The Benefits of Geospatial Routing for Today's 9-1-1 Systems

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Executive Summary

In addition to meeting the Next Generation 911 vision of real-time, location-based call delivery, geospatial routing also provides significant benefits to legacy environments. Systemic issues with the selective routers currently used in legacy architecture create lag times in information updates from the three distinct databases upon which they rely. The lack of synchronicity in data results in downstream errors causing significant pain points for the users, service providers, and the PSAPs that depend on the 9-1-1 system.

Geospatial routing is purpose built to eliminate those problems by integrating all the critical call variables at the time of the call with *Real-Time Network Routing*. The most-up-to-date user information, location information, and PSAP information are integrated at the time of the call in total synchrony, reducing call routing errors. Geospatial routing excels over current technology in meeting today's demands for accuracy, reliability, and resiliency.

Current System Description and Limitations

Most installed 9-1-1 selective routers offer a combination of one or more of these features:

1. *Automatic Location Identification* ***(ALI)*** forwards the calling telephone number's registered address and billing name for display to the PSAP, and *emergency services routing digits* ***(ESRD)*** forwards the cell site/section serving the caller.

   Limitations:

   - Pre-registration of land line and cell site addresses into a separate address database is the single biggest contributor to lag time and synchronization issues with the selective routers used today. Current systems require subscriber registration through a complex back office procedure requiring human intervention, manual updates, and address validation lookups in address range databases. This process renders the subscribers' changes labor intensive and slow to complete. A lag time of one to three weeks is typical for land line order completion causing database gaps and known errors while the system catches up to the new address.

   - The address ranges defining valid addresses often change, rending the address invalid when, for example, the county renames the street. The ALI administrator must schedule updates to the ALI databases to update address ranges, and the resulting lag time can render whole sections of subscribers on the same street "invalid" during such an event.

2. *Automatic Number Identification* ***(ANI)*** forwards the calling telephone number to a PSAP for display and callback of landlines and, the *emergency services query key* ***(ESQK)*** achieves a similar function for mobile directory numbers and VoIP phones.

The equipment used today requires that the NPA-NXX of the ANI's for all potential callers must be loaded into the selective router ahead of time, and, generally, the numbers that can be loaded are defined by the rate center boundaries in the selective router administrator's area rather than being defined by the PSAP jurisdictions.

Limitations:

- There are boundary mismatches in the database due to the nature of NPA-NXX rate center differences from PSAP boundaries. Calls for an entire rate center that should not be sent to a given PSAP may be sent anyway just because the PSAP is responsible for a few of the telephone numbers in the rate center. These callers must then be transferred by the receiving PSAP to the appropriate PSAP losing valuable time.

  Most telephone company 911 tariffs even spell out that the PSAP will be required to accept calls outside their jurisdictions and must be prepared to transfer these out-of-territory callers to the proper PSAP, placing extra burdens on the dispatchers and charging the PSAPs for the subscribers in these rate centers.

- If the landline subscriber's ANI does not match the NPA-NXX that has been loaded into the selective router, then the subscriber is either issued a new number or given a "Pseudo-ANI" that is already loaded. This process delays registration and eats up two numbers per subscriber instead of one. It can also cause confusion when the P-ANI displays as the callback number on the PSAP console.

- ILEC selective routing administrators do not offer service providers the less expensive direct peering IP trunks to send calls and display ANI; rather, only traditional SS7, CAMA, or PRI trunks are offered. These additional costs are borne by the PSAPs through cost recovery invoices from the service providers.

- ESQKs are the numbers used for the nomadic and mobile caller's temporary use during a 911 call. While the ESQK itself must be pre-registered just like a land line, its use does not require the subscriber to pre-register their own NPA-NXX in each selective router. Basically the subscriber is "borrowing" a local number for the moment. This unties the subscriber and allows them to travel freely between selective routers without delays in obtaining service due to pre-registration of their personal numbers. Landline CLECs and enhanced cable providers are often discouraged from or never informed about the possibility of using ESQK's to manage lag-time issues.

3. *Selective Routing **(SR)*** routes the 911 call to the correct PSAP when the administrator has loaded tables of ANI (or ESQK) NPA-NXXs matched up to the preferred PSAP and backup PSAPs for those numbers. The PSAP is coded in the SR table as an *emergency services number **(ESN).*** Sometimes ESNs represent smaller zones within a PSAP, in which case a PSAP may have multiple ESNs.

Limitations:

- The ESN is loaded into the selective router through human intervention using the MSAG tables. *Master Street Address Guide **(MSAG)*** administration is generally the same administrator as the selective routing administrator. It maintains the ESN-to-coverage area descriptions for each PSAP. There can often be 30-90 day lag times between an ESN boundary change and an update to the MSAG. Further delays are experienced when an engineer at the selective router has to update the ESN's from the MSAG to the selective routing table.

In summary, traditional selective routers and their NPA-NXX tables are not fully accommodating of subscriber ANI, ESQK, or trunk needs. In addition, they are not automatically integrated with the ALI databases and the PSAP ESN databases (the MSAGs), and, therefore, the registration process for landlines is a multi-step process from the start. It continues to have synchronization problems when the PSAPs update their street files, because the other two databases must be updated to accommodate the street changes in a separate step. The lag time between synchronization of the telephone number registration and the address registration and the ESN changes can create errors and discrepancies of up to 20-30% in the resulting call routes.

How Geospatial Routing Works

Using the latest geospatial technology and databases, the geospatial router integrates all the key variables into one efficient router and database system. The best part of the architecture is that individual tables can continue to be maintained by their expert owners but the owners need not worry about downstream data errors because there is no downstream data exchange. The data is all exchanged at the time of registration for test purposes, then again at the time of the 9-1-1 call. There is no need to go hunting for downstream databases that may have old data, because there is only one source (with backups, of course) for the primary data.

As an illustration, the geospatial router is able to tap into the PSAP information, the customer TN and address information, the network routing codes and information, the steering information, and PSAP formatting requirements information with each and every call to obtain the latest and most accurate information. There is no need to keep the customer database "in synch" with the PSAP ESN during non-calling times, because we know that information could change before a 9-1-1 call is launched. Rather than 'spinning wheels' to keep records updated with information that will continue to change, the geospatial router provides the ability to tap into accurate information when it is most needed: at the time of the call. This allows information owners to spend more time managing their primary data quality, rather than downstream errors caused by legacy system designs.

Figure 1 – Geospatial Routing

Geospatial Routing Solutions for Today's System Limitations

Geospatial Routing addresses the following pain-points of today's system:

- Registration lag time due to synchronization delays caused by using address range tables

  The VIXXI Solutions geospatial router providers 24 x 7 x 365 web access for user registration and address validation. In those cases where an address will not meet validation thresholds as entered, the system provides suggested valid alternatives to choose from. Over 99% of interactive registrations are validated on the first attempt, compared with the typical 80-85% using legacy methods and procedures.

- Updates to user addresses lag behind MSAG changes

  As depicted in Figure 1, the MSAG boundary changes and ESN assignment changes are checked during the call. Therefore, all updates that the PSAPs make to the Street files and MSAG files are captured up until the time of the call.

- Users beyond the PSAP boundaries are routed to the incorrect PSAP due to rate center overlap

  Only addresses that geocode to points within the PSAP boundary are forwarded to the PSAP during an emergency call. Callers outside the boundary are forwarded to their respective PSAP's. Also, subscribers outside the PSAP boundary will not be included in any subscriber counts used for billing or auditing.

- Need for P-ANI's on out-of-territory numbers coming into the district

  ESQK's enable nomadic users to be registers, without delays due to Selective Router NPA-NXX loading or acquiring and assigning additional pseudo-ANI's to users.

- Lack of flexibility in selecting preferred trunk protocols, especially IP trunks

  IP trunks offer the same QOS, when engineered properly, as traditional TDM trunking and often cost far less. All service providers will be able to utilize the most cost effective trunking and, thereby, reduce the PSAP E911 trunk reimbursement expenses.

- Untethering fixed providers from land line processes

  Fixed providers, especially CLECs who are offering both enhanced and traditional offers, will benefit from the ability to complete registration of new clients, including 911 registration, in the same sitting or session rather than having to access an MSAG database, an SR rate center database, and ALI upload process for fixed land lines. The geospatial router eliminates multiple step order processes by automatically handling these functions in a user friendly web application.

- ESN updates in the selective router lag behind MSAG changes

The geospatial router obtains the most up-to-date ESN information for a caller, at the time of the call, eliminating misroutes due to the old issue of lag times in updating the ALI records from MSAG changes. The latest ESNs entered into the geospatial MSAG will be utilized.

Given the multitude of 911 pain-points addressed by geospatial routing, it benefits all carriers, 911 authorities, and PSAPs to work with providers that offer this accurate, reliant, and resilient call routing technology.