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Communications Security, Reliability and Interoperability Council

March 2016 WORKING GROUP 1

Evolving 911 Services

Final Report – Task 1: Optimizing PSAP Re-Routes

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# Results in Brief

## Executive Summary

The Communications Security, Reliability and Interoperability Council’s (CSRIC) mission is to provide recommendations to the FCC to ensure, among other things, optimal security and reliability of communications systems, including telecommunications, media, and public safety.

Under current practice, a wireless 9-1-1 call is routed to a Public Safety Answering Point (PSAP) based on the originating cell sector that handles the call. For a variety of reasons, once a 9-1-1 call is routed to a primary PSAP, sometimes the call needs to be re-routed to a different primary PSAP. How 9-1-1 calls are re-routed is often based on Best Practices and Standard Operating Procedures.

Best Practices represent voluntary guidance for various communication network and public safety entities and allow each entity some flexibility. In this report Working Group 1 reviews legacy Best Practices and identifies those with continued relevance and modifies some legacy Best Practices to make them relevant in today’s environment. In addition, Working Group 1 has developed a number of new recommendations to optimize the re-routing process.

# Introduction

This final report documents the efforts undertaken by the CSRIC V Working Group 1 with respect to its Task 1 to review existing Best Practices, identify gaps in those Best Practices and make recommendations towards Best Practices that optimize PSAP reroutes.

## CSRIC Structure

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Communications Security, Reliability, and Interoperability Council (CSRIC) V** | | | | | | | | |
| **CSRIC Steering Committee** | | | | | | | | |
| Chair or Co-Chairs: Working Group 1 | Chair or Co-Chairs: Working Group 2 | Chair or Co-Chairs: Working Group 3 | Chair or Co-Chairs: Working Group 4A | Chair of Co-Chairs: Working Group 4B | Chair or Co-Chairs: Working Group 5 | Chair or Co-Chairs: Working Group 6 | Chair or Co-Chairs: Working Group 7 | Chair or Co-Chairs: Working Group 8 |
| Working Group 1: Evolving 911 Services | Working Group 2: Emergency Alerting Platforms | Working Group 3: EAS | Working Group 4A: Submarine Cable Resiliency | Working Group 4B: Network Timing Single Source Risk Reduction | Working Group 5: Cybersecurity Information Sharing | Working Group 6: Secure Hardware and Software – Security by Design | Working Group 7: Cybersecurity Workforce | Working Group 8: Priority Services |

Table 1 - Working Group Structure

## Working Group 1 Team Members

Working Group 1 consists of the members listed below.

|  |  |
| --- | --- |
| **Name** | **Company** |
| Jeff Cohen – Co-Chair | APCO International |
| Susan Sherwood – Co-Chair | Verizon Wireless |
| Trey Forgety | NENA |
| Dorothy Spears Dean | (VITA) NASNA |
| Christian Militeau | Intrado |
| Ryan Jensen | T-Mobile |
| Eric Hagerson | T-Mobile |
| Brice Hall | DHS |
| Tony Montani | Verizon |
| Laurie Flaherty | DOT |
| Willie King | CSD |
| Melissa Wood | Comcast Cable |
| Elaine Sze | AT&T Services, Inc. |
| Eric Parry | Utah Communications Authority |
| Roger Marshall | TCS |
| Kathy Whitbeck | Nsight |
| Firdaus Aryana | CenturyLink |
| Jeanna Green | Sprint |
| Peter Musgrove | (AT&T) ATIS |
| Jim Thompson | California Governor’s Office of Emergency Services |
| Brent Bischoff | Cox Communications |
| Andre Savage | Cox Communications |
| Steve Mace | NCTA |
| Roger Hixson | NENA |
| Greg Schumacher | Sprint |

Table 2 - List of Working Group Members

# Objective, Scope, and Methodology

## Objective

Working Group 1 of CSRIC V has been charged with completing the following two tasks:

**Task 1: Review Cell-Sector Routing Practices**

This objective is to review public safety and industry Best Practices and Standard Operating Procedures on Legacy, Transitional (IP-based) and Next Generation 9-1-1 (NG9-1-1) systems for rerouting 9-1-1 calls between PSAPs due to the use of cell sectors for routing purposes, and where necessary identify gaps and make recommendations towards optimizing PSAP re-routes. This report provides the recommendations of Working Group 1 for this Task.

**Task 2: Make Recommendations for Implementing Location-Based Routing**

This objective is to study and make recommendations on the architectural, technical, operational standards, and cyber security requirements of location-based routing that uses longitude and latitude information or other location identification methods (when available) to determine the appropriate PSAP to route a 9-1-1 call to when a 9-1-1 call is placed. This also involves exploring and reporting on the pros and cons of various sources of location information available for location-based routing, the reliability and accuracy of the sources, and the transition path to location-based routing of 9-1-1 calls from Legacy to Transitional and then fully deployed NG9-1-1 systems, in particular identifying the roles and responsibilities of key stakeholders involved in supporting 9-1-1 calls and existing and future standards to support the transition. Working Group 1 will deliver a report with guidelines and recommendations for this Task in September 2016.

## Scope

This report is focused on Task 1, Review of Cell-Sector Routing Practices.

Working Group 1 has identified numerous sources of public safety and industry Best Practices and Standard Operating Procedures related to re-routing of 9-1-1 calls following initial routing based on originating cell sector. Recommendations are based upon the Best Practices and Standard Operating Procedures that Working Group 1 was able to identify, and the collective expertise of Working Group 1 members.

## Methodology

### Identify Relevant Best Practices and Standard Operating Procedures on Cell Sector-Based Routing, and Rerouting

Task Force members sought to identify existing Best Practices and Standard Operating Procedures for legacy, transitional (IP-based) and NG9-1-1 systems that address wireless 9-1-1 call routing and re-routing. This involves both the initial routing decision and subsequent re-routing between PSAPs. Sources that were explored included associations, federal agencies, and individual states and localities. The Working Group also studied efforts in progress or recently completed in certain states to review routing and re-routing cases.

### Identify Gaps in Best Practices and Standard Operating Procedures

Working Group 1 members reviewed and analyzed each Best Practices and Standard Operating Procedures document to identify where gaps exist to optimize PSAP re-routes.

### Make Recommendations Towards Optimizing PSAP Reroutes

Upon review of existing Best Practices and Standard Operating Procedures, Working Group 1 members formulated recommendations for optimizing PSAP re-routes. For the initial routing decision, this included analyzing inter-jurisdictional coordination on MSAG Master Street Address Guide (“MSAG”) and Geographical Information Systems (“GIS”). This analysis addresses areas where cell sector coverage may lead to the routing of a 9-1-1 call to a PSAP that is not serving the jurisdiction of the caller, the initial set up and maintenance procedures for the wireless voice 9-1-1 call routing decision process, and analysis of existing data on routing and re-routing. The Working Group identified potential improvements to the current process, including transition considerations.

The Working Group next focused on re-routing and identified gaps and recommendations towards optimizing re-routing Best Practices. This included an assessment of whether current Best Practices and Standard Operating Procedures address re-routing issues associated with the deployment of legacy, transitional (IP-based), and NG9-1-1 systems that handle 9-1-1 calls for multiple jurisdictions operating in collaboration but which may not incorporate PSAPs bordering the regional partnership. Further, the Working Group considered situations causing the need to re-route, including immediately adjacent jurisdictions, radiofrequency coverage variances and call origination dynamics, policy routing rules that provide alternate routing for specific situations, failover routing due to exigent circumstances, and third party calling situations where the person in need is not in the same jurisdiction as the caller.

# Background

The timing of the wireless 9-1-1 call flow provides an explanation for the current practice of routing calls based on cell sector. Determination of Phase 2 estimated caller location takes on average 15 seconds. Thus, due to the critical, time-sensitive requirements of wireless 9-1-1 calls, wireless 9-1-1 calls are currently routed using a pre-agreed cell sector-to-PSAP arrangement. This method helps to provide PSAPs with a call volume that can be anticipated and in some cases, is associated with PSAP funding. Cell sector-based routing also helps to troubleshoot call routing issues. At the same time, cell sector routing presents certain challenges, such as when more than one PSAP is within the coverage area of a cell sector or radiofrequency propagation results in a 9-1-1 call not originating on the nearest cell sector. These challenges can cause re-routes of calls between PSAPs and can result in slower emergency response times.

However, advancements in wireless 9-1-1 location technologies may hold promise for enabling location-based routing. The potential to leverage these services into location-based routing may lead to quicker and more accurate routing of 9-1-1 calls to the PSAP in the same jurisdiction of the caller, thereby minimizing the need for reroutes between PSAPs. A number of legal, regulatory, technical and operational factors would need to be considered in moving to location-based routing, including reliability, accuracy, and cybersecurity. The Task 2 report will focus on the architectural, technical, operational standards, and cyber security requirements of location-based routing.

# Analysis, Findings and Recommendations

## Analysis

Working Group 1 members reviewed a total of 51 standards and best practices comprised from the following entities:  CSRIC Best Practice and previous Working Groups, Report to Congress-Legal & Regulatory Framework for NG911 Services, PSAPs, NENA, and FCC.  Each standard and best practice was analyzed for the 9-1-1 call routing and re-route coordination execution.  The Working Group categorized the Best Practices to determine what was still valid, needs modification, or whether a new Best Practice needs to be written.  Six Best Practices were deemed valid, six needed some modification and eleven new Best Practices were written to optimize the rerouting process within public safety entities.

## Findings

The Work Group found that some existing Best Practices directly related to the routing and re-routing of 9-1-1 calls to PSAPs and some, while not directly related, did have an impact on 9-1-1 call routing.  For example, Best Practices relating to obtaining wireless 9-1-1 Phase 2 location information have an impact on the decision a call taker makes on whether to re-route the 9-1-1 call and to where.  This architecture for 9-1-1 call routing could change if early, reliable location information becomes available.  WiFi, Bluetooth and handset location may be opportunities to provide routing data that could be used to provide more exact location information for initial 9-1-1 call routing.

## Recommendations

### Valid 911 Call Routing Best Practices

Members of Work Group 1 reviewed existing CSRIC Best Practices and have identified the following Best Practices as being related, directly or indirectly, to the routing or re-routing of 9-1-1 calls and are still valid as written. These are identified by the Best Practice number assigned in the CSRIC database:

9-9-3216 - For Network Operators that cannot default route 9-1-1 calls based on cell sector/tower location, switch level defaulted calls should be routed to a “fast busy” tone or to an appropriate recorded announcement.

9-9-3218 - Public Safety should provide Training to educate PSAP personnel as to the process to obtain E9-1-1 Phase II data.

9-9-3219 - Public Safety should provide training to educate PSAP personnel as to the proper meaning and interpretation of the E9-1-1 Phase II display parameters.

9-9-3239 - Network Operators, Service Providers, and Public Safety should implement testing and verification processes for 9-1-1 pseudo Automatic Number Identification (pANI) to prevent bad data from being entered into the wrong routing databases typically occurring at the Automatic Location Information (ALI) or Selective Router (SR) stage of the provisioning process.

9-9-3243 - Service Providers, Network Operators, and Public Safety should coordinate and perform necessary testing of all new call paths between their network and the emergency services network (e.g., Selective Routers, or the Emergency Services IP Network (ESInet)) that includes a test call using all routing elements.

9-9-0568 - Network Operators, Service Providers and Public Safety should establish routing plan so that in the case of lost connectivity or disaster impact affecting a Public Safety Answering Point (PSAP), 9-1-1 calls are routed to an alternate PSAP answering point.

### Modified 911 Call Routing Best Practices

Members of Work Group 1 reviewed existing CSRIC Best Practices and have identified the following Best Practices as being related, directly or indirectly, to the routing or re-routing of 9-1-1 calls and are still valid, but needed some modification. These are identified by the Best Practice number assigned in the CSRIC database. These Best Practices are shown below with the modifications shown as 1) a strike out of letters/words to be deleted and 2) new words in bold:

9-9-3215 - For Network Operators that operate Mobile Switching Centers (MSCs), the MSC should default route 9-1-1 calls based on cell sector/tower location **toward** the ~~proper~~ **designated** serving Public Safety Answering Point (PSAP) when necessary and where feasible.

9-9-3223 - Network Operators, Public Safety and Service Providers should implement dedicated **and as diverse** trunk groups **as feasible and commercially reasonable as possible** between the Mobile Switching Center (MSC) end office or similar source and the E9-1-1 Selective Router (SR), based on the geography served by the default Public Safety Answering Points (PSAPs).

9-9-3224 - Network Operators, Service Providers, and Public Safety should use dedicated **and diverse** Signaling System 7 (SS7) or Multi-Frequency (MF) controlled trunk groups **as feasible and commercially reasonable as possible** for the normal routing of 9-1-1 calls from originating switching entities to 9-1-1 Selective Routers(SRs) rather than using shared Public Switched Telephone Network (PSTN) trunk arrangements and where appropriate and necessary supported by service levelagreements.  **Network Operators, Service Providers, and NG9-1-1 PSAPs should use dedicated, geo-diverse and redundant IP connection points when feasible & commercially available.**

9-9-0901 - Voice over Internet Protocol (VoIP) Service Providers (VSP) should conduct extensive 9-1-1 call-through testing for environments that have a high user capacity (e.g., university campuses, large commercial enterprise campuses, and densely populated multi-tenant buildings/complexes) to immediately reduce the risk of misrouting a block of callers at a particular facility. ~~and in turn reduce the liability for those same entities~~

9-9-0902 - Service Providers and Network Operators when reconfiguring their network (e.g., changes to ~~Virtual Private Cloud~~ **VoIP Positioning Center** (VPC), Mobile Position Center (MPC), Gateway Mobile Location Center (GMLC), or Emergency Services Gateway (ESGW)) should assess the impact on the routing of 9-1-1 calls.

9-9-3240 - Network Operators, Service Providers, and Public Safety should establish ~~an assignment~~ a provisioning accuracy process ~~to send a list of all applicable Master Street Address Guide (MSAG) ranges to Virtual Private Cloud (VPC) and Mobile Positioning Center (MPC) operators~~ to ensure pseudo Automatic Number Identification (pANI) shell records are built correctly during original pANI provisioning to reduce negative impact ~~of errors related to data entry~~ **and mis-routing of 9-1-1 calls.**

### New 911 Call Routing Best Practices

Members of Work Group 1 have identified the following new Best Practices for routing or re-routing of 9-1-1 calls to public safety:

1. Public Safety should develop relationships and agreements with PSAPs outside of their normal service jurisdiction in an effort to improve their ability to handle calls in an overflow, backup, or disaster situation. Features within NG9-1-1 will help foster the capabilities available to PSAP administrators to meet these enhanced operational needs.
2. Network Operators, Service Providers, and Public Safety should develop procedures that consider the full capability of NG9-1-1, including the rerouting of calls from other PSAPs as a result of overflow, backup, and disaster situations. Inter-agency agreements should be updated to reflect the updated procedures.
3. Network Operators, where MSC capabilities exist, should default route calls based on the location of the cell tower, to the MSC-SR trunks designated for that cell site to the serving PSAP. Switch level defaulted calls shall be routed to a "fast busy" tone or, where that option is not available, to an appropriate recorded announcement.
4. Public Safety should conduct on-going regional meetings with several bordering or nearby PSAPs to clarify the wireless 9-1-1 call routing determination process. For example, it may be appropriate to route a cell site/sector based on the area covered or where the highest density population exists.
5. Public Safety should consider obtaining GIS data from bordering PSAP jurisdictions and expanding and testing their transfer list to bordering PSAPs. This is necessary as the routing of wireless 9-1-1 calls may require a PSAP to receive and transfer calls for an area larger than the wireline coverage area.
6. When the initial PSAP receives a call that should be transferred to another jurisdiction, the transferring PSAP should transfer to the primary PSAP for that jurisdiction and not directly to the secondary PSAP. While transferring directly to the secondary PSAP seems a time saver, it bypasses local protocols, causing confusion and disjointed responses.
7. Public Safety should use one year of 9-1-1 call data to determine the best PSAP to designate as the pre-selected PSAP under current routing sheet methods for each cell and sector. This may require coordination with adjacent PSAPs to make joint decisions on the most effective routing plans with wireless carriers. If there is a state level data group and/or use of wide ranging data across many PSAPs for call handling analysis, this can assist the overall analysis of routing.
8. Public Safety should avoid the use of cold transfers (non-handshake transfer) of 9-1-1 calls. The initial PSAP should transfer and stay on the line to coordinate already gathered info from the caller, rather than force the caller to repeat from scratch. This allows verification that the transfer was accurately performed, to avoid reprocessing of the call.
9. Public Safety should review 9-1-1 call routing decisions for a given area at least every 3 years.
10. Public Safety should review routing on new cell towers six months after deployment using call data captured at the PSAP to determine if routing should be adjusted. The review period could be extended to a year in areas with low call volumes.
11. Public Safety should keep call transfers for mobile 9-1-1 callers that move across public safety jurisdictions, at a minimum due to the potential increase to response time from the transfer coordination between the two jurisdictions. It is estimated that every transfer adds 45 seconds to response time.

# Conclusions

Members of CSRIC V, Working Group 1 reviewed various authoritative SME sources for existing Best Practices that dealt with 9-1-1 call routing to initial PSAPs and for re-routing practices between PSAPs. Working Group 1 found some limited Best Practices that were directly related to routing/re-routing practices and other Best Practices that, while not directly related, had an indirect impact on how 9-1-1 calls would be re-routed. For example, default and alternate routing practices could impact how the 9-1-1 call is initially routed in mass calling events or outages.

To that end, this document provides a review of existing, legacy Best Practices that directly or indirectly impacts 9-1-1 call routing/re-routing and identifies those with continued relevance in Section 5.3.1 and modifies others in Section 5.3.2 to make them relevant in the current 9-1-1 environment. In addition, in Section 5.3.3, Working Group 1 developed new recommendations to optimize the routing/re-routing process.