesn't know the zip code from where they are calling.

Database LookUp

There are a number of static database sources that can be used to look up the caller's location based on an index or key, typically these use the caller ID (phone number) of the caller. Some

of these databases create a one-to-one relationship between the ID and a location, such as the address corresponding to a fixed phone line. Others have a many-to-one relationship with multiple entries for home, work, school, etc., and the user may be asked to indicate which one is applicable at the time of a call. Still others are designed for the mobile environment, identifying the fixed location of each cell site in a wireless network and associating a mobile caller's current location with the location of the site in use for communication.

Caller ID Key: Fixed line 911 is an extremely effective, accurate, life saving example of identifying caller location based on the caller's phone number delivered by the telephone network, known as "caller ID". When a caller dials 911 from a landline, the service address is retrieved from a database to be presented to the emergency services operator. The 911 industry makes a substantial investment in maintaining the integrity of the address database. However, this 911 database is not available for commercial use, due to privacy constraints. Commercial databases based on telephone company records are a source of caller addresses; however unlisted phone numbers, virtual numbers, and lagging record updates can result in unknown or inaccurate results. If an enterprise has its own CRM database that includes wireline phone numbers of its members or customers, it can be a good source of accurate caller location using the caller ID key. However, this is only true if the call originates from the phone number stored in the customer database.

User ID Key: Some enterprise applications may use a location-specific code as a key to access a stored location record. Either a fixed location caller or a mobile caller manually enters a defined key for their location that maps to a predefined list, such as in a mobile worker application visiting a pre-defined customer site. The method can be efficient; however the caller location is only applicable to trusted uses, since the validity cannot automatically be validated.

VoIP Key: IP routed calls may provide router and access point identifiers that can be used to access caller location from databases that have been compiled from various sources of geocoded IP addresses, including some open sources. The accuracy of such information can be very good, or quite poor and may include triangulation (described below for cell towers) to refine a location using signal measurements from multiple Wi-Fi access points. This is a technology that is still evolving as a commercial source of accurate location information.

Cellular Tower and Sector: Mobile network operators survey and record the geographic locations of their cell site towers and create radio network plans that model the radiated signal around those towers ("coverage"), or cells, which are often segmented into pie-shaped wedges called sectors. The geographic center point of each cell-sector is determined by the operator and stored in a database. These "cell" and "sector" centroid entries are uniquely identified in the network operator's databases and can be used to estimate a mobile caller's location based on the cell-sector being used for communication by the caller's mobile telephone. This method of location is commonly referred to as a "cell ID" or "cell-sector" location. The location provided is a latitude/longitude approximating the caller's location as accurately as a city block in dense, urban environments, to as coarse as many miles in rural areas.

Computed Wireless Location

Computed locations of varying accuracy can be determined by measuring and processing signals received by mobile telephones from global positioning system (GPS) satellites or cell towers in wireless networks. The ability to locate mobile phones became common in the U.S. in the late 1990's after being mandated by the U.S. government for enhanced wireless 911 services. The Federal Communication Commission (FCC) required all U.S. wireless service providers to support wireline "equivalent" caller location for public safety purposes.

The FCC's Enhanced 911 (E911) rules established accuracy standards for emergency caller location that have driven solutions the location technologies deployed by wireless operators such as AT&T, Verizon, Sprint and T-Mobile. The FCC accuracy solutions standards, adopted in 1996 and 1999, are shown in the adjacent table.

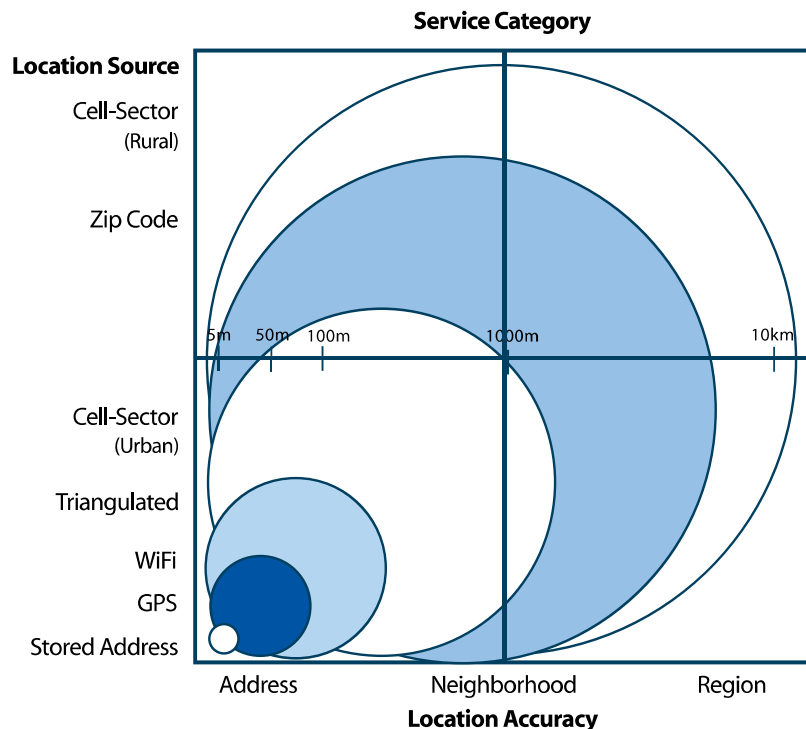
FCC E911 Location Accuracy Requirements		
	67% of calls	95% of calls
Handset-based solutions (e.g., GPS)	≤ 50 meters	≤ 150 meters
Network based solutions (e.g., triangulation)	≤ 100 meters	≤ 300 meters

GPS: GPS technology is ubiquitous in everything from cell phones to vehicle navigation systems to pet locating collars and more. In the U.S. and Canada, virtually 100% of CDMA phones are equipped with GPS technology – that's more than 150 million such devices! CDMA phones and many smart phone models in use by all wireless carriers, GSM/UMTS and CDMA, provide GPS location capabilities using highly accurate chipsets from manufacturers like Broadcom, Infineon, SiRF, QUALCOMM, and others. GPS typically provides the latitude/longitude (lat/lon) of a caller's location within accuracies ranging from just a few meters to dozens of meters.

Tower Triangulation: Mobile phones continuously monitor signals received from nearby cell sites to select the best serving cell and to facilitate hand-off from one cell to another as the user moves about. Location servers in the carrier networks process information from multiple cell towers, combined with cell phone signal measurements derived from timing, angle, and/or signal strength. These servers determine mobile phone location using any of a variety of triangulation and trilateration methods known by acronyms such as TDOA, AOA, AFLT, EFLT, RTT, RFS, E-CID, and more. These geolocation methods provide an estimate of where a caller is located that is typically accurate to within a hundred to a few hundred meters.

Estimate of the Computational Error: Unlike database look-up of caller location information, the accuracy of a computed location can vary depending upon the accuracy of the measurements used to derive the result, the geometry of the satellites or cell towers, and signal propagation anomalies in the vicinity of the mobile phone. The various computational methods used to determine the caller's location also provide an estimate of the error associated with each resulting location.

Computed location lat/lon values are usually accompanied by a value called Uncertainty that is an estimate of the location error in meters. This error estimate, or Uncertainty, is a statistical measure representing the distance between the computed location and the caller's location with a certain degree of confidence, typically 67% or 90% depending on the technology used. Therefore, just as a database lookup of a caller's location can be wrong due to data entry or transcription errors, a computed location may be farther from the caller's actual location than the error suggested by the Uncertainty with a probability typically of about 10% to 33% (100% minus the confidence). The adjacent figure illustrates the typical levels of location accuracy achieved by the various location methods described above.



Time to Location Fix

Another factor in obtaining caller location is the response time, or as it is commonly called “time to fix” or “time to first fix”. This is time required to obtain the caller's location when requested from the wireless network's location server. The time can vary from “instant” (less than a second) to tens of seconds, depending on the location technology used and other factors such as wireless network congestion. Even “instant” database lookup can take time such as the “Please wait while I look up your address” response from customer service operators.

Depending on the method, three factors can contribute to the time required to obtain the caller location:

1. Time for the caller to verbally state their location
2. Database access time for the system to look up the caller location
3. Time required to gather the signal measurements and compute the location

Accuracy and time to fix are most often a trade off. A caller stated address may be highly accurate, but require the longest amount of time to collect. A GPS location fix that can be equally accurate requires capture of satellite signal measurements, transmission of measurements across the wireless networks and location computation which can require from 10 to 30 seconds. And lastly, the database lookup generally has the capability of being “instant”, even sub-second, but may provide only a coarse location for wireless callers.

Mobile Caller Location Privacy Considerations

Beyond the performance and operational aspects of mobile caller location technology, this new capability brings along its own set of rules around consumer privacy and data security. Today, the personal data of mobile callers, including location, are carefully protected by wireless carrier policies and technology. The work of trade organizations is helping to foster the uniform application of these policies. Best practices and guidelines have been advocated by wireless trade groups such as the Cellular Telecommunications Industry Association (CTIA) and the Mobile Marketing Association (MMA). The current rules for mobile telephone location privacy are based on two key precepts: the caller's permission must be explicitly requested and granted before his/her location may be obtained; and the caller must be clearly informed of the intended use of the location information. The caller's consent may be obtained temporarily for a one-time use or persistently for recurring uses. In the latter case, the caller must be periodically reminded that he/she has granted consent to be located and informed of the means by which he/she may revoke their consent.

Conclusions and Lessons

The principle lessons to be applied by call center IT and IVR solution designers is that the answer to "Where are you?" can come from a variety of sources and be provided with varying degrees of accuracy. Traditional methods that simply ask the caller result in a cost to the call center and to the caller in time, money, and convenience. This "manual" method also suffers from the inability to help locate a caller that does not know their location, communicates it unclearly, or is incorrectly recorded by a customer service agent or speech-to-text system. For enterprise applications and services that can be enhanced by locating the caller, doing so in a way that assures the greatest accuracy and minimizes the time required to obtain the location information will deliver the maximum benefit in terms of operating efficiencies, customer satisfaction and service costs. New technologies available from wireless operators to solve the challenges of accurate and timely mobile caller location are now available. Applying these technologies properly to call center and IVR applications can deliver benefits that have not traditionally been possible to date.