An Overview of Policy Rules for

Call Routing and Handling in NG9-1-1

NENA
INFORMATION DOCUMENT

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1   Executive Overview

This document is an overview of what policy rules are, how policy is defined, and the ways that they may be used. Policy rules influence the delivery of calls to a PSAP and, how these calls are handled based on call taker skill sets and other criteria. Policy Rules are defined and implemented by the governing 9-1-1 Authority.

2   Introduction

2.1   Operational Impacts Summary

The 9-1-1 Authority is responsible for determining the policy rules for their PSAP(s). Policy rules drive various aspects of call routing based on certain pre-defined or dynamically changing conditions. Identifying and establishing appropriate policy rules is a required part of the implementation plan for migrating to a functional NG9-1-1 system.

2.2   Security Impacts Summary

Acknowledgement of Security Standards, Guidelines and best practices is of vital importance when planning and implementing business rules/policy. NENA Next Generation-SEC - NENA 75-001, Version 1, February 6, 2010.

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 being issued to serve as a guideline for the development of Policy Rules in an NG9-1-1 system. 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	08/24/2010	Initial Document

2.5   Recommendation for Additional Development Work

As new implementations of NG9-1-1 become more widely available this document will be updated to provide additional guidance in developing policy rules.

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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

This document should be used when planning for NG9-1-1. Since NG9-1-1 requires many enhancements over the existing systems, the time required to migrate to NG9-1-1 will vary.

2.8　Costs Factors

This will be a new function and responsibility of the 9-1-1 Authority. Potential costs may be interfacing to a policy database as well as the labor cost of the person authorized to make updates to the database. Once the policies are established and built, it is felt that updates will be required infrequently and possibly only during a disaster, a major incident or a new capability.

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 considered for any cost recovery mechanism.

2.11 Additional Impacts (non cost related)

The information/requirements contained in this NENA document are expected to have impact to **9-1-1 Center operations.** The primary impacts are expected to include items such as:

- One or more staff members must be granted authority to create the policy rules

- The staff members granted authority must have the Technical and Operational skills to develop, create, modify, test, and implement the policy rules

- Improved coordination, communication, collaboration, and cooperation with 9-1-1 authorities and emergency responders at local, state and national levels will be required

- 9-1-1 Authorities must agree on all policy rules that may affect other PSAPs

- There must be an interface agreement in-place between all entities that share the ESInet

- A policy editor must be implemented along with a web service

- New SOP's must be implemented on how to handle the policy rules that have been implemented

- A needs assessment must be performed to identify any additional staff training that will be required once the new policy rules are implemented

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.

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2.13 Acronyms/Abbreviations/Definitions

Some acronyms/abbreviations used in this document have not yet been included in the master glossary. After initial approval of this document, they will be included. 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 Terms and Definitions are used in this document:		
Term	Definition	**(N)ew (U)pdate
Policy-based Routing Function (PRF)	A database function that analyzes and applies ESInet or PSAP state elements to route calls, based on policy information associated with the next-hop.	U
Policy Store	A data base that contains the policy rules.	N
Boolean Expression	An expression that contains logical (i.e. true or false) expressions and Boolean operators (i.e. NOT, AND, OR), i.e. "An Orange is a vegetable" is FALSE, 3 is less than 5 is TRUE	N
Policy Editor	A tool to edit policy in a user-friendly way.	N
Calls	A generic term used to include any type of request for emergency assistance (RFEA);and is not limited to voice	U
Queue	A stored arrangement of calls or data waiting to be processed	N
Web service	A self-contained, self-describing, modular application that can be published, located, and invoked across the Web. Web services perform functions that can be anything from simple requests to complicated business processes	N
Next Hop	Common IP packet routing term that indicates the IP address of the intermediate destination to which data packet's should be forwarded to along the path of the packet's final destination.	N

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3   Technical Description

3.1   Background on the Policy Routing

Public communication technologies have evolved significantly over the last 30 years. Telephone numbers refer not only to physical locations but also to specific individuals. Portable devices have enabled person-to-person communication on an unprecedented scale in human history. The rise of digital communication technologies have repurposed our existing telephone infrastructure and completely redefined our expectations.

Current (legacy) solutions for emergency communications reflect the constraints and requirements of the environment in which they were created. The capabilities of modern and near-future systems present new challenges for the next generation of 9-1-1 to overcome. Routing an emergency call based solely on its originating location and/or call type may not always provide the best solution for public safety. There may be instances where the normal routing destination is inaccessible, or the agency is unable to process the call. Current E9-1-1 technology is robust and its reliability proven. It employs functions such as alternate routing to deal with situations where the 9-1-1 call-answering agency may not be available to receive the call. This system however may rely on pre-programmed decision trees with a limited range of capabilities which could be compromised by widespread outages. Augmenting the legacy systems with new functionalities has proven to be challenging as demonstrated with the introduction of external systems to accommodate the routing and delivery of mobile wireless and IP-enabled calls.

NG9-1-1 technology allows the delivery method of a call to be dynamically altered based on conditions that exist at the time of the call and information that will come with the call. These conditions may include, but are not limited to:

- Network state
- PSAP state
- Location of the call
- Type of call (voice, multi-media, text)
- Language preference

Designed to be extensible, flexible, and easily adaptable to meet all needs, NG9-1-1 will allow customization and increased interoperability while preserving existing features.

3.2   Policy Rules and NG9-1-1

The functional elements of NG9-1-1 include but are not limited to the:

- Location Validation Function (LVF)
- Emergency Call Routing Function (ECRF)
- Border Control Function (BCF)
- Policy Routing Function (PRF)

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Software and databases within these functional elements control how calls will be delivered to PSAPs and how they will be processed. The software rules that control how this processing takes place are known as "Policies". Policy Rules are used to evaluate the many conditions (states) that exist within the NG9-1-1 functional elements. The logic contained within the Policy Rules is designed to automatically alter how a call is processed in response to different conditions that the call may encounter. The state of the destination PSAP or the content of Additional Data being transmitted with a call are examples of conditions that a Policy Rule may need to evaluate.

There are two broad types of policy rules:

- **Call Management Rules** modify call flow within the NG9-1-1 system prior to PSAP call delivery, and

- **Routing Policy Rules** modify normal call routing for time, date, PSAP availability, or similar conditions

These Policy Rules comprise the NG9-1-1 functional element known as the Policy Routing Function. The NG9-1-1 Policy Routing Function (PRF) allows Local 9-1-1 Authorities to establish the policies for call routing and handling within their PSAP coverage area. All calls will initially be routed based on the location of the call. The location information will be part of the call in NG9-1-1.

The Next Generation of 9-1-1 technology allows for the transport of calls over an IP network. Conventional telephone trunk lines will gradually become obsolete. NG9-1-1 calls will traverse secure IP networks as packets of information. These packets will originate at the caller's location and will then be delivered to the appropriate PSAP. The transport of the 911 call packets often involves multiple intermediate delivery points before the final destination PSAP receives the call. These delivery points are referred to as "Hops" within the IP network. An example of a hop can be seen with calls that begin with delivery to a Statewide 911 network. The Statewide network must pass the 9-1-1 call to its' next "hop" which may be a County network where the destination PSAP is located.

In NG9-1-1 the policy rules can dynamically alter the next-hop. The policy is determined primarily by the management of the entity (PSAP) that serves the area the call originates from, but policy elements from higher level authorities (e.g. the local, regional or State 9-1-1 Authority) may be involved. If a call is routed to another PSAP, the PSAP the call was re-routed too will have their own Policy take effect. If, for example, PSAP A is busy, the PSAP A policy may say to route the call to PSAP B. When the call is routed to PSAP B, then the policy rules of PSAP B will prevail.

Policy rules enable the NG9-1-1 system to deliver calls, based on current conditions and local needs. Policy rules enable the system to perform many functions including the following:

- Inspect information which comes with the call and change the priority of a call

- Automatically acquire additional data when it is available

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- Specify the delivery of a call to a specific position in the PSAP based on the skill set and or technologies available to a telecommunicator. Management of alternate routing and / or default routing

- Pre-definition of disaster routing

- American Sign Language over video, or, adding an interpretation service automatically to the call before or at presentation to the telecommunicator

- Automatic query for additional data that is not included with the initial call, such as: Structural floor plans, additional structure specific information, medical information, telematics information, etc.

- Optional ability to pass certain calls directly to dispatch or responding agency based on call type, call priority and circumstances indicated by additional data such as: sensor data and alarms, and high priority telematics (calls being sent directly to agency specified by the policy rules)

- Time of day, day of week, or even month of year

- Location

- Media Type (Text, Video, Picture, streaming data from sensors)

- Language Preferences (e.g. Spanish, French)

- Queue states

  - The number of registered agents (telecommunicators)
  - Number of working and /or active telecommunicators
  - The number of available telecommunicators
  - Current duration of active calls
  - Number of pending calls in queue
  - Current maximum and average waiting time of the queues
  - Number of active calls
  - Other real-time metrics

Or any possible combination of allowable defined conditions

3.3 Policy Rules Creation and Administration

Policy Rules will be created and maintained using a Policy Editor running over a web service. The Policy Editor will allow for the easy creation and modification of Policy Rules by authorized staff. The Policy Editor will allow the authoritative entity to specify and build policy without having to know programming language and policy rule semantics.

Policy Rules are stored as logical groupings or sets in a "Policy Store". The authentication to the web service identifies the agency storing or retrieving a Policy in the Policy Store. The rights

management policy (also stored in the policy store) can limit which users are allowed to retrieve, modify, and create Policy Rules. The rights management policy can also allow an agency to store policies on behalf of another agency. The Policy Store will contain all the policy rules for each entity.

3.4   Policy-based Routing Function (PRF)

As a call progresses through the network, routing decisions will need to be made to allow the call to move from its originating source to its final destination. Each time a routing determination must be made the Policy Routing Function (PRF) extracts a rule set from the policy store for the entity "serving" the next hop and evaluates the applicable rules. If applicable rules exist, the policy rule is applied and the routing decision for the next hop is made. At each hop the policy is applied by the PRF. The PRF may use the policy of the next hop destination, destination state, congestion state, time of day, and other elements to determine the proper routing of the next hop that will receive the call.

The PRF resides in the Emergency Services Routing Proxy (ESRP) for each hop in the network. The ESRP determines routing based initially on location and then on any applicable policy, to determine the next hop. The next hop is either another ESRP (i.e. a state or regional ESRP) or a terminating ESRP (i.e. an ESRP for the PSAP). When the ESRP queries the PRF, the PRF extracts a rule set from the policy store for the "serving" next hop and evaluates the applicable rules. Based on its policy rule evaluation, the policy rule is applied and the route decision made. The ESRP then forwards the call to the next hop.

4   Components of a Policy Rule

A Policy rule has three components: a Condition, an Action and a Priority.

A **Condition** is a requirement (or dependency) that must be satisfied before something else can happen. Conditions are noted as Boolean expressions and are evaluated as being ***True or False***. Conditions that may be used are varied and extensive, but may include:

- Next hop entity's availability
- Security posture
- Number of calls in queue
- Time of day
- Originating domain of the call
- Specific information about the call
- Location of the calling device

Once a Condition is evaluated as being True or False, a specific **Action** can then be taken. The Action can be a single action or a series of actions. For example if a Condition of "Is the PSAP receiving calls" evaluates to true, then the action is to send the call to the PSAP.

For those Conditions that evaluate to "true", there is an optional **Priority** that can be assigned. Policy rule sets should have priority to facilitate the application of the rules. The priority indicator is used to set a higher priority for certain rules. Priority does not change the "priority" of the call, only the order in which the policy is evaluated when multiple rules exist. For example, a Policy Rule indicating availability of a PSAP, would be assigned a higher number and, have priority over a rule for "Media Type" to prevent sending a call to a PSAP that was closed.

Priority is optional and if none is assigned, the rule is treated as if it has the lowest possible priority. If multiple rule conditions evaluate to true, only those with the highest priority are selected. Policy Rules that are selected then have their actions executed.

When all conditions for call delivery are normal there is a "Default" policy that dictates where a call will be delivered.   Most calls will route via this rule. Default policy rules have a priority of zero (0).

Policy Rules normally use the following syntax:

IF <condition> THEN <action> {<priority>}; <comment>
  <condition> is a Boolean expression that evaluates to true or false.
  <action> is a procedure or a series of procedures separated by commas.
  <priority> is zero or a positive integer, where lower values have a higher priority.

The following example illustrates how Policy Rules may be used within a PSAP routing policy:

IF <this Condition is true> THEN <perform this Action> {using this priority level}

IF <condition 1> THEN <route to PSAP A>{1}
IF <condition 2> THEN <route to PSAP B>{2}
IF <condition 3> THEN <route to PSAP C>{3}

The following are typical scenarios that will need to be addressed via Policy Rules. These scenarios are not written as Boolean expressions and will need to be converted to the correct syntax before being sent to the Policy Store:

- Send the call to the Primary PSAP that would normally receive the calls based on the location of the originating call. If the Primary PSAP is busy, send to the designated alternate PSAP. If the designated alternate PSAP is also busy, then send to the next available telecommunicator anywhere in the state or region.

- IF Primary PSAP NOT Busy THEN Send call to Primary PSAP queue, {priority 1}

- IF Primary PSAP busy AND Alternate PSAP NOT busy THEN send to Alternate PSAP queue, {priority 2}

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- IF Primary PSAP busy and Alternate PSAP busy THEN send to the queue of next available telecommunicator anywhere in the state or region {priority 3}

- If a call comes in with the preferred language is Spanish, then send the call to the Spanish queue

- IF preferred language equals "Spanish" THEN send call to "Spanish" queue{priority 4}

- If a call comes in with the media type as TEXT, then send the call to the TEXT queue

- IF media type equals "Text" THEN send call to "TEXT" queue

- If a call comes in with the event type set to Sensor (data only call) and the sensor type is a traffic flow and the flow (direction of travel along a roadway) indicator indicates the vehicle is traveling in the wrong direction of normal traffic, then send the call event notice directly to traffic control and to post a warning on the intelligent transportation system signs. Note that some calls may be data only calls, such as a sensor, and may not need to be sent to the PSAP, as in this example.

- IF event equals "Sensor" AND "Sensor Type" equals Traffic Flow AND "Flow Indicator" equals wrong direction of travel THEN send event to Traffic Control AND send event to Intelligent Transportation System AND send event to Traffic Sign Message Manager.

- If the number of calls waiting in the call queue is greater than some percentage of available PSAP positions, then send incoming calls to an alternate PSAP. This is an example of how a policy rule can be in place that will automatically re-route incoming calls on an as-needed basis.

- IF call queue greater than xx% of total PSAP Positions THEN send call to alternate PSAP

5   Examples of Conditions and Policy Rules

Below are examples of conditions that can impact call routing, and how these conditions can be incorporated into Policy Rules; these examples are for illustrative purposes only.

Element State

The *Element State* is a condition that is applied to a specific item (in this case a PSAP); it can be automatically determined or can be determined dynamically by PSAP management.

- Element State includes:
  - **Normal**: The element is operating normally, accepting calls and events
    - IF ElementState (PSAP Primary) = *Normal* THEN route to PSAP Primary

- **Unmanned**: (applies to PSAPs only) The PSAP is operating, but no staff is available to answer calls

  o IF ElementState (PSAP_A) = *Unmanned* THEN route to PSAP_B

- **Scheduled Maintenance**: The element is undergoing maintenance activities and is not processing calls

  o IF PSAP A between *Scheduled Maintenance* time to time (Scheduled Maintenance, time), then send calls to PSAP Alternate

- **Service Disruption**: The element has significant problems and is unable to answer calls

  o IF ElementState (PSAP Primary) = *Service Disruption*, THEN route to PSAP Alternate

- **Major Incident In Progress**: The element is operating normally, but is handling a major incident and may be unable to accept some kinds of calls

  o IF ElementState (PSAP A) = *Major Incident in Progress* THEN Route (PSAP_B)

- **Disaster**: The element is in a disaster condition and is completely overloaded

  o IF ElementState (PSAP Primary) = *Disaster* THEN route to PSAP Alternate

- **Going Down**: The element is being taken out of serviceDown: The element is unavailable

  o IF ElementState (PSAP_A) = *Going Down* THEN Route(PSAP_B) {1}

- **Coming Up**: the element is being put back in service

Queue State

The destination of every routing decision is conceptually a queue of calls. The queue can be large or small, it can have one or many sources entering calls on a queue, it can have one or many sources taking calls off the queue. The *Queue State* is a condition that indicates that a queue of calls within a downstream entity, such as a PSAP, has exceeded a pre-determined value. A PSAP call queue may be overloaded and may be unable to accept any additional calls. Overload is normally defined as exceeding the size of the primary queue that a PSAP's calls are sent to. Routing rules for the PSAP would then cause calls to receive an alternate call treatment:

- Calls can be diverted to one or more alternate PSAPs

- Calls can be diverted to an Interactive Multimedia Response unit

- Calls can be sent a "Busy" indication

QueueState (and implied "Reachable or Not Reachable" state) is an event that indicates the state of a queue to an upstream entity. The event includes the URI of the queue, the current queue length, allowed maximum length (Queue threshold) and a state enumeration including:

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- **Ready:** One or more entities are actively available or are currently handling calls being enqueued. Calls may be in queue

- **Blocked:** No entity is available or actively handling calls being enqueued. Blocked is a result of the queue being automatically filled up, or manually blocked until the queue is empty

- **Disabled**: The queue is disabled by management action and no calls may be enqueued - any incoming call would be rejected

Call Suspicion

The Border Control Function may be able to identify calls that may be part of a deliberate attack on the system. The Border Control Function inserts a parameter that comes with the call. The parameter Call Suspicion is enumerated by the following values:

- **Legit**: Call appears to be legitimate

- **Suspicious**: Call may fit a known attack, but the BCF is unsure

- **Bad**: Call fits a known attack pattern and is considered fraudulent

Policy Rules can become very complex. Some of the other conditions and variables that can be used when creating Policy Rules are provided below as an overview and should not be considered complete:

Time of Day/Day of Week

Time of Day can be used in Policy and it is expressed as TimeOfDay or DayOfWeek, where TimeOfDay is wall clock time (0000 to 2359) and DayOfWeek is Mon, Tue, Wed, Thu, Fri, Sat, Sun

- IF TimeOfDay < 0900 OR TimeOfDay >=1700 THEN Route (PSAP_C) {1}; Single shift PSAP divert to County except between 9 AM and 5PM

Security Posture is an event that states a downstream entity's current security state. The defined values are:

- **S1 = Green**: The entity is operating normally

- **S2 = Yellow**: The entity is receiving suspicious activity, fraudulent calls/events and is stressed, but is able to continue most operations.

- **S3 = Red: The entity is under active attack and is overwhelmed.**

- **Miscellaneous Conditions -** Call Source is the best determination of the domain of the service provider that handled the call.

- Specific headers in the call INVITE message such as Language, Priority, Subject, Organization etc

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- The location used for routing, expressed as PIDF

- Any element provided within the Additional Data about a call, caller, location or PSAP

6   Conclusion

This document is an overview of ESInet policy rules. Full cooperation among all involved entities at all levels will be required to properly implement ESInet policy rules. ESInet policy rules are evolving and a proactive approach to the proper development and use of these rules is required. Future versions of this document will go into more details about Policy Rules, including the management, auditing, development, and specific examples

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