Virginia Information Technologies Agency

# Best Practice for
# Wireless 9-1-1 Call Routing
# Optimization

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# Commonwealth of Virginia
## Wireless 9-1-1 Call Routing Optimization

ABSTRACT:  This document has been created to serve as a best practice for optimizing the routing of wireless 9-1-1 calls in the commonwealth. It is an overview of how 9-1-1 calls are routed, how to determine if 9-1-1 calls from a specific cell tower sector are routed to the most appropriate PSAP, and overviews the process of working with 9-1-1 service providers to adjust wireless call routing when appropriate.

This publication serves as a recommended informational resource. As explained in the Foreword, use or implementation of any content in this document is optional and voluntary.

Developed by the

Integrated Services Program

in consultation with the

Best Practice Steering Committee

and/or appropriate workgroup(s)

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# Foreword

A best practice is a generally accepted method that, when followed, shows consistent superior results based on experience and/or research. Best practices should be used as a benchmark by which to maintain quality, and are an alternative to mandatory legislated standards. When developing a best practice, it is important to identify the core principle, purpose and/or goal of the practice, while allowing flexibility for how it is implemented so it remains flexible for a variety of local conditions. Also, when best practices are considered for implementation on a wide scale, the document's developers must remain aware of sites with minimal to no resources, and consider how those sites will be supported in order to create the desired outcomes.

This best practices document was developed through a collaborative effort by ISP staff, the Best Practices (BP) Steering Committee and applicable workgroups or committees, as well as individual subject matter experts (SME) who have volunteered their time and insights.

These are consensus best practices, and their use is voluntary. Management of PSAPs is a local responsibility. Decisions regarding applicable content and practices, including whether and/or how a Virginia locality should implement this best practice, are strictly local decisions. VITA and the 9-1-1 Services Board assume no responsibility or liability for any such decisions or other use of this document. This best practice is not intended to be an exclusive resource; the reader should also consider other qualifications, standards, or documents related to this topic. All best practices are subject to change and will be reviewed by ISP staff and/or the BP Steering Committee at least annually following its publication date.

Outside of scheduled review, comments regarding VITA ISP best practices are accepted at any time and can be submitted to Stefanie.McGuffin@vita.virginia.gov. If the comment includes a recommended change, it is requested to accompany the recommendation with supporting material. If you have a question regarding any portion of this best practice, VITA ISP will consider and/or respond to your question in accordance with applicable law, policies, and procedures.

# Acknowledgements

## Best Practice Workgroup

Integrated Services Program staff developed the content of this document which was review by the stakeholder community and the Best Practice Steering Committee.

# Abbreviations, Acronyms & Definitions

*Note: A complete listing of 9-1-1 specific definitions can be found on the NENA website and is called the [NENA Master Glossary of 9-1-1 Terminology](.)*.

For the purpose of this best practice the following applies:

| Term | Meaning |
|------|---------|
| Cell Sector | One face of a cellular antenna (typically 3-sided) that operates independently of the other sectors. |
| DBMSP (Data Base Management System Provider) | Entity providing Mobile Positioning Center (MPC) or Automatic Location Identification (ALI) data services to a wireless service provider. |
| pANI (Pseudo Automatic Number Identification)<br><br>AKA: emergency services routing key (ESRK) | A telephone number used to support routing of wireless 9-1-1 calls. It identifies the wireless cell tower, cell sector and PSAP to which the call should be routed. |
| Wireless 9-1-1 Call | A 9-1-1 call for service presented over wireless 9-1-1 trunks with a class of service shown as WPH0, WPH1, WPH2, WRLS or MOBL. |
| Wireless Trunk | Communication path between the 9-1-1 Selective Router (SR) and a PSAP through which 9-1-1 calls by wireless devices are sent. |

# Chapter 1: Introduction

## 1.1 Scope

This best practice has been developed to support and/or strengthen the efficiency of routing wireless 9-1-1 calls to PSAPs in the commonwealth. Use of this best practice will promote the standardization of a methodology for determining appropriate routing of wireless 9-1-1 calls among PSAPs.  It will also provide consistency in optimizing the efficiency of wireless 9-1-1 call routing and thus, reduce 9-1-1 call transfers and ultimately decrease response times across Virginia. Using the best practices contained in this guide, and other documents and standards cited within, PSAPs should develop, document, and continuously train on and refine these processes and procedures to specifically meet the needs of their environment and operations. This document explains how to identify, investigate and correct wireless cell sector 9-1-1 call misrouting or inefficient routing. A best practice for identifying, investigating and correcting individually misrouted wireless or VOIP 9-1-1 calls, will be developed in the future.  For further information, users of this document should also refer to the *NENA E-911 Wireless Maintenance Call Routing & Testing Validation Standard* (NENA 57-002), and implement any applicable information suitable to their operational needs.

## 1.2 Purpose

According to the fiscal year 2016 Annual True-up[1] (a process where PSAPs report their annual call load numbers) more than 75% of 9-1-1 calls are delivered to PSAPs over wireless trunks. PSAP personnel involved in the call routing process must understand how wireless 9-1-1 calls are delivered to the PSAP.  Reviewing, understanding and implementing the guidance in this document will assist with identifying when the call routing plan should be adjusted to reduce the number of 9-1-1 call transfers and reduce emergency service response times. Thus, the efficiency of the PSAP and service to the public will be improved.

# Chapter 2: Wireless 9-1-1 Call Routing

## 2.1 How Routing is Determined

As cellular towers are erected, the wireless service provider or the DBMSP will contact the PSAP covering the area where the tower is located and will have them review information about the tower. This information may include a call routing and testing validation workbook/spreadsheet and a call routing or cell sector coverage area map. After reviewing this information, along with local GIS datasets as necessary, the PSAP will complete the appropriate sections of the spreadsheet detailing to which PSAP 9-1-1 calls from a particular cell sector should be routed, and then return the completed spreadsheet to the provider. This process will be done for initial deployment of towers, or as maintenance to towers occurs. PSAPs must review the routing spreadsheets and associated maps closely, and involve any resources necessary (e.g., wireless carriers, neighboring PSAP(s), ISP regional coordinators, reference local GIS data), to aid them in determining to which PSAP calls from

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[1] *Fiscal Year 2016 Annual True Up Numbers*. Retrieved from  http://www.vita.virginia.gov/isp/default.aspx?id=8488

each sector of a tower should be routed. A response shall always be provided by the PSAP. Remain aware that the spreadsheet(s) are sent to the PSAP that covers the area where the tower is located, however one or more of the cellular sectors may include area(s) covered by an adjacent PSAP(s) (see figure 1 below).
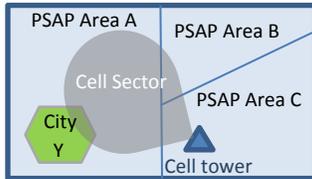


**Figure 1**: This figure depicts a cell tower in PSAP Area C with a NW cell sector that covers parts of Areas A & B and City Y, but primarily covers Area A. The PSAP in Area C, where the tower physically exists, will be the one to receive the routing spreadsheet. That PSAP should consult with adjacent PSAPs regarding the best solution for routing of this cell sector.

## 2.2 The Routing Process

In Virginia, calls made to 9-1-1 from a wireless device are routed to a primary PSAP in the following manner. The call is made and is received by an antenna on one of three sectors of a cellular tower. Each sector is assigned a pseudo automatic number identifier (pANI), which is a telephone number used to define which PSAP the call will be routed to. Once received by a sector, the call is passed to the mobile switching center (MSC) where information from a database is gathered (a data dip) to determine to which 9-1-1 selective router the call should be sent. Once at the selective router, another database is consulted and the appropriate PSAP to receive the call is determined. The call is then sent to that PSAP via wireless trunks, and then arrives on the call taker's console screen. Call information passed along with the call includes only the pANI. When the PSAP's call handling equipment retrieves the ALI record for that pANI, it includes the cell phone number, the carrier's name, and the address of the associated cellular tower with sector information. Coordinate information (latitude and longitude) regarding location of the caller may not be displayed to the call taker on this initial ALI. A re-bid of information (see Public Safety Call Processing Best Practice[2] for further information about re-bids) may be necessary to receive the most accurate caller location information. The accuracy of this information is dependent on several variables, but depends primarily on the technology (handset or network solution) in use and the location of the caller (indoors or outdoors). Figure 2 below, depicts the process of delivering a wireless 9-1-1 call to a PSAP.

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[2] *Public Safety Call Processing Best Practice*. Retrieved from
http://www.vita.virginia.gov/isp/default.aspx?id=6442476272

**Figure 2**: Wireless 9-1-1 Call Routing



## 2.2 Identifying Misrouted Calls

Each PSAP should develop a methodology and written procedure for identifying, logging, evaluating and determining next steps in dealing with misrouted 9-1-1 calls. There are several ways to identify misrouted wireless 9-1-1 calls and a variety of conditions that cause misroutes. Call takers may notice, during call processing, that they have received a wireless 9-1-1 call from a caller located outside their PSAP's coverage area, or, with time and experience, they may observe that they receive calls from certain cell sectors of a tower that they most often transfer. Each PSAP should have a process in place that educates call takers to notice these trends and to report them when observed.

For identifying misrouted wireless 9-1-1 calls caused by inefficient cell sector routing, PSAPs should utilize the ECaTS Wireless Call Sector report with criteria of "Percent transferred" set to >= 60%. This report provides transfer information based on cell sectors for a user specified date range. A report with this criterion will show if more than 60% of calls from a specific cell sector were transferred to the same destination PSAP (sample report below). PSAPs may also utilize call transfer reports from other management information systems (aka call accounting) they have in place. Reports should be run and reviewed at least quarterly and may need to be evaluated over time to give a clear picture of what is occurring, and thus providing more information to use in determining a path forward.

**Figure 3:** Sample ECaTS Wireless Call Sector Report

**Wireless Call Sector**
PSAP 1

Month - Year:          April 2014

| | |
|---|---|
| Report Date: | 02/25/2015 14:49:37 |
| Report Date From: | 02/01/2014 |
| Report Date To: | 01/31/2015 |
| Period Group: | Month |
| Calls in Sector (>=): | 1 |
| % Transferred (>=): | **60** |

| Originating PSAP | "Transferred to" PSAP | Cell Sector | Telco | Total 9-1-1 Calls | Total 9-1-1 Calls Transferred | Percentage of Calls Transferred |
|---|---|---|---|---|---|---|
| PSAP 1 | PSAP 2 | 2345 CELL SECTOR AVE | TMOB | 12 | 9 | 75.00% |
| PSAP 1 | PSAP 2 | 123 EAST BL TOWER 0629 D1 S | SPPCS | 10 | 6 | 60.00% |
| PSAP 1 | PSAP 2 | 123 EAST BL TOWER 0629 D1 S | SPPCS | 6 | 4 | 66.00% |

Once the reports are run, they should be evaluated with the "transferred to" PSAP(s) to determine appropriate next steps. PSAPs will want to consider these reports in context with known events or conditions to determine if a greater than sixty percent result is due to an anomaly (e.g. a random event, an earthquake for example, or a special event like a festival, that may have caused this percentage of call transfers) or if the trend of transfers continues over time. This evaluation will aid in determining next steps including if or when optimization is warranted. When considering re-routing a cell sector factors like population within a sector and access and unit response times should also be considered. VITA ISP staff are available to aid PSAPs in the call routing optimization process, and may produce wireless transfer reports for PSAP review and consideration.

# Chapter 3 Optimizing Wireless 9-1-1 Call Routing

According to the Commonwealth NG 9-1-1 Feasibility Study[3] and review of cell sector routing reports and data from the pilot statewide 9-1-1 data analytics initiative, it has been estimated that around ten percent of all 9-1-1 calls are transferred from the originating PSAP. 9-1-1 call transfers have several negative effects including: lengthening the duration of the call, typically increasing the time it takes to dispatch emergency response and creating a confusing and frustrating experience for the caller in an already stressful situation. Also, there is most often a loss of vital ALI data when a 9-1-1 call is transferred (see VITA's *9-1-1 Call Processing Best Practice* for further details regarding transferring 9-1-1 calls), and, call transfers occupy the time of multiple call takers when other calls may be in queue. While it is impossible to completely eliminate the need to transfer some 9-1-1 calls, care should be taken to ensure that calls are routed and received in the most efficient manner possible. This will ultimately have a positive effect on caller safety and outcomes, and call taker work load.

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[3] Mission Critical Partners, *Commonwealth of Virginia Internet Protocol (IP) Based 9-1-1 Network Based Feasibility Study,* May 2015. http://vita.virginia.gov/uploadedFiles/VITA_Main_Public/ISP/E-911/2015/FS_Revised.pdf

## 3.1 Wireless Call Routing Optimization Process

Using the observations, loggings and reports and reference information previously described, the PSAP has now determined that there is a routing concern relating to a particular tower(s) and cell sector(s). Following are steps that should be followed as a best practice for optimizing wireless 9-1-1 call routing.

### 3.1.1 Review Reports and Consult All Affected Adjacent PSAPs

As mentioned previously, each PSAP has authority for establishing the sector routing of the towers physically located in their jurisdiction.  However, it is important to keep in mind that adjusting the routing of a cell tower sector will also affect the call load and operations of adjacent PSAPs. It is paramount that PSAPs work together to determine the most appropriate routing of wireless 9-1-1 calls. PSAPs should jointly review all cell sector routing reports that reveal wireless 9-1-1 call transfer rates of sixty percent or greater. During joint review the PSAPs involved should determine if the current routing is acceptable due to operational considerations or if further investigation, monitoring or rerouting is warranted. Agreement among PSAPs on how to proceed should be reached.

### 3.1.1.1 Contact Wireless Carrier and/or Data Base Management System Provider (DBMSP)

Also during joint review, each affected PSAP should contact the wireless carrier(s) indicated on the reports or ALI feed and/or the DBMSPs to request the cell sector routing spreadsheet(s) and cell sector map(s), as well as to report the issue of misrouted calls. To aid in making these contacts, each PSAP should maintain contact information for the wireless carrier providers with service in the PSAPs coverage area. Once received, review of this information will also help the PSAPs determine the appropriateness of the sector routing and/or reinforce their intention to reroute. The call routing spreadsheets (aka. call routing form or cell sector routing spreadsheet) contain portions to be completed by the PSAP to specify rerouting requested. Instructions and a return contact are also provided on the spreadsheet.

**Figure 4**: Sample of a Call Routing or Cell Sector Routing Spreadsheet (PSAP completion section)

| PSAP To Receive Wireless 9-1-1 Calls | Wireless ESN | Customer Name | House Number | House Number Suffix | Street Prefix Directional | Street Name Field | Street Post Directional | Street Name Suffix | Community | Location (Building) |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | 470 | | | TOWER ROAD - NE Sector | | | | |
| | | Carrier name will appear here | 470 | | | TOWER ROAD - SE Sector | | | | |
| | | | 470 | | | TOWER ROAD - W Sector | | | | |
| | | | 470 | | | TOWER ROAD - NE Sector | | | | |
| | | | 470 | | | TOWER ROAD - SE Sector | | | | |
| | | | 470 | | | TOWER ROAD - W Sector | | | | |

*The yellow header reads:* PSAP to complete these Columns* — Provide and Format the Address as you prefer it to appear on the PSAP display. (Important Note: Format is subject to your Local Exchange Carrier requirements, PSAP equipment and solution.)

*Footnote:* *This section to be completed with information that corresponds with your local exchange carrier's information. If you choose to have your Wireless MSAG look like a Wireline MSAG, then please put the pertinent information in the appropriate columns. If you choose to have the entire address in the Street Field/Name (example: 123 E. Main St - NW Sector) please ensure that your CAD system can accept this addressing scheme.

### 3.1.2 Adjustment Confirmation and Testing

If it is determined that cell sector rerouting is necessary, the completed spreadsheet must be remitted to the DBMSP. The DBMSP will often require confirmation from the other affected PSAP(s) regarding the rerouting. Continued contact between the PSAP and the DBMSP and wireless carriers should be maintained throughout the adjustment process to assure that action is being taken and to understand the status of the adjustment. Once the PSAP is notified that the change has been made they should perform test 9-1-1 calls on a variety of devices from the impacted wireless carrier and in a variety of physical locations. If errors still exist further work with the carrier and/or DBMSP may be warranted.

# Conclusion

The routing of wireless 9-1-1 calls is a detailed process that must be understood, and reviewed and assessed periodically, to assure it is occurring in the most efficient way possible. The information and best practices detailed in this document will assist PSAPs in determining if current call routing should be adjusted to increase efficiencies and service to the public. The best practices included in this document should be incorporated into local policies and procedures as the locality, agency, department, and/or division see fit.

## Version History

| Version | Summary | Date |
|---------|---------|------|
| 1.0 | Initial BP document developed by the ISP staff. | 2/8/2017 |
| 1.1 | Final draft after review by staff, steering committee, and stakeholder community | 7/25/2017 |
| 2.0 | Published document | 8/28/2017 |