NENA

ESQK Guidelines for VoIP to E9-1-1 Connectivity

Technical Information Document (TID)

ESQK Guidelines for VoIP to E9-1-1 Connectivity
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Prepared by:
National Emergency Number Association (NENA) Network Technical Committee ESQK Working Group

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NENA's Technical Committee has developed this document. Recommendations for change to this document may be submitted to:

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Acknowledgments:

The National Emergency Number Association (NENA) Network Technical Committee developed this document.

NENA recognizes the following industry experts and their companies for their contributions in development of this document.

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1 Executive Overview

1.1 Purpose and Scope of Document

NENA formed an Ad Hoc Working Group to address and provide guidance on VoIP E9-1-1 deployment issues that need a national approach – specifically Emergency Services Query Key (ESQK) assignment methods.

First and foremost, it is recognized as a preliminary matter that full compliance with the NENA Interim Solution (i2) recommended standard may not be completely feasible **in initial deployments**, due to dependency on establishing the core Interim Solution functions, such as Validation Databases (VDBs) and Emergency Services Zone Routing Databases (ERDBs) and associated Root Servers nationally. This should not delay initial VoIP E9-1-1 service or delay subsequent efforts and commitments to reach full i2 compliance and wireline equivalent service levels within a reasonable time as i2 capabilities become available. Second, it is also recognized that additional immediate guidance is needed related to the assignment of ESQKs, which are central to the provision of E9-1-1 for VoIP services.

This document is a guide to orient VSPs, ESGW operators, and VPC operators on the use and assignment of ESQKs for 9-1-1 Emergency Services Gateway (ESGW) to Selective Router (SR) connectivity and call routing. It is not in the scope of this document to explain exact details of any particular 9-1-1 SR, but to act as a way to understand the dynamics of the assignment and use of these routing codes. As stated earlier, this document is secondary to any network disclosure or other translation policy guides from any 9-1-1 System Service Provider. The reader of this document is encouraged to contact the 9-1-1 System Service Provider for any detailed questions on SR translations or policy details.

The Working Group seeks to give the reader the knowledge required to better understand and implement service, using recommended methods that are applicable in the field today.

2 Introduction

2.1 Operational Impacts Summary

The working group has determined that no additional operational impacts would result due to the recommendations set forth in this TID. Current operational environments with respect to Phase I or Phase II wireless call delivery would have addressed any issues related to the delivery of a routing key or query key as the ANI of a 911 call. The recommendation submitted by the working group minimizes the operational impacts associated with the application of an Emergency Services Query Key (ESQK) for 911 call delivery from a VoIP end point.

2.2 Security Impacts Summary

No security risks have been identified.

2.3 Document Terminology

The terms "shall", "must" and "required" are used throughout this document to indicate required parameters and to differentiate from those parameters that are recommendations. Recommendations are identified by the words "desirable" or "preferably".

2.4 Reason for Issue/Reissue

This document is issued to serve as a NENA Technical Information Document to address the need for guidance on obtaining, assigning and using ESQKs in the implementation of VoIP E9-1-1 service under i2 and pre- i2 infrastructures.

NENA reserves the right to modify this document. Upon revision, the reason(s) will be provided in the table below.

Version	Date	Reason For Changes
Original	03/09/2009	

2.5 Recommendation for Additional Development Work

None identified.

2.6 Date Compliance

All systems that are associated with the 9-1-1 process shall be designed and engineered to ensure that no detrimental, or other noticeable impact of any kind, will occur as a result of a date/time change up to 30 years subsequent to the manufacture of the system. This shall include embedded application, computer based or any other type application.

To ensure true compliance, the manufacturer shall upon request, provide verifiable test results to an industry acceptable test plan such as Telcordia GR-2945 or equivalent.

2.7 Anticipated Timeline

Application of the recommendation in this TID would follow current business practices.

2.8 Costs Factors

The working group considered three alternatives with regard to the administration of Emergency Services Query Keys in the implementation of VoIP E9-1-1 service under i2 and pre- i2 infrastructures. The recommended approach minimizes costs for all impacted parties.

2.9 Future Path Plan Criteria for Technical Evolution

In present and future applications of all technologies used for 9-1-1 call and data delivery, it is a requirement to maintain the same level or improve on the reliability and service characteristics inherent in present 9-1-1 system design.

New methods or solutions for current and future service needs and options should meet the criteria below. This inherently requires knowledge of current 9-1-1 system design factors and concepts, in order to evaluate new proposed methods or solutions against the Path Plan criteria.

Criteria to meet the Definition/Requirement:

1. Reliability/dependability as governed by NENA's technical standards and other generally accepted base characteristics of E9-1-1 service
2. Service parity for all potential 9-1-1 callers
3. Least complicated system design that results in fewest components to achieve needs (simplicity, maintainable)
4. Maximum probabilities for call and data delivery with least cost approach
5. Documented procedures, practices, and processes to ensure adequate implementation and ongoing maintenance for 9-1-1 systems

This basic technical policy is a guideline to focus technical development work on maintaining fundamental characteristics of E9-1-1 service by anyone providing equipment, software, or services.

2.10 Cost Recovery Considerations

Normal business practices shall be assumed to be the cost recovery mechanism.

2.11 Additional Impacts (non cost related)

The information or requirements contained in this NENA document are not expected to have significant technical or operational impacts, based on the analysis of the authoring group.

2.12 Intellectual Property Rights Policy

NENA takes no position regarding the validity or scope of any Intellectual Property Rights or other rights that might be claimed to pertain to the implementation or use of the technology described in this document or the extent to which any license under such rights might or might not be available; nor does it represent that it has made any independent effort to identify any such rights.

NENA invites any interested party to bring to its attention any copyrights, patents or patent applications, or other proprietary rights that may cover technology that may be required to implement this standard.

Please address the information to:

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2.13 Acronyms/Abbreviations/Definitions

See NENA Master Glossary of 9-1-1 Terminology located on the NENA web site for a complete listing of terms used in NENA documents.

The following Acronyms are used in this document:		
Acronym	***Description***	***** (N)ew (U)pdate***
ALI	Automatic Location Identification	
ANI	Automatic Number Identification	
ATM	Asynchronous Transfer Mode	
ATIS	Alliance for Telecommunications Industry Solutions	
CAMA	Centralized Automatic Message Accounting	
CAS	Call path Associated Signaling	
CBN	Call Back Number	
CdPN	Called Party Number	
CGL	Calling Geodetic Location parameter	
CHGN	Charge Number parameter	

The following Acronyms are used in this document:		
CpCAT	Calling party CATegory	
CPE	Customer Premises Equipment	
CPN	Calling Party Number parameter	
E9-1-1	Enhanced 9-1-1	
ESN	Emergency Service Number	
ESP	Emergency Service Protocol	
ESRN	Emergency Service Routing Number	
ESQK	Emergency Service Query Key	
ESGW	Emergency Services Gateway	
FCC	Federal Communications Commission	
FG-D	Feature Group D	
GDP	Generic Digit Parameter	
IAM	Initial Address Message	
ISDN	Integrated Services Digital Network	
ISUP	ISDN User Part	
LEC	Local Exchange Carrier	
MF	Multi-Frequency	
MSC	Mobile Switching Center	
MTP	Message Transfer Part	
NCAS	Non-Callpath Associated Signaling	
NPA	Numbering Plan Area	
OLI	Originating Line Identification parameter	
PAM	PSAP to ALI Message specification	
PSAP	Public Safety Answering Point	
PSTN	Public Switched Telephone Network	
RNA	Routing Number Authority	
SIF	Signaling Information Field	
SIO	Service Information Octet	
SS7	Signaling System Number 7	
TIA	Telecommunications Industry Association	
TID	Technical Information Document	
VSP	VoIP Service Provider	

****** Required entry of New or Update. Any change made to an existing Acronym, Abbreviation or Definition constitutes an Update.

3 Technical Description

This NENA TID provides a reference and guidelines for Public Safety Authorities, E9-1-1 SSPs, VPCs, and VSPs on the assignment of ESQKs. This document is subject to any network disclosure or configuration documents published by any company that provides interconnection to a SR.

4 VoIP Solutions Defined

NENA has defined three phases of VoIP deployment for E9-1-1: i1, i2, and i3.

4.1 9-1-1 Solution (i1)

The NENA i1 solution refers to immediately available technologies for VoIP 9-1-1 service.

4.1.1 Static/Fixed VoIP with Native Telephone Number

A solution that delivers E9-1-1 service for static/fixed VoIP users emulates a traditional wireline call. Static/fixed VoIP service refers to the inability to move the instrument while maintaining the same service characteristics. For those i1 solutions that emulate a traditional wireline call, the Callback Number (CBN) is transmitted from the i1 ESGW to the E9-1-1 SR via dedicated E9-1-1 trunks.

The CBN is the input to the selective routing process and is transmitted to the PSAP via traditional router-to-PSAP MF signaling schemes or Integrated Services Digital Network (ISDN) trunks or other signaling arrangements. The CBN is subsequently used by the PSAP to retrieve the Automatic Location Identification (ALI) information from the ALI database. Typically, there are NPA and porting restrictions that must be taken into consideration when using a CBN as the key to the ALI data. As with wireline, the ALI database is pre-provisioned at the time of VoIP service establishment with the subscriber's address. In i1 static solutions, the CBN travels from the ESGW to the PSAP in the call path. All of the ALI data is retrieved directly from the ALI database using the CBN as the query key. There is no ALI steering.

At this time, this solution is already supported by a number of service providers using existing landline trunk specifications.

This solution does not use ESQKs and is out of scope for this TID.

4.1.2 Nomadic – Native/Non-Native Telephone Numbers

Nomadic is a reference to a communication instrument that is constrained within an access network such that the location can be represented as a definitive civic address for that network attachment.

The end user may move the instrument from one network attachment to another but cannot maintain a session during that move. Non-Native Telephone Numbers refers to a telephone number that is not valid for the local exchange associated with the subscriber's location or location of the VoIP end point (e.g. different area code or international telephone number). Conversely, a Native TN is where the end user is assigned an NPA-NXX native to any of the local exchanges within the region covered by the customer's serving PSAP.

The i1 solutions for Nomadic – Native/Non-Native Telephone Numbers route 9-1-1 calls from a VSP to an appropriate 10-digit emergency number that serves the caller's area. Routing of the call is based on the caller's location. Examples of i1 solutions for these types of VoIP end points may use one of the following methodologies.

- **10 Digit Direct**: A subscriber record, including their address, are pre-provisioned and stored in a TN-to-PSAP 10 digit emergency number database using the subscriber's Telephone Number as the key. Once the pre-provisioning step has completed, an emergency call from the subscriber can be handled. The VoIP Service provider obtains routing instructions by querying the TN-to-PSAP database. The response to the query includes the designated local 10-digit emergency telephone number (TN) based on the caller's location. The VoIP Service Provider uses the returned TN to route the call through the public switched network. There is no Automatic Location Identification (ALI) record delivered with the call so no location information is available to the PSAP. If the agency has Caller Identification service and the callers TN was provided with the network signaling, the PSAP may receive the subscriber's callback telephone number otherwise, no call back number will be available.

- **10 Digit Mediated**: This is the same method as above with the exception that the caller is routed to the VSP's or a third party's contracted call center and the call may be transferred to the appropriate PSAP 10 digit emergency number manually.

It should be noted that the primary objective is to deliver ANI and ALI with VoIP originated 9-1-1 calls. Because the above solutions do not incorporate ANI and ALI as well as other limitations (not detailed in this TID), these solutions are not recommended.

4.2 Interim/Migratory Solution (i2)

The NENA Interim Solution (i2) has been designed to accommodate emergency calls originated by static and nomadic VoIP customers, without modifications to the existing E9-1-1 infrastructure.

The i2 NENA Standard is predicated upon existing wireless "Wireline Compatibility Mode" concepts described in J-STD-036. In order to provide some or all of the service options described in this document, some components of the E9-1-1 infrastructure (selective routers and/or ALI database) may need to be equipped with Wireless E911 features.

This solution involves the use of ESQK resources.

4.2.1 Delivery of a Single 10-digit Number

In the NENA VoIP i2 Migratory Solution as defined in NENA 08-001 Issue 1, only the ESQK is sent to the SR. The other ALI data is delivered via a separate data link to the ALI database. The SR uses the ESQK to query the SRDB (which may be an ALI-SRDB) for PSAP routing information, then sends the ESQK on to the PSAP with the call. The PSAP uses the ESQK to query the ALI database for the ALI data. The ALI database will obtain the location information and call back number from the VoIP Positioning Center (VPC) and will transmit it back to the PSAP. The VPC assigns the ESQK from a pool designated for a specific PSAP ESZ on a per call basis.

4.2.2 Delivery of Two 10-digit Numbers

NENA TID 03-503 - SS7 Guidelines for Wireline and VoIP Emergency Services Gateway Interconnection to 9-1-1 Selective Routers, describes a method for passing both the ESQK and the Calling Party Number (CPN) in band with the call signalling to the SR. While NENA i2 Issue 1 does not include provisions for the delivery of the CPN to the SR, it is nevertheless a solution that needs to be considered based on its potential merits. The i2 Issue 2 Working Group is currently assessing the possibility of delivering 20 digits to the SR.

Many North American E9-1-1 Service Providers supporting Wireless Phase 1 and 2 have already upgraded the Selective Routers to allow for the delivery of two 10-digit numbers to the Selective Router. To extend this capability to VoIP, it will require the ESGW to support the delivery of those (i.e., the CPN plus the ESQK) to the SR.

4.3 Definition of "pre-i2"

Pre-i2 evolved as the VPCs and VSPs implemented the concepts of i2 in the absence of many of the required components described in the NENA i2 standard such as the LIS, the ERDB and the VDB. There is no pre-i2 "standard". However, a description of a "pre-i2" VoIP solution would typically include the following functionality:

4.3.1 Location Validation

In the absence of a shared, accessible VDB, VPC vendors are using commercially available GIS Systems to geo-code the user provided civic address. If the user supplied address successfully geo-codes the address is considered valid. Some VPC operators are constructing proprietary VDB like databases by collecting MSAG data and using them for further address validation.

4.3.2 Routing

The standard i2 solution assumes the availability of MSAG based ERDBs for the purpose of determining proper call routing. In the absence of ubiquitous i2-compliant ERDB availability, however, VPCs have resorted to the use of GIS-based routing. GIS based routing entails geo-coding a civic address to a LAT/LONG and using a point and polygon algorithm with a set of shape files. This requires the maintenance of shape files at either the landline ESN or PSAP level depending upon the requirements of the 911 governing authority. Even after the evolution of MSAG-based routing per the NENA i2 standard, some legacy use of shape files may remain as a fall back mechanism in default scenarios.

Note: When the pre-i2 routing functionality fails and default routing must be invoked, it will be performed in the same manner as default routing in an i2-compliant solution. Calls may be routed to a 10-digit PSTN number at a PSAP, or may be defaulted to a commercial call center contracted by a VSP or VPC for human intervention.

4.3.3 ESGW Routing

In both an i2 and pre-i2 solution, all VoIP 911 calls are routed through an ESGW to the selective router via a route identifier established by the ESGW Operator.

4.3.4 ALI Steering

Some VoIP deployments rely upon ESQK shell records to be displayed upon receipt of an ESQK. Under the circumstances, this may be the best possible solution due to a lack of ALI steering between the ALI database and VPC. In this document, solutions that only deliver ESQK shell records are not considered pre-i2 because they deliver neither location information, nor call back number.

4.3.5 Single ESN vs. Multi ESN

Although pre-i2 technology can accommodate multiple ESNs per PSAP, most pre-i2 deployments have relied upon a single VoIP ESN per PSAP. In an i2 compliant implementation, separate pools of ESQKs are assigned per ESN that are the same as or equivalent to the wire line ESNs in the 911 MSAG. This is to ensure selective routing, selective transfer functions and display of ELTs comparable to wire line E9-1-1 services.

In most instances, the 9-1-1 Authorities have chosen a single ESN for VoIP and have established a new VoIP only ESN with VoIP-specific ELTs. However, some 9-1-1 Authorities have used only a single, existing landline ESN for routing. In these cases, a Call-Taker needs to be aware that the ELT information may not be accurate.

4.4 i3 IP-based Solution

i3 refers to technologies in which IP-capable PSAPs will receive E9-1-1 VoIP calls via an IP network with E9-1-1 features, replacing the existing TDM infrastructure as we know it. NG9-1-1 is beyond the scope of this document.

5 ESN considerations

For VoIP, use of wireless ESNs are not appropriate. VoIP service providers currently provide calling services that replace or replicate wireline-type service.

The ESN used for VoIP E9-1-1 should be either the primary routing ESN or the associated ESZ level administrative ESN. Use of administrative ESNs for assignment of ESQK pools depends on the availability of an i2 compliant ERDB function or the availability of wireline ESZ boundary information either in the form of `shape files' or tabular MSAG data that is supplied to the applicable VPC provider.

5.1 Pre-i2 Recommended Methods

For pre-i2 implementations, ESQK pools may be associated with a single primary routing ESN per PSAP. This is not ideal, and does not provide the equivalent of wireline E9-1-1 features, such as display of specific responding agencies in the ALI data and support of selective transfer capabilities. Pre-i2 arises due to the lack of VDBs/ERDBs and an automated LIS. Without an ERDB it is difficult to do ESZ level routing. In some circumstances 9-1-1 Authorities are requesting ESZ level routing using shape files that they provide and maintain.

5.2 PSAPs using Selective Transfer

The use of Selective Transfer supports the PSAP call taker's ability to have the E9-1-1 system automatically determine which responding agency should get a one-button transferred 9-1-1 call., This is based on pre-established database relationships, where multiple Fire, EMS, or even Law Enforcement responders exist within the PSAP's overall jurisdictional area. The ability to use this feature depends on the existence of a detailed ESN for that set of responding agencies per ESZ in the Selective Routing switch, as a function of the original 9-1-1 call processing. The presence of just an overall single primary routing ESN in the SR does not allow Selective Transfer to work.

As a result, in order for PSAPs who actively use Selective Transfer to continue this procedure for VoIP 9-1-1 calls, the ESQK pools for a given primary PSAP must be set up against each detailed ESN rather than a single Primary ESN. As an example, If the PSAP uses 20 detailed ESNs to support 20 different combinations of responding agencies or ESZs, twenty 20 ESQK pools will be required for the primary PSAP. VPC service vendors must accommodate the requirements for

ESQK pools for each detailed ESN where the Public Safety Authority requires it to maintain normal operations and levels of service.

5.3 Implications in choice of ESN on ALI Display

Use of the ESNs associated with the landline MSAG entries will result in wire line equivalency in the ALI Display at the PSAP. If the PSAP jurisdiction is served by multiple ESZs, then the use of a single VoIP ESN will result in an ALI display with nonspecific ELT information similar to wireless.

5.4 Implications of ALI Steering protocol

Unless special modifications are made by the VPC, applications where the PSAP ALI Messaging (PAM) protocol is used will not display a VoIP class of service. If PAM is used, ELTs sent from the VPC will be displayed at the PSAP. Conversely, in applications where the E2 or E2+ protocol is used, the ALI display will include a VoIP class of service and the ELTs will match the ESN of the shell record of the ESQK associated with the call. ALI steering links between ALI service providers and VPCs may support both protocols on a shared data link (i.e., a single link may be used for both VE2 and PAM).

6 ESQK Assignment and Management Methods

Careful consideration was given to the advantages and disadvantages of each ESQK assignment option and of what will achieve the best balance to maintain E9-1-1 functionality, transition to full i2 compliance, potential costs and efforts on involved parties, and conservation of numbering resources. It has been concluded by the Working Group that the best option for VoIP E9-1-1 deployment is that ESQKs pools be assigned by VPCs across all related VSPs.

6.1 Summary of Options

The NENA Interim Solution (i2) specifies ESQK pools by VPC by ESZ level ESNs. ESQKs will be assigned and administered by the Routing Number Authority.

For purposes of ESQK assignments, several options have been raised:

(1) ESQK pools assigned to VPC. VPC allocates ESQKs by PSAP ESZ for all interconnected VSPs;

(2) ESQK pools assigned to VPC. VPC assigns ESQK block to VSPs and allocates VSP block by PSAP ESZ; and

(3) ESQK pools assigned to VSPs. Each of these options has different advantages and disadvantages.

297 ### 6.1.1 Option 1

298 RNA assigns ESQK pools to VPCs by NPA and 911 Governing Authority. VPC allocates by PSAP
299 ESZ for use by all VSPs.

PROs	CONs
♦ Uses fewer ESQK pools than any other option and correspondingly fewer shell records are stored in ALI ♦ VPCs are generally more familiar with MSAGs and 9-1-1 databases than VSPs, and possibly more able to do routing on MSAG or ESN boundary. ♦ Fewer entities that need to be informed of ESZ-ESN updates by Public Safety Authorities ♦ Minimum effort required for new VSP to begin service ♦ Less testing required (testing of previously tested ESQKs does not have to be repeated with addition of new VSP) ♦ Minimizes exhaust of N11 codes for use as ESQKs ♦ May not have to increase ESQK pool size when adding a new VSP ♦ Can minimize the number of VSP to PSAP contacts ♦ Less administration for the RNA ♦ Where network based Selective Transfer is required, ESQK pools must be assigned to each ESN. Therefore fewer ESQK pools are required if ESQK pools are assigned per VPC ♦ Simplifies implementation of steering and maintenance of steering tables	♦ The CoID in the shell record is that of the VPC, in the event of a steering failure the VSP would have to be identified by contacting the VPC

300 ### 6.1.2 Option 2

301 RNA assigns ESQK pools to VPC by NPA and 911 Governing Authority. Each VPC further
302 allocates ESQK pools to each VSP on a PSAP ESZ basis.

303 The working group has included Option 2 to demonstrate that all possible ESQK assignment options
304 were reviewed. Option 2 shares all of the drawbacks of Option 3 without any of the benefits of

Option 1 or Option 3. In addition, Option 2 requires a significantly greater quantity of ESQK pools than either Option 1 or 3 and there has been no identified interest in Option 2 in the industry. Therefore the list of Cons for Option 2 has been omitted from this section. For a list of the drawbacks to Option 2, please see Section 5.1.3, Option 3, below.

6.1.3 Option 3

RNA assigns ESQK pools to VSPs by NPA and 911 Governing Authority.

PROs	CONs
♦ CoID of the VSP is in the Shell record ♦ VSP could become a VPC without acquiring ESQK pools.	♦ Uses many more ESQK pools than Option 1 and greatly increases the number of records are stored in ALI ♦ Greater number of entities that need to be informed of ESZ-ESN updates by Public Safety Authorities ♦ Increases effort required for new VSP to begin service ♦ ESQK pools for every VSP must be tested and dramatically increases demand on resources of all stakeholders, including PSAPs. ♦ Would increase the number of VSP to PSAP interactions and contacts ♦ More administration for the RNA than Option 1 ♦ If a VSP changes VPC, retesting of ESQK pools to the PSAPs would be required
	♦ Moving ESQKs from one VPC to another VPC may negatively impact live 9-1-1 calls. ♦ Where network based Selective Transfer is required, ESQK pools must be assigned to each ESN. Therefore the number of ESQK pools required increases exponentially. ♦ Greatly increases the complexity of implementing ALI steering and the maintenance of steering tables ♦ Accelerates exhaust of N11 codes for use as ESQKs.

	• If a VSP goes out of business, the ESQK pools assigned to the VSP may be stranded • Obtaining allocations requires a relationship with each 911 governing authority. Smaller VSPs may not have the capability to manage relationships with numerous 911 authorities. • In the event of an ALI failure, VPCs may be better prepared than VSPs to answer calls on a 24X7 basis for in-progress emergencies • Huge quantity of RNA Forms required • RNA ESQK pool sizing calculations, whether to establish a minimum number to allocate to a VSP or to determine the actual quantity required for a particular VSP, will result in rounding up. The resultant allocation has the net effect of increasing the quantities being allocated which may exceed actual need, and could potentially lead to a large number of ESQKs sitting idle for long periods of time

6.2 Recommendation

The working group considered the options listed above and recommends Option 1: *Assignment of ESQKs to VPCs, shared among all VSPs served by that VPC*. The practicalities of deployment and the more efficient use of numbering resources strongly favor Option 1. The primary value in Option 3 of having the identity of the VSP from the shell record, thus allowing the PSAP to contact the VSP even if the ALI query fails was recognized. However, that value is mitigated by losing the identity of the VPC in that instance, and it is the VPC which must address the ALI query failure. In addition, while some VSPs will have efficient 24/7 support for 9-1-1 calls that experience difficulties, not all VSPs are expected to have 24/7 staffed centers. The VPCs may be in the best position to immediately supply available information on the call, determine and correct the problem, and if necessary, bridge in the VSP with the PSAP.

7 ESQK Conservation

North American Numbers (based on E.164 ITU-T recommendation) are valuable resources that should be managed efficiently. ESQK assignments require number administration resources in the form of an RNA. The VPC operator, as a beneficiary of those resources, is expected to efficiently manage their number utilization. This includes proper initial pool sizing (understanding that the nomadic nature of VoIP may prevent an accurate sizing) and ongoing best management practices to ensure the appropriate number of resources are allocated. Furthermore, the VPC operators are expected to return to the RNA any unused ESQKs for reutilization elsewhere. Refer to the RNA Administration Guidelines [ATIS- 0300089 - p-ANI Administration Guidelines] for ESQK reclamation and returns. This document is maintained under the direction of the Alliance for Telecommunication Industry Solutions (ATIS) and the Industry Numbering Committee (INC). The RNA documentation is located on the ATIS web site using the following URL:
https://www.atis.org/docstore/product.aspx?id=22570

7.1 Aggregation of ESQK Pools

VPCs may acquire ESQKs in a variety of ways. A VPC may gain ESQKs that are associated with a given ESZ from more than one source, or in different allocations over time. Each of these assignments may have varying quantities of ESQKs. The VPC may treat all ESQKs for a given ESZ as a single pool, shared across all VSPs it serves.

7.2 VPC Leaving Business

Of the options listed above, Option 1 provides the best means to conserve ESQK pool(s) if a VPC leaves the business. ESQK resources allocated to a VPC operator that leaves the business must be returned to the RNA.

Since ESQK pools at a VPC are shared across VSPs for a PSAP ESZ, when a VSP contracts with a different VPC operator, the VSP will use the same ESQK pools shared by all other VSPs using that VPC operator. The VPC operator may need to evaluate the ESQK pools due to the addition of new VSP customers. Additional ESQK pools may be required to support the new PSAP ESZs not previously accommodated by the VPC operator with the introduction of a new VSP.

7.3 VPC Mergers/Acquisitions

When VPC operators merge their operations or there is a business acquisition of one VPC operator by another, this action may have an impact on the allocated ESQK resources. Option 1 above allows the least cumbersome method for ESQK conservation in the case of VPC mergers/acquisition. A thorough analysis of the ESQK pools that are in use by the separate entities, how they overlap and the amalgamated traffic requirements must be taken into consideration to properly size the number of resources required. After the analysis is complete, any excess ESQK resources must be returned to

the RNA. In a merger/acquisition situation, it is unlikely that the combined quantity of ESQKs assigned to both VPCs would be needed to serve their collective VSP clients. This may result in a significant number of ESQK resources being returned to the RNA.

7.4 ESZ mergers

With an ESZ merger (e.g., a PSAP consolidation) two or more ESZs may combine to a form a single ESZ represented by a single ESN. A thorough analysis of the ESQK pools that are in use for each ESZ must be conducted. After the analysis is complete, any excess ESQK resources must be returned to the RNA.

7.5 Pool Size changes in accordance with Subscriber Size

When a VPC operator gains or loses a new VSP customer, the VSP will use the same ESQK pools shared by all other VSPs using that VPC operator. The VPC operator may need to evaluate the ESQK pool size due to the addition or subtraction of a VSP customer. Any excess ESQKs should be returned to the RNA.

As the number of subscribers covered by a VSP significantly changes the ESQK pool size may have to be evaluated as above.

7.6 NPA Splits/Network Rearrangements

It may occur that an area code geographic split changes the permissible NPAs a PSAP can receive. For this to happen, all of the following conditions must apply:

- The split must be geographic.
- Telephone numbers in the affected PSAP boundary are changed to the new NPA.
- The PSAP is only capable of receiving 8 ANI digits from the SR.
- The PSAP can not accommodate the old area code.

This is expected to be rare, but possible. If it occurs, ESQKs allocated from the old NPA must be returned to the RNA and new ones from the new NPA allocated by the RNA.

8 ESQK Exhaust

ESQK resources are considered a public resource and are not owned by the ESQK Requestor or the RNA. The RNA will assign ESQKs to facilitate the most effective and efficient use of a finite numbering resource in order to prevent premature exhaust. As discussed in Section 5, the working group supports assignment of ESQKs to VPCs for shared use among VSPs (Option 1). This method of assignment maximizes the use of ESQK resources. However, even with the efficient management and use of ESQK resources, it is anticipated that the current ESQK resource (using the 211 NXX

and, in some cases, the 511 NXX) will reach exhaust as pre-i2 deployments convert to full i2 deployments and additional ESQK pools are required for landline ESZ boundaries.

The RNA is responsible for ESQK relief planning. The RNA will track and monitor p-ANI assignments (including ESQKs). When the projected exhaust of the 211/511 resources within an NPA[1] is within 2 years, the RNA will notify the Industry Numbering Committee (INC). INC will examine the available options and will determine the next non-dialable resource to be utilized for p-ANI purposes.

Refer to the RNA Administration Guidelines [ATIS- 0300089 - p-ANI Administration Guidelines] for additional information on the role of the RNA and the INC. This document is maintained under the direction of the Alliance for Telecommunication Industry Solutions (ATIS) and the Industry Numbering Committee (INC). The RNA documentation is located on the ATIS web site using the following url: https://www.atis.org/docstore/product.aspx?id=22570

Analysis of the ESQK quantities suggest that even 5-6 VPCs each with an average pool size of 5 ESQKs, and all primary PSAPs requesting VoIP carriers to route by landline ESNs in the USA is a combination that may exceed the available codes in the NPA-211 number set nationally. Exhaustion in many urban areas would occur more rapidly, due to the number of ESNs in use. This is rapidly accelerated if individual VSPs are assigned sufficient ESQKs (Option 2 or Option 3) instead of assigning ESQKs to VPCs (Option 1).

9 Roles and Responsibilities

The roles and responsibilities outlined below will coincide with Option 1 of the ESQK assignment and management methods.

9.1 VPC Operator

- Request ESQK resources from the RNA.
- Manage ESQK resources efficiently.
- Return un-used/obsolete ESQK resources to the RNA.
- Provide Projections of ESQK resources required to the RNA for resource planning.
- Work with the appropriate 9-1-1 Authority to determine optimal pool size and ESN coverage.
- Allocate appropriate ESQK during a 9-1-1 call.
- Establish new ESQK pools, as required when new ESNs are established.
- Establish shell records in the appropriate ALI DB for each ESQK assigned.
- Work with the applicable E911 SSP to determine the allowable NPAs for a given PSAP.
- Coordinate ESQK testing/verification with the VSP, ESGW, 9-1-1SSP and the appropriate 9-1-1 Authority.

[1] It is assumed that more than one NPA will be applicable and when the last NPA is exhausted this process will be invoked.

- Rework ESQK assignments from splits and merges of ESNs.
- Rework ESQK assignments from geographic NPA splits.
- Identify 24 x 7 contact for E9-1-1 emergency resolution.
- Work cooperatively with VSPs, ESGW providers, E9-1-1 SSPs, and 9-1-1 Authorities to resolve any failure scenarios regardless of which stakeholder initially became aware of the problem.

9.2 9-1-1 Authority

- Work with the VPC Operators to determine optimal ESQK pool size
- Determine whether single ESN or wireline equivalent ESNs will be used
- Establish MSAG entries to support ESQK shell records.
- Notify applicable entities of ESN additions or deletions
- Promptly inform the VPC and ESGW providers and identified VSPs of any 9-1-1 system changes that may affect E9-1-1 Service.
- Support all testing/verification activities to be undertaken by VSP, ESGW, or VPC, if applicable.
- Where the 9-1-1 Authority desires to assert more control over the ESQK assignment process, the 9-1-1 Authority may request to be an approver.
- Work cooperatively with VPCs, VSPs, ESGW providers, and E9-1-1 SSPs to resolve any failure scenarios regardless of which stakeholder initially became aware of the problem.

9.3 VSP

- Identify to the VPC Operators the quantity of end users and their geographical location to assist the VPC in determining ESQK pool sizes.
- Support all testing/verification activities to be undertaken by VPC, ESGW, or 9-1-1 Authority, if applicable.
- Promptly respond to any 9-1-1 system changes that may affect E9-1-1 service.
- Work cooperatively with VPCs, ESGW providers, 9-1-1 Authorities and E9-1-1 SSPs to resolve any failure scenarios regardless of which stakeholder initially became aware of the problem.

9.4 ESGW Provider

- Preserve the integrity of the ESQK and/or CBN received from the VSP and then delivered to the SR.
- Support all testing/verification activities to be undertaken by VPC, VSP, or 9-1-1 Authority, if applicable.
- Promptly respond to any 9-1-1 system changes that may affect E9-1-1 service.
- Work cooperatively with VPCs, VSPs, 9-1-1 Authorities and E9-1-1 SSPs to resolve any failure scenarios regardless of which stakeholder initially became aware of the problem.

9.5 9-1-1 SSP

- Load MSAG entries in appropriate ALI DB to support ESQK shell records.
- Load shell records in the appropriate ALI database for each VPC.
- Update SR DB with ESQK and ESN from ESQK shell records.

- Notify the RNA of changes/additions to NPAs in the 9-1-1 Selective Router.
- Promptly inform the VPC and ESGW providers and identified VSPs of any 9-1-1 system changes that may affect E9-1-1 Service.
- Support testing/verification activities to be undertaken by VSP, ESGW, VPC or 9-1-1 Authority, if applicable.
- Work cooperatively with VPCs, VSPs, ESGW providers, and 9-1-1 Authorities to resolve any failure scenarios regardless of which stakeholder initially became aware of the problem.