NRIC VII

December 2005

FOCUS GROUP 1A
Near Term Issues for Emergency / E9-1-1 Services

Final Report

Table of Contents

1 Results in Brief

1.1 Executive Summary

The FCC has chartered NRIC VII to present recommendations regarding the following:

- Requirements for wireless location accuracy
- A consistent format for information passed to Public Safety Answering Points (PSAPs) for Phase 1 and 2 call and location information
- A consistent, common set of thresholds for the time required to complete database queries
- Identification of all major traffic concentration points in the E9-1-1 architectures and definition of the metrics and thresholds that should be used to determine where traffic concentrations are unacceptably high
- Near term emergency communications network Best Practices

NRIC VII Focus Group 1A (FG1A) was formed to study these issues and to reach consensus among the various stakeholders with regard to resolution. The stakeholders consisted of representatives from the wireless industry, the Public Safety community, and other participants in the wireless E9-1-1 industry.

Accuracy Requirements
The stakeholders approached the discussions regarding accuracy testing from divergent viewpoints. With considerable concessions from all parties, FG1A was able to reach a majority consensus[1] on its recommendations. Accordingly, each of these recommendations is dependent upon implementation and completion of all other recommendations and should be implemented as a whole. FG1A emphasizes to the Council and the FCC that the completion of the identified wireless work efforts within the Emergency Services Interconnection Forum (ESIF) are critical to the implementation of these recommendations.

Consistent Format for Location Information
Regarding a consistent information format, with the exception of the following four specific issues, Focus Group 1A has agreed that NENA 02-010, Data Exchange Standard, revised November 9, 2004, ensures a consistent format for

[1] One of the public safety organizations, APCO, although participating in this proceeding, elected not to support the final consensus document.

information passed to Public Safety Answering Points (PSAPs) for Phase 1 and 2 call and location information. The exceptions are as follows and are addressed in this report:

1. Standardization of Class of Service
2. Confidence and Uncertainty
3. Lat/Long display with Phase 1 calls
4. Cell Sector Identification and Orientation

Timing Thresholds for Database Queries

Optimum timing thresholds for database queries have been identified and are based on existing network element technology. Focus Group 1A addressed timing thresholds and did not address delivery of content or actions when timers expire.

Concentration Points, Metrics and Thresholds

In terms of concentration points, Focus Group 1A agrees that there are no concentration points in the network where concentration is unacceptably high. Furthermore, the group does not foresee any circumstance in which concentration will become excessive except as explained later in this report. In some cases excessive concentration can be mitigated by adding redundancy and/or diversity. Even in cases where such redundancy and diversity do not exist, however, Focus Group 1A does not necessarily recommend immediate implementation of such mitigation. The short term cost of duplicating soon-to-be replaced network components may outweigh the benefits of replacing the components with new and more reliable technology. Therefore Focus Group 1A recommends, where commercially reasonable, the implementation of such mitigation be considered on a forward looking basis as new E 9-1-1 systems are created and modified.

Note that congestion is not the same as concentration; therefore, recommendations for congestion will not be provided in this document. It is suggested that a future NRIC is the appropriate entity to review this issue.

Best Practices

After evaluation of all existing E9-1-1 Best Practices, Focus Group 1A carefully considered the recommendations within the scope of its Charter related to traffic concentration, size and diversity of different databases, and data processes that could reduce the number of queries, to determine if new Best Practices should be considered. Recognizing that a variety of implementations exists within wireless E9-1-1 Phase II, FG1A has identified 20 new Best Practices that should be considered for adoption by the NRIC VII Council, (see Section 4.5.2). The proposed Best Practices are related to, and provide opportunities for, improved

processes for not only network operators and service providers working to deploy Wireless Phase II, but also for public safety answering points where PSAP operational procedures can impact the E9-1-1 network.

1.2 Key Findings/Recommendations

The members of FG1A are pleased to provide these recommendations for the consideration of the NRIC and the FCC. The following sections provide greater detail and background for the below recommendations.

1.2.1 Accuracy Requirements

The issues and recommendations surrounding accuracy requirements include:

- Recommendations for Accuracy certification and reporting area
  - It was agreed that accuracy shall be certified and reported on a statewide basis after specified deployment levels are attained.
- Recommendations for Certification and Reporting area for carriers operating in rural areas
  - It was agreed that rural carriers will meet accuracy levels attained by Tier 1 and Tier 2 carriers within the rural carrier's coverage areas.
- Recommendations for Compliance Testing
  - Carriers agreed to certify compliance to the FCC at the State level using ESIF/OET based testing methods when Phase II deployment meets defined thresholds.
- Recommendations for Maintenance Testing
  - All parties agreed to maintenance testing concepts with specific methods and procedures, including accuracy verification, to be further defined by ESIF.
- Recommendations for Consolidated Representative Performance Statistics
  - Carriers agreed to provide representative performance characteristics for various topographical areas.
- Recommendations for Access to Compliance & Maintenance Testing Data
  - Carriers agreed to make test data available to the FCC and Public Safety upon request if confidentiality can be maintained.
- Indoor versus Outdoor Location Testing
  - All parties agreed to specified percentages of test calls that must be conducted from indoor locations for compliance and maintenance testing.
- Recommendations for Equipment Used For Location Accuracy

  - It was agreed that test equipment should be typical of equipment used by ordinary customers.
- Recommendations for Confidence and Uncertainty
  - All parties agreed that wireless carriers will provide, and E9-1-1 SSPs shall pass confidence and uncertainty estimates in accordance with standards being developed by ESIF.

1.2.2 *Consistent Format for Location Information*

These recommendations are forward looking, and are not intended to require conversions of existing deployments. Rather, these recommendations should be incorporated into future wireless E9-1-1 Phase 1 and Phase 2 implementations when commercially reasonable. They should also be considered as system requirements for future changes associated with Phase 1 or Phase 2.

Standardization of Class of Service

Focus Group 1A recommends that the following wireless Classes of Service be used consistently going forward:

Pre-Phase 1	MOBL
Phase 1	WRLS
Phase 1 data from a Phase 2 capable wireless service area	WPH1
Phase 2	WPH2

Further, Focus Group 1A recommends that the following actions should be taken to resolve inconsistencies in the use of Class of Service (CoS) for wireless calls:

1. The wireless industry should take action to verify that all carriers and vendors are aware of the standard CoS codes.
2. Older procedures should be updated to ensure compliance with this standard.
3. Within 12 months of the acceptance of these recommendations by the Council, ESIF must establish clear interpretation rules for available data including POSSource leading to accurate Class of Service indication to PSAP call takers.

Confidence and Uncertainty

Focus Group 1A has agreed that the Uncertainty estimate, expressed in meters, is a more useful value to provide to the 9-1-1 call taker than the Confidence factor. The Uncertainty estimates should have comparable meaning from carrier to carrier.

Focus Group 1A recommends the following:

- Uncertainty estimates should reflect the most meaningful[2] value to the PSAP and should be delivered in the ALI record on every Phase 2 call.

- Confidence factor is not useful on a call-by-call basis and should not be reported.

- Within 12 months of the acceptance if these recommendations by the Council, ESIF should complete the evaluation of the technical feasibility of standardizing the meaning of the Uncertainty estimates reported to the PSAP. The wireless carriers shall provide through ESIF, any publicly available information regarding the methods by which the Confidence factor is generally defined and utilized for each deployed PDE technology, plus any publicly available analysis of the accuracy of the Uncertainty estimates.

LAT/LONG display on Phase 1 Calls

Focus Group 1A recommends suppression of lat/long on a Phase 1 call, where commercially reasonable. If the Phase 1 lat/long cannot be suppressed, it should be displayed to the call taker in a manner that makes it clear that it is not caller lat/long data (i.e., separate fields, distinct labels). Focus Group 1A requests ESIF to determine how lat/long should be suppressed on a Phase 1 call, and where the suppression, if necessary, should occur.

Cell Sector Identification and Orientation

For consistent presentation of data, Focus Group 1A recommends that on a going forward basis, sector and orientation should be included in the ALI address field and the cell sector description should be included in the ALI location field.

Examples of sector and orientation are:

St Number and Street Name:	1401 Martin Dr – 3SW	1401 Martin – OMNI
Location:	5213A	Westfield Mall
Community:	Westchester	Westchester

(The “3” in -3SW in the example above is representative of a 3 sectored tower, and the “SW” is representative of the compass direction for the sector applicable to the current call.)

[2] The term “meaningful” is interpreted as the smallest possible Uncertainty estimate that has a high probability that the caller is located within that range.

1.2.3 Timing Thresholds for Database Queries

Focus Group 1A identified three areas that are involved in the timing of database queries and established recommended timing thresholds, where possible. The three areas are as follows:

1. Routing query from Mobile Switching Center (MSC) to Mobile Positioning Center (MPC)/ Gateway Mobile Location Center (GMLC)
2. PSAP initial query to ALI for location of E9-1-1 caller
3. PSAP re-bids for updated caller location information

1.2.4 Concentration Points, Metrics and Thresholds

The team approached the traffic concentration discussions by first defining the differences between concentration and congestion. Concentration is defined as the point within the telecommunication network, where the function of E9-1-1 related network infrastructure elements and/or networks converge (e.g., E9-1-1 Selective Router). A concentration point may or may not be susceptible to congestion. The team was able to focus on the chartered objective of presenting recommendations for identifying all major traffic concentration points and where traffic concentrations are unacceptably high.

The concentration metrics and thresholds should define the point where the level of traffic concentration is unacceptably high. Together, the definition of concentration and what determines a major concentration point have clarified that the concentration threshold is the point at which a single failure or interruptive incident could significantly delay or prevent the delivery of calls to the PSAP and/or diminish the adequacy or availability of data. To the extent that the capacity of a component is not exceeded, there should be no limit to the amount of traffic concentration. The mitigation of a single failure or interruptive incidence is achieved by network redundancy and diversity or by internal network component fault tolerance e.g., 99.999% per year ("five nines").
Traffic concentration has been determined to be unacceptably high when:

- Concentration exceeds the design limits of the hardware/software.
    - If a component is designed for a maximum amount of voice or data throughput while maintaining a P.01 grade of service, these limits must not be exceeded. In the event that such limits are exceeded, installation of redundant and diverse components will NOT restore adequate concentration levels, since failure of the redundant node will then overwhelm the remaining node and exceed the capacity of the network. In such cases the solution may be to increase the design limits of the existing components. In all cases, care should be taken to recognize or anticipate the potential impact downstream.
- Uptime of a single, non-redundant and non-diverse network component fails to achieve five nines availability (where availability is defined as the

average proportion of time that the network component functions within its specified requirements)

- In the event that a single, non-redundant and non-diverse component cannot achieve five nines availability, the component should be made redundant and diverse such that the functional component achieves five nines availability, and should be adequately provisioned to ensure acceptable performance in all failure-caused recovered states. In the event that a component cannot maintain five nines even when redundant and diverse, triple and quadruple redundancy should be considered until such reliability is achieved.

Design for the delivery of E9-1-1 service today depends upon a high degree of concentration. The network today appropriately manages concentration to avoid unnecessary call delay or failure to provide for the delivery of complete and accurate data to handle emergencies effectively. We do not foresee any circumstance in which E9-1-1 network concentration is or may become excessive.

Although FG 1A is chartered with addressing near-team issues, it is important to consider future technology advances, such that these recommendations do not impede those advances.

Focus Group 1A has agreed that the following entities are the major concentration points in an E9-1-1 network.

- PSAP
- ALI Database
- E9-1-1 Selective Router
- SS7 Network Elements
- MPC
- GMLC
- PDE
- SMLC

*1.2.5 **Best Practices***

FG1A evaluated all current E9-1-1 Best Practices to determine if any of the Charter recommendations related to near term issues had business practices in place that were not currently documented and beneficial as proposed new Best Practices. A total of 20 new Best Practices were identified and focus primarily on E9-1-1 Phase II Network Elements. The Best Practices identified in Section 4.5.2 fall into the following categories: Public Safety Answering Point, Automatic Location Identification, E9-1-1 Selective Router, Signaling System 7 Elements, Mobile Positioning, Position Determining Entity, Gateway Mobile Location Center and Serving Mobile Location Center.

2 Introduction

Following is the NRIC VII Charter pertaining to the deliverables for Focus Group 1A:

The Council shall address the following topics:

Focus Group 1A - Near Term Issues for Emergency / 9-1-1 Services

The Council shall, by December 16, 2005 provide a report that contains near term emergency communications network Best Practices with supporting documentation.

In addition, the Council shall study specific issues that are identified below. The Council shall coordinate with other forums (e.g., Emergency Services Interconnection Forum (ESIF), National Emergency Numbering Association, etc.) so that each issue can be addressed as efficiently and completely as possible. The Council shall:

- Recommend accuracy requirements for location information particularly for rural, suburban, and urban areas and recommend ways to verify that accuracy requirements are met.[3] Investigate location technologies that could improve accuracy and / or reduce cost.
- Develop recommendations that will lead to a consistent format for information passed to Public Service Answering Points (PSAPs) for Phase 1 and 2 call and location information. This format must resolve any inconsistencies that would otherwise result from using vendor specific formats for transmitting information from Mobile Positioning Centers to PSAPs.
- Develop a consistent, common set of timing thresholds for the database queries and for obtaining location information.
- Identify all major traffic concentration points in E9-1-1 architectures, such as E9-1-1 Selective Routers (“SR”), E9-1-1 Selective Routing Databases (“SRDB”), Mobile Positioning Centers, and Automatic Location Identification (“ALI”) databases. The Council shall then define metrics and thresholds that should be used to determine where traffic concentrations are unacceptably high. The Council shall develop Best Practices to reduce traffic concentration wherever it has been determined to be too high. This includes developing Best Practices for the size and diversity of different databases. This may also include developing Best

[3] The work of ESIF Study Group G will be considered in this effort.

Practices aimed at improving the database process or reducing the number of database queries.

The following two items were originally assigned to 1A and have since moved to 1C:

- Specify the information that is to be sent to callers when major E9-1-1 network elements fail.

- Enumerate and evaluate the factors that should be considered in deciding whether redundant E9-1-1 SRs and alternate PSAPs should be provided to avoid a "fast busy" or a recorded message when one or more non-redundant network elements fail.

The following two items were originally assigned to 1A and have since moved to 1B:

- Recommend ways to extend E9-1-1 services to satellite communications.

- Recommend ways to provide location information to PSAPs for calls originating from multi-line telephone systems (MLTS).

Final Milestone

By December 16, 2005, the Council shall present a report recommending ways and describing Best Practices to address near-term E9-1-1 issues. The report shall include issues from the earlier interim reports. The report shall recommend Best Practices addressing high E9-1-1 network concentration points.

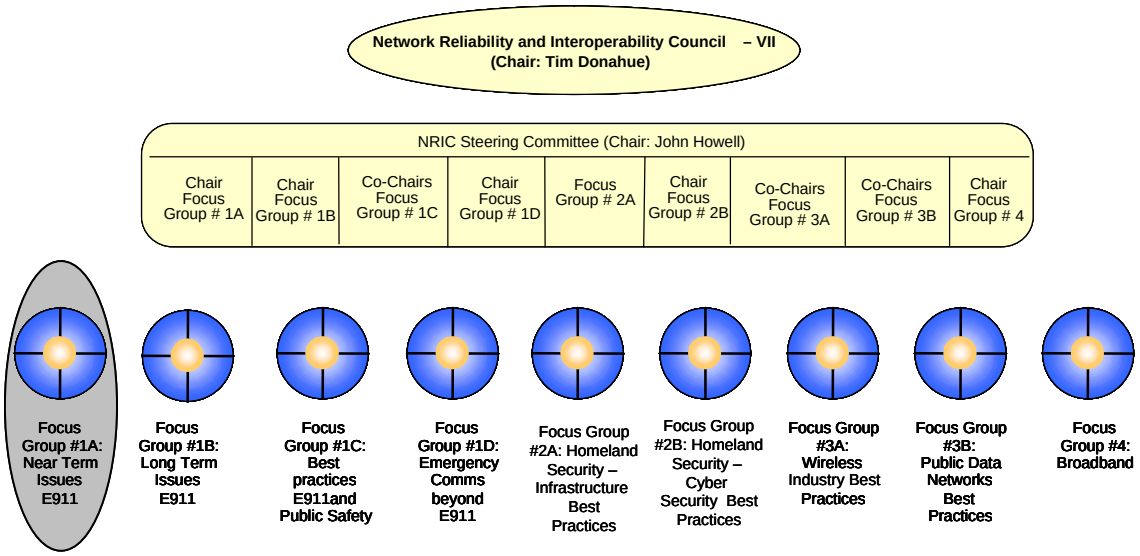
Based on the Charter, the Focus Group addressed the following five key issues in this final report:

- Accuracy Requirements – Accuracy requirements for location information and ways to verify that accuracy requirements are met. Work from ESIF Study Group G was taken into account.
- Consistent Format for Location Information – Recommendations to ensure that PSAPs receive call and location information in a consistent format regardless of vendor.
- Timing Thresholds for Database Queries – Consistent timers for database queries, regardless of service provider or equipment used.
- Concentration Points, Metrics & Thresholds – Identification of major traffic concentration points in E9-1-1 architectures and the metrics and thresholds that should be used to determine if concentration is unacceptably high.

- Best Practices – Existing industry Best Practices addressing near-term E9-1-1 issues, including high E9-1-1 network concentration points.

2.1 Structure of NRIC VII

The structure of the Network Reliability and Interoperability Council is as follows:



2.2 Focus Group 1A Team Members

Focus Group 1A consists of 55 total members.

Amy Sanders-Lucent
Anna Hastings-SBC
Art Prest-Rural Cellular Assoc.
Bill Cade-APCO
Bob Dressler-Polaris Wireless
Brian Fontes-Cingular
Brian McNiff-TechnoCom
Bruce Drawert-Motorola
Brye Bonner-Motorola
Charles McKee-Sprint
Charlie Hoffman-NTIA
Dale Morgenstern-AT&T
Darold Whitmer, (former FG1A Chair)-Intrado
Darryl Foster-Cox Communications
Dick Dickinson-TCS

Doug Rollender-Lucent
Fran Ryan-Sprint
Francis Malnati-Verizon Wireless
Greg Arnold-Nokia
Greg Ballentine-APCO / MARC
Gregg C Vanderheiden Ph.D.-Univ. Wisconsin-Madison
Gustavo Pavon-True Position
Jackson A. Mobbs-Alltel
Janice Partyka-TechnoCom
Jean-Michel Rousseau-Nokia
Jeng Mao-NTIA
Jim Nixon, (FG1B Chair)-T-Mobile
Jim Propst-Sprint
John Howell-Sprint
John Rosnick-Sprint
Kamil Grajski-Qualcomm
Karl Rauscher-Lucent
Leo Fitzsimmons-Nokia
Lolita D. Forbes-Verizon Wireless
Marc Linsner-Cisco Systems, Inc.
Marilyn Ward
Mary Boyd, (FG1A Chair)-Intrado
Michael Anderson-Ericsson Inc
Nathan Glazier-Western Wireless
Paul Marrangoni-FCC OET Office
Philip Linse-Qwest
Rick Kempe-CTIA
Rob Seawright, ENP-Cingular
Robert (Bob) Gurss-APCO
Robert Paterson-Nortel
Roger Hixson-NENA
Ryan Jensen-T-Mobile
Steve Marzolf-State of Virginia & NASNA
Stu Goldman-Lucent
Susan Sherwood-Verizon Wireless
Tim Lorello-TCS
Tom Breen-BellSouth
Wanda McCarley-Tarrant County, TX 911
Wayne Ballantyne-Motorola
Wendy Wheeler-Alltel

The following 31 members worked on this final report:

Anna Hastings-SBC
Art Prest-Rural Cellular Assoc.
Bill Cade-APCO
Brian McNiff-TechnoCom
Charles McKee-Sprint
Charlie Hoffman-NTIA
Dale Morgenstern-AT&T
Dick Dickinson-TCS
Doug Rollender-Lucent
Fran Ryan-Sprint
Gustavo Pavon-True Position
Jackson A. Mobbs-Alltel
Janice Partyka-TechnoCom
Jim Nixon, (FG1B Chair)-T-Mobile
Jim Propst-Sprint
John Howell-Sprint
John Rosnick-Sprint
Mary Boyd, (FG1A Chair)-Intrado
Michael Anderson-Ericsson Inc
Nathan Glazier-Western Wireless
Paul Marrangoni-FCC OET Office
Philip Linse-Qwest
Rick Kempe-CTIA
Rob Seawright, ENP-Cingular
Roger Hixson-NENA
Ryan Jensen-T-Mobile
Steve Marzolf-State of Virginia & NASNA
Susan Sherwood-Verizon Wireless
Tom Breen-BellSouth
Wanda McCarley-Tarrant County, TX 911
Wayne Ballantyne-Motorola

In order to effectively represent the interests of all stakeholders and to also accomplish the objectives of Focus Group1A, members were divided into multiple subcommittees to review and make recommendations on all deliverables. The subcommittees were as follows:

2.2.1 **Accuracy Requirements**

Standard Policies Subcommittee

Susan Sherwood - Leader
Bob Iwasko
Brain McNiff

Dick Dickinson
Janice Partyka
Joe Hanna
John Rosnick
Philip Linse
Roger Hixson
Ryan Jensen
Steve Marzolf
Wanda McCarley

ESIF Subcommittee Committee-G Review Subcommittee

Dale Morgenstern - Leader
Charles Spann
Gustavo Pavon
Ryan Jensen
Steve Marzolf
Wayne Ballantyne

Local PSAP needs Subcommittee

Steve Marzolf - Leader
Dick Dickinson
Joe Hanna
Ryan Jensen

New Technologies Subcommittee

Wayne Ballantyne – Leader
Dale Morgenstern
Gustavo Pavon,
Ryan Jensen

Testing Area & Reporting Subcommittees

In an attempt to research consensus specific to the wireless testing area and reporting recommendations for accuracy testing, the various stakeholders were asked to work within the following subgroups for a temporary timeframe; and were represented as follows:

Tier 1 Carriers

Jim Nixon - Leader
Ryan Jensen- T-Mobile
Charles McKee-Sprint
Jim Propst- Sprint,
Greg Garrelts-Sprint
Susan Sherwood-Verizon

Steve Hardin-Cingular
Gary Hight-Cingular
John Rosnick-Sprint

Tier 2 Carriers

Nathan Glazer - Leader
Nathan was the only member of this sub group

Tier 3 Carriers

Art Prest - Leader
The Board of Directors of the Rural Cellular Association

Public Safety

Roger Hixson - Leader
Bill Cade-APCO
Steve Marzolf-NASNA
Nancy Pollock-APCO
Rick Jones-NENA
Wanda McCarley-APCO

Industry / Technology Providers

Wayne Ballantyne - Leader
Charles Spann-Nortel
Dick Dickinson-TCS
Gustavo Pavon-True Position
Dale Morgenstern-AT&T
Doug Rollender-Lucent
Janice Partyka-TechnoCom
Philip Linse-Qwest

2.2.2 **Consistent Format for Location Information**

Consistent ALI Display Subcommittee

Anna Hastings - Leader
Dick Dickinson
Janice Partyka
John Howell
John Rosnick
Mary Boyd
Roger Hixson
Steve Marzolf
Susan Sherwood

Wayne Ballentyne

2.2.3 **Timing Thresholds for Database Queries**

Consistent, Common Set of Timing Thresholds

Susan Sherwood - Leader
Dick Dickinson
Mary Boyd
Steve Marzolf
Wayne Ballentyne
Anna Hastings
Fran Ryan
Jackson Mobbs
Scott Carlson
Michael Anderson
Dale Morgenstern
Charlie Hoffman
Rick Kemper
Paul Marrengoni
Bob Montgomery
Doug Rollender
Bob Sherry (Intrado)

2.2.4 **Concentration Points, Metrics and Thresholds**

Major Traffic Concentration Points

Philip Linse – Leader
Fran Ryan
Dick Dickinson
Tom Breen
John Rosnick
Rob Seawright
Roger Hixson
Doug Rollender
Joe Jurecka
Bob Sherry (Intrado)
Anna Hastings
Mary Boyd
Larry Meyers (Sprint)
Scott Carlson
Michael Anderson
Dale Morgenstern
Charlie Hoffman

Rick Kemper
Paul Marrengoni
Bob Montgomery

2.2.5 **Best Practices**

Anna Hastings-SBC
Art Prest-Rural Cellular Assoc.
Bill Cade-APCO
Brian McNiff-TechnoCom
Charles McKee-Sprint
Charlie Hoffman-NTIA
Dale Morgenstern-AT&T
Dick Dickinson-TCS
Doug Rollender-Lucent
Fran Ryan-Sprint
Gustavo Pavon-True Position
Jackson A. Mobbs-Alltel
Janice Partyka-TechnoCom
Jim Nixon, (FG1B Chair)-T-Mobile
Jim Propst-Sprint
John Howell-Sprint
John Rosnick-Sprint
Mary Boyd, (FG1A Chair)-Intrado
Michael Anderson-Ericsson Inc
Nathan Glazier-Western Wireless
Paul Marrangoni-FCC OET Office
Philip Linse-Qwest
Rick Kempe-CTIA
Rob Seawright, ENP-Cingular
Roger Hixson-NENA
Ryan Jensen-T-Mobile
Steve Marzolf-State of Virginia & NASNA
Susan Sherwood-Verizon Wireless
Tom Breen-BellSouth
Wanda McCarley-Tarrant County, TX 911
Wayne Ballantyne-Motorola

3 Objective, Scope, and Methodology

3.1 Objective

The objective of this Final Focus Group 1A report is to present the recommendations based on the Focus Group's work to meet the NRIC VII Charter. Focus Group 1A, in response to the Charter, has made recommendations with respect to:

- Requirements for wireless location accuracy
- A consistent format for information passed to Public Safety Answering Points (PSAPs) for Phase 1 and 2 call and location information
- A consistent, common set of thresholds for the time required to complete database queries
- Identification of all major traffic concentration points in the E9-1-1 architectures and the metrics and thresholds that should be used to determine where traffic concentrations are unacceptably high
- Near term emergency communications network Best Practices

3.2 Scope

3.2.1 Accuracy Requirements

Focus Group 1A agrees and acknowledges that the current limits of location technology do not allow precise location for all callers in all locations. The scope of this document with regard to location accuracy is threefold:

- To advise the Council regarding the various issues surrounding the delivery, compliance and reporting of Phase 2 location accuracy.
- To advise the Council on the fundamental differences of opinion and interpretation of FCC guideline OET-71, as related to Phase 2 accuracy testing, compliance and reporting.
- To provide to the Council recommendations reached by consensus agreement among the stakeholders regarding resolution of the issues in dispute.

3.2.2 Consistent Format for Location Information

Regarding information delivery, Focus Group 1A agrees that substantial investment in personnel, procedures and technology have been made by wireless carriers, the public safety answering points (PSAPs), local exchange carriers (LECs), E9-1-1 System Service Providers (E9-1-1SSP), and Customer Premises Equipment providers to support Phase I and Phase II location information delivery.

Therefore, the recommendations in this report are forward looking, and are not intended to require conversions of existing deployments. Rather, these recommendations should be incorporated into future wireless E9-1-1 Phase 1 and Phase 2 implementations when commercially reasonable. They should also be considered as system requirements for future changes associated with Phase 1 or Phase 2.

3.2.3 Timing Thresholds for Database Queries

Timing thresholds for database queries are found to be inconsistent across various E9-1-1 wireless service providers and equipment used in the delivery of E9-1-1 database information to PSAPs. FG1A agrees that consistent timing thresholds are necessary for numerous reasons as outlined in the following report and focused its recommendations on the routing query timing thresholds from the MSC to MPC/GMLC, PSAP initial query to ALI for location of E9-1-1 caller, and PSAP re-bids for updated caller location information.

3.2.4 *Concentration Points, Metrics and Thresholds*

With regard to the concentration thresholds, FG 1A agrees that traffic concentration must exist for a network to be operationally efficient and is often managed through telecom advances. The scope of that portion of this document is to advise the council on the recommendations of how to manage traffic concentration. The recommendations of this document are to include both ANSI-41 and PCS-1900 networks. Please reference J-STD-036B for specific architectural detail.

3.2.5 Best Practices

FG1A evaluated all current E9-1-1 Best Practices to determine if any of its work related to near-term issues had practices in place that would be beneficial as documented NRIC Best Practices. The following report reflects twenty (20) recommended Best Practices that encompass charter issues in the categories of Public Safety Answering Point, Automatic Location Identification, E9-1-1 Selective Router, Signaling System 7 Elements, Mobile Positioning, Position Determining Entity, Gateway Mobile Location and Serving Mobile Location Center.

3.3 Methodology

To develop the contents of this report, Focus Group 1A divided into subcommittees to examine and report on existing standards and practices, public safety needs and new technologies.

Conference calls and face to face meetings were held periodically to collaborate and recommend language for the report. Final acceptance of the report was

accomplished through many conference calls and face to face meetings.

4 Background and Recommendations

4.1 Accuracy Requirements

4.1.1 Background

In 1996 the FCC released NPRM 94-102 for wireless Enhanced 9-1-1 (E9-1-1). The wireless E9-1-1 rules seek to improve the effectiveness and reliability of wireless 9-1-1 service by providing 9-1-1 dispatchers with additional information on wireless 9-1-1 calls.

The wireless E9-1-1 program is divided into two parts - Phase 1 and Phase 2. Phase 1 requires carriers, upon appropriate request by Public Safety Answering Points (PSAPs), to report the telephone number of a wireless 9-1-1 caller and the location of the antenna that received the call. In Phase 2, wireless carriers are required to additionally report the estimated location of the handset that places the call. This location is reported in terms of latitude and longitude. The FCC has stipulated accuracy requirements for the reported location of the handset. These accuracy requirements vary according to the technology used by the carrier to determine location. Carriers using handset based solutions (e.g., Assisted Global Positioning Systems (AGPS)), must attain accuracies within 50 meters on 67% of calls and within 150 meters for 95% of calls. Carriers using network based solutions that work with legacy handsets, (e.g., Uplink Time Difference of Arrival (UTDOA)) technology (i.e., triangulation), must attain accuracies of 100 meters on 67% of calls and within 300 meters for 95% of calls.

On April 12, 2000 the FCC Office of Engineering and Technology issued Bulletin No. 71 (OET-71), Guidelines for Testing and Verifying the Accuracy of Wireless E9-1-1 Location Systems. This bulletin clarifies how the performance of location systems and equipment may be tested and verified for compliance with the accuracy rules. Despite the intentions of OET71, ambiguities and unanticipated issues have developed during the deployment process that requires further clarification.

This report will address those issues requiring additional clarification, with particular focus on Phase 2 of the FCC NPRM, using OET-71 as the baseline for developing the recommended best practices for accuracy testing.

Focus Group 1A considered the findings of the ESIF Subcommittee-G and engaged representatives of Tier 1, II, and III wireless carriers, urban, suburban and rural Public Safety Answering Points (PSAPs), and appropriate private industry companies to establish our findings.

It was not the intent of this Focus Group to “re-invent the wheel”. Where good work had been done by others and FG1A reached consensus on such work, the

results were adopted into our findings, specifically those of ESIF Subcommittee-G.

4.1.2 Recommendations

After many substantive discussions, consensus was reached on the following recommendations, which should be implemented as a whole. However, the Focus Group wishes to emphasize that several of these recommendations defer to ongoing work at ESIF. In the event that ESIF is unable to resolve the issues referred to them, the consensus embodied by these recommendations will be compromised. The following recommendations are specific to Location Accuracy Compliance, Maintenance, Reporting and Data Access for carriers providing service in Urban and Rural America. Additionally FG1A makes recommendations for the methodology of testing.

- ***Recommendations for Accuracy certification and reporting area (general)***

  Given the current state of location technology, it is understood that the FCC accuracy rules will not be met at every PSAP. Thus, Focus Group 1A has reached a consensus that FCC compliance will be measured at the State level. Consistent with FCC rules interested parties (PSAPs, States, etc.) may seek FCC relief in the event they reasonably demonstrate non-compliance with the FCC accuracy rules.

- ***Recommendations for Certification and Reporting areas for carriers operating in rural areas***

  Tier III Rural Carriers are to perform to an accuracy that is no worse than the average accuracy results being achieved by Tier I/II carriers (using the same Phase II location technology type --network or handset based) operating in that rural market area.

  If any carrier operating in a rural area has too few contiguous cell sites or cell sites that are geographically dispersed in a manner that prevents reliable triangulation within any RF footprint to practically meet FCC accuracy mandates, the carrier shall make a commercially reasonable effort to provide the best service possible without extraordinary efforts. In the event that a rural carrier is unable to meet the FCC's accuracy requirement, that carrier will provide its accuracy results to the FCC and the FCC will compare those results with other carriers using the same Phase II location technology type in that market area.

  Rural carriers will consolidate the statistically valid tests of their coverage areas within a state per the ESIF testing methods, and will report the consolidated statewide results. Rural carriers will be subject to the same statewide reporting rules as all other carriers in terms of frequency, maintenance, possible FCC random retesting, and PSAP complaint

options. As with all other carriers, rural carriers will make good faith efforts to improve performance in under performing areas but will not be required to meet compliance standards at any level of granularity less than statewide.

- ***Recommendations for Compliance Testing***

  The carriers will certify compliance to the FCC at the State level using ESIF/OET based testing methods. Beginning no later than twelve months after the FCC adopts this NRIC VII recommendation, state level compliance testing will be performed [4]when a carrier has deployed Phase 2 capability in 50% of their cell sites in the State. Once compliance testing has begun, it shall be completed and certified to the FCC no later than 12 months after the date the 50% target is reached, unless otherwise mutually agreed upon by the parties. The carrier will repeat this state level compliance testing and/or certification to the FCC when their deployment reaches 90% of their cell sites[5]. There is an issue surrounding States where the Carrier(s) may have too few contiguous cell sites deployed to make compliance possible and testing consistent with ESIF/OET methods practical. The parties recommend the FCC take such factors into consideration when evaluating compliance results.

  The carriers further commit to make commercially reasonable efforts to improve performance in under performing areas. Should Public Safety believe reasonable efforts are not being taken, they shall work with the Carrier to resolve the issue. This process is not intended to reduce or eliminate the right of any party to seek FCC relief should efforts to resolve the issue fail.

- ***Recommendations for Maintenance Testing***

  Once a system is compliant the wireless carrier shall ensure that its network maintains compliance through a methodology consistent with ESIF recommendations for maintenance testing that includes accuracy verification. If ESIF is not able to produce a consensus document (including buy-in from both public safety and the wireless carrier communities) within 12 months of adoption of this recommendation, the FCC should consider random statewide testing, using OET 71 /ESIF Subcommittee-G processes, until maintenance testing is standardized.

  Maintenance testing shall be triggered by:

  - Major network changes that significantly impact location accuracy.

[4] See the maintenance section for details surrounding the use of previously accumulated test data when it is used for compliance testing

[5] Testing would not need to be repeated if prior test results data are still valid per the maintenance testing recommendations.

- Problems, such as unexplained significant degradation of service; systematic failed delivery of service; catastrophic events (but not single events), or
- Every two years, at a minimum.

- ***Recommendation for Consolidated Representative Performance Statistics***

  The parties agree there is little information publicly available to educate the public about how various location technologies perform in various types of topologies. While it is unclear how useful this information might be, carriers agree to provide to Public Safety, representative performance data collection results described in the following paragraph, subject to the same non-disclosure parameters identified under "Recommendations for Access to Compliance & Maintenance Testing Data." The parties agree to work together to develop possible information materials for public education.

  The Tier I and II Carriers agree to do representative performance data collection in various types of topologies. NRICVII FG1A has liaise an Issue statement to ESIF requesting ESIF Subject Matter Expert's to define those topologies and the methodology to accomplish this data collection within 12 months of adoption of this recommendation. The Carriers agree to perform such data collection for each type of location technology implemented in their networks (not within every State). Where possible, Carriers would be permitted to "roll up" or "aggregate" results from testing done as part of their overall State level compliance testing.

  This recommendation is describing a one time good faith effort by carriers to quantify average performance in various topologies, and does not imply an ongoing effort. To the extent that topology information can be reasonably included in ongoing data collection processes, it should be.

- ***Recommendations for Access to Compliance & Maintenance Testing Data***

  All of the aforementioned test data will be made available to the FCC upon request. The relevant test data will also be made available to public safety (a governmental entity or their agent for the purpose of providing E9-1-1 services) upon request, provided the data is not subject to public disclosure. NRIC FG1A seeks support from the FCC to deem the data confidential and not subject to public disclosure. In the event that such protection cannot be assured, the Carriers will work with Public Safety consistent with the privacy laws of the State to provide a mechanism for Public Safety to review the data. Also the test data may be provided to NENA, APCO and NASNA upon request in a manner that protects the privacy of each Carrier.

It is recommended that wireless carriers and Public Safety organizations jointly and periodically perform an analysis of maintenance testing data by State and nationally, and make aggregated results available to the public safety community.

- ***Recommendations for Methodology of Testing***

  Indoor versus Outdoor Location Testing

  The Standard Policies subcommittee recommends that for the near term, approximately 5% of accuracy test calls should be conducted indoors. Indoors is defined as within an enclosed structure, such as a building or a parking structure. The 5% value was chosen because no data currently exists that defines the actual number of wireless 9-1-1 calls made from indoors and because of practical limitations of location technologies currently deployed.

  The subcommittee also recommends that public safety attempt to track the amount of wireless 9-1-1 calls that are made from indoor versus outdoor locations.

  Recommendations for Equipment Used For Location Accuracy Testing

  Handsets used for testing shall be representative of the commercially available equipment provided by the wireless service provider. No external or special modification shall be made to any handsets used for testing to enhance or modify the overall handset or location network performance. Care shall be taken and handsets should be monitored for proper functioning during all testing. If test calls are routed to the PSAP, then handsets so utilized shall be capable of voice communications.

- ***Recommendations for Confidence and Uncertainty***

  It is agreed that wireless carriers will provide, and E9-1-1 SSPs shall pass confidence and uncertainty estimates in accordance with standards being developed by ESIF.

4.2 Consistent Format for Location Information

4.2.1 *Background*

Hundreds of ALI formats have evolved in response to individual PSAP preferences and LEC or CPE vendor options. The interfaces that feed data to the ALI, however, have been standardized into three primary formats: E2, PAM and NENA. In order to make the data fields display data in a manner suitable to the PSAPs, many contortions of data format and content have evolved. Therefore, Focus Group 1A has been chartered to identify situations subject to inconsistent display at the PSAP, and to develop recommendations that will lead to consistent

formats for data to be passed to PSAPs for Phase 1 and Phase 2 call and location information.

Focus Group 1A has agreed that NENA Data Exchange Standard, (November 9, 2004), ensures a consistent format for information passed to Public Safety Answering Points (PSAPs) for Phase 1 and 2 call and location information, with the exception of the following four specific issues:

1. Standardization of Class of Service
2. Confidence and Uncertainty
3. Lat/Long display with Phase 1 calls
4. Cell Sector Identification and Orientation

4.2.2 ***Recommendations***

The Focus Group wishes to emphasize that some of these recommendations defer to ESIF to perform the necessary work to ensure these recommendations can in fact be implemented in an effective and timely manner. The following recommendations are intended to lead to a consistent format for information passed to Public Safety Answering Points (PSAPs) for wireless Phase 1 and 2 call and location information.

The recommendations in this report are forward looking, and are not intended to require conversions of existing deployments. Rather, these recommendations should be incorporated into future wireless E9-1-1 Phase 1 and Phase 2 implementations when commercially reasonable. They should also be considered as system requirements for future changes associated with Phase 1 or Phase 2.

- ***Standardization of Class of Service for Wireless E9-1-1 Calls***

  Class of Service (CoS) is a traditional indicator for E9-1-1 calls that allows the PSAP call taker to determine both the type of origination point, and certain considerations in responding to the 9-1-1 call. For instance, if a call is indicated as residential, the call taker can ascertain that the source is a single line, with typically a limited number of people involved, and likely in a low traffic level location (depending on address indicated). On the other hand, if the CoS indicates a PBX, the call taker can be alerted that the call is from a multi-line business or large scale residential complex. Depending on how much information the caller can provide, the CoS may be meaningful in decisions about how to appropriately respond, in terms of victim search needs and resources to be dispatched, for instance.

In the wireless E9-1-1 arena, where users are by definition mobile or capable of being mobile, Class of Service is used to indicate level of service, such as pre-Phase 1 (MOBL), Phase 1 (WRLS), Phase 1 data from a Phase 2 capable wireless service area (WPH1), and Phase 2 (WPH2). Both NENA and ESIF have validated that these codes should be the standard indicators for wireless CoS.

Focus Group 1A recommends that the following Wireless CoS be used consistently going forward:

Pre-Phase 1	MOBL
Phase 1	WRLS
Phase 1 data from a Phase 2 capable wireless service area	WPH1
Phase 2	WPH2

However, not all carriers and carrier vendors trigger or use these standard codes consistently across all wireless 9-1-1 calls.

Reasons for this inconsistency may fall into four categories:

- lack of knowledge of the standard terms
- failure to revise procedures established prior to defining CoS standards
- inability to drive the proper indicator for specific calls
- differences in interpreting the factors that drive the indicators

Lack of knowledge can be treated through industry educational processes, as can pre-existing procedure compliance cases. In a least one wireless location technology type, the Position Source code is not generated in a way that can be used to clearly identify the type of wireless call as above. In this and other cases, the available factors from the Position Determining Entity (PDE) can be interpreted in differing ways, typically affecting whether the call location data is interpreted as Phase 1, Phase 1 data in a Phase 2 service area, or Phase 2. In these cases, there may also be issues around initial general location `fix' data, as compared to generation of location data later in the call and systems sequence, either because of PDE operations or re-bid activity.

Unresolved, these conditions leave the call taker with potential questions of how much they can trust the CoS indicator, and therefore the interpretation of the displayed location data during the often stressful conditions of handling an emergency situation. In this environment, PSAPs are often forced to establish manual guides (`cheat sheets') by

carrier or vendor to assist in interpreting screen display data. This can generate undesirable delays in processing a call.

A related factor in the issue of CoS has to do with which service provider is best situated to determine and trigger the appropriate code into the data stream that is passed through the E9-1-1 system data process to the PSAP. Where the E2 interface is utilized, the ALI server operator controls the CoS interpretation. In the PAM interface, either the MPC provider or the ALI server can perform this step[6]. Coordination of operations might be simpler if one party to the service process always managed the CoS interpretation. One solution might be if the MPC could actually set the POSSOURCE to a value that specifies a true CoS instead of the ALI system interpreting the Position Method used. As it stands now, every time a new type or variation of PDE location technology is developed, a new POSSOURCE code may be established in standards. ALI providers then have to add the new code and CoS information in order to keep in step.

The parties agree that at least three actions should be taken to resolve the above issues.

1. The wireless industry should take action to verify that all carriers and vendors are aware of the standard CoS codes.
2. Older procedures should be updated to ensure compliance with this standard.
3. Focus Group 1A recommends that ESIF establish clear interpretation rules for available data leading to accurate Class of Service indication to PSAP call takers.

Focus Group1A recognizes that ESIF is currently working on defining what actions need to be taken to make Position Source or alternative identification methods available for all location technologies, in a way that can clearly indicate level of service provided. Within 12 months of the adoption of this recommendation, ESIF should define methodologies to assure common application of CoS codes across technologies, carriers, and service providers.

[6] Some ALI systems have the ability to create the CoS that the MPC provider specifies for each POSSOURCE. For instance the infamous POSSOURCE 7 could be WPH2 for one MPC provider and WPH1 for another when the ALI has this ability. Another ALI system may always display WPH1.

PAM has two CoS fields. One allows the PAM host to send the actual CoS text description and the other field carries the CoS value. The CoS value field carries the character indicator such as G, H, etc. Most ALI systems simply pass the resulting CoS standard text description on to the PSAP. However, there are implementations that use the CoS value to create custom CoS text.

- ***Confidence and Uncertainty***

  To appropriately respond to calls to 9-1-1, the public safety answering point (PSAP) would benefit from a measure of the reliability of the location provided on a call-by-call basis. Many factors impact the accuracy of the determined location. To the extent that these can be used to predict the probable accuracy of the longitude and latitude, a meaningful prediction should be provided to the PSAP. Simply stated, the Confidence factor is a value that defines the statistical probability that a caller lies within the area defined by the associated Uncertainty estimate. The Confidence factor is expressed in terms of a percentage, while the Uncertainty estimate is expressed in meters.

  For some carriers, the Uncertainty estimate relates to an estimate of the average error of the location reported, as compared to the actual location of the caller (i.e. "standard deviation[7]"). For a given location solution, a larger Uncertainty estimate should indicate the emergency response team may have to search a larger area to locate the caller. For location solutions such as, but not limited to GPS or U-TDOA, the Uncertainty estimate is a function of a number of factors such as Signal to Noise ratio, satellite or base station geometry, and the number of satellites or base stations participating in the location solution.

  There are several problems with the way the Confidence factor and Uncertainty estimate are currently being reported that impacts the consistency of the data displayed to the call taker. First and most importantly, not all wireless carriers and 9-1-1 system service providers are generating or forwarding these data to the PSAP. It is either not produced or is not forwarded, at least in part because there is no FCC requirement to provide the data. Though many carriers fix their Confidence factor at a specific value, this value may differ from carrier to carrier. This leaves the call taker to assess whether a 30% Confidence factor with a 20 meter Uncertainty estimate is better or worse than an 80% Confidence with a 50 meter Uncertainty estimate. The Confidence factor is a statistical measure that is very difficult for the call taker to assess on a call-by-call basis. The Uncertainty estimate, however, is expressed in meters and provides a much more useful value for the call taker to assess.

  Each wireless carrier may employ different mathematical algorithms to calculate the Confidence factor and Uncertainty estimate. One wireless carrier may calculate the Uncertainty estimate using a Confidence factor

[7] The standard deviation, often denoted as σ in statistics textbooks, is a measure of the spread of data in any scenario involving random data. It is computed as the square root of the variance σ^2.

of X, while another wireless carrier may calculate the Uncertainty estimate using a Confidence factor of Y, but the resultant Uncertainty estimates may be equally accurate.

As a result, the parties agree to the following:

- The Uncertainty estimate, expressed in meters, is a more useful value to provide to the 9-1-1 call taker than the Confidence factor. The Uncertainty estimate should reflect the most meaningful[8] value to the PSAP and should be delivered in the ALI record on every Phase 2 call. The Confidence factor is not useful on a call-by-call basis and should not be displayed at the PSAP.

- Uncertainty estimates should have comparable meaning from carrier to carrier. Focus Group 1A recommends that ESIF evaluate the technical feasibility of standardizing the meaning of the Uncertainty estimates reported to the PSAP.

- The wireless carriers shall provide through ESIF, any publicly available information regarding the methods by which Confidence factor is generally defined and utilized for each deployed PDE technology, plus any publicly available analysis of the accuracy of the Uncertainty estimates.

- All parties acknowledge that the Uncertainty estimate is not a measure of location accuracy. It is a prediction based on average performance and therefore cannot be evaluated to determine accuracy or overall performance of the location technology.

- ***Lat/Long Display with Phase 1 Calls***

  This issue relates to whether cell tower lat/long data should be displayed to the PSAP call taker on a Phase 1 call. By definition of Phase 1, there is no caller lat/long data, but PSAPs will often have ALI display formats that provide caller lat/long fields due to display upgrades in preparation for Phase 2 (or in use for Phase 2 data for already implemented carriers at that PSAP). Some carriers or vendors have, sometimes at the request of PSAPs, inserted Phase 1 cell tower lat/long in the display fields provided and labeled for caller location data. Or, a PSAP may have an ALI display format that provides no separate fields for caller lat/long, and this data is

[8] The term "meaningful" is interpreted as the smallest possible Uncertainty estimate that has a high probability that the caller is located within that range.

inserted in available fields for Phase 2 calls, but cell tower lat/long is inserted when Phase 1 calls occur.

In either case, the net effect for the call taker is potential confusion on what the displayed lat/long data represents, and a need to further depend on the Class of Service to indicate how the lat/long data in the common fields should be interpreted.

Focus Group 1A recommends suppression of lat/long on a Phase 1 call, where commercially reasonable. But if the Phase 1 lat/long cannot be suppressed, it should be displayed to the call taker in a manner that makes it clear that it is not caller lat/long data (i.e. separate fields, distinct labels). ESIF has been asked to determine how it should be suppressed, and who should suppress it.

- ***Cell Sector Identification and Orientation***

  The cell sector description and the number of sectors and their orientation are provided as part of the Phase 1 data. Unfortunately, no unique data fields currently exist in the most commonly used ALI data formats to send this data to the PSAP. As a result, the data must be included in one or more other fields. Among different carriers and PSAPs, this data may be included in the street name, community or location fields of the wireline ALI record. As a result, the 9-1-1 call taker must search the screen to find this information.

  The data elements are the literal street address and community name of the cell tower, the total number of sectors and the orientation of the sector processing the call expressed as a compass direction. The cell sector description is expressed in terms of an ID number or name such as "5213A" or "Mountain Tower".

  For consistent presentation of data, the parties agree that on a going forward basis that sector and orientation should be included in the ALI address field and the cell sector description should be included in the ALI location field.

  Examples of sector and orientation are:

St Number and Street Name:		
1401 Martin Dr – 3SW	1401 Martin – OMNI	
Location:	5213A	Westfield Mall
Community:	Westchester	Westchester

(The "3" in -3SW in the example above is representative of a 3 sectored tower, and the "SW" is representative of the compass direction for the sector applicable to the current call.)

NOTE: If a carrier is delivering Phase 1 street location description with a Phase 2 latitude/longitude, it should be presented according to the above recommendation.

4.3 Thresholds for Database Queries

4.3.1 Background

Currently, timers for database queries are inconsistent across the various E9-1-1 service providers and equipment used in delivery of E9-1-1 data to PSAPs. This results in inconsistent delivery of location data to a given PSAP and may cause difficulties in standardizing PSAP operations and training call takers. Consistent timers would increase efficiency in E9-1-1 deployments as well as PSAP operations and call taker training.

4.3.2 Recommendations

Consistent timing thresholds are necessary for a number of reasons that include: efficient PSAP operations, ease of PSAP call taker training, consistent vendor software and equipment development, efficient and quicker deployment of Enhanced 9-1-1 services, and consistent delivery of location information. Timing of re-bids, in particular, is important in order for the PSAP to receive the most accurate and up-to-date Phase 2 location information and will reduce the overall number of database queries. Re-bidding too frequently can result in interruption of PDE/SMLC location calculations resulting in less accurate location fixes, extended voice path disruption, and overloading of data circuits.

The Focus Group identified three areas that are involved in the timing of ALI queries and established recommended timing thresholds, where possible. The three areas are as follows:

1. Routing query from MSC to MPC/GMLC,
2. PSAP initial query to ALI for location of E9-1-1 caller, and
3. PSAP re-bids for updated caller location information.

Note that the FG 1A addressed timing thresholds and did not address delivery of content or actions when timers expire.

Focus Group 1A recommends that the following timing thresholds to be used consistently going forward. The recommendations below indicate the highest timing thresholds. This Focus Group recognizes that certain timing thresholds

may impact the delivery of location data. In many instances we expect that performance will be better than the following thresholds:

- ***Routing Query from MSC to MPC/GMLC (applies to Phase 1 and Phase 2)***

  Phase 1
  - MSC query to MPC/GMLC for routing instructions is made in less than 1 second.
  - MPC/GMLC responds to MSC immediately or no later than 4 seconds with cell sector routing information.
  - MSC routes calls immediately upon receipt of a response from the MPC/GMLC, but it will wait no less than 5 seconds, nor more than 6 seconds for a response from the MPC/GMLC. This is to avoid causing the MSC to invoke default routing.

  Phase 2
  - MSC query to MPC/GMLC for routing instructions is made in less than 1 second.
  - For situations where an interim or quick fix is intended to be used for call routing, the MPC/GMLC directly or indirectly queries, depending on network protocols, the PDE/SMLC and waits up to 4 seconds to get response before deciding whether to route call on lat/long or cell sector.
  - MPC/GMLC responds to MSC within 5 seconds with routing instructions.
  - MSC routes calls immediately upon receipt of a response from the MPC/GMLC, but it will wait no less than 5 seconds, nor more than 6 seconds for a response from the MPC/GMLC. This is to avoid causing the MSC to invoke default routing.

- ***PSAP Initial Query to ALI for Location of E9-1-1 Caller (applies to Phase 1 and 2 as specified)***

  Phase 1 (Cell Sector Address and Callback Number)
  - PSAP receives call and should query ALI for location immediately.
  - ALI should respond with location immediately, if available, or send query to MPC/GMLC immediately.
  - MPC/GMLC gateway responds to ALI with CBN and cell sector location information in up to 8 seconds.

- ALI waits up to 10 seconds for location response from MPC/GMLC (regardless of interface type) before responding to PSAP query. Upon receipt of the information from the MPC/GMLC response, the ALI is transmitted.

Phase 2 (Caller Latitude & Longitude, callback number)

- When the MPC/GMLC originally becomes involved in processing a call, it will directly or indirectly query, depending upon the network protocol, the PDE/SMLC and the PDE/SMLC performs location calculations and has up to 30 seconds to respond to MPC/GMLC with caller latitude and longitude. MPC/GMLC places response in a cache (temporary storage).
- PSAP receives call and queries ALI for location immediately.
- ALI should respond with location immediately, if available, or send query to MPC/GMLC immediately.
- Upon initial query from ALI, MPC/GMLC responds to ALI with cell sector (Phase 1 information) or caller latitude/longitude (Phase 2 information), depending on timing of response from PDE/SMLC. MPC/GMLC gateway responds to ALI in up to 8 seconds.
- ALI waits up to 10 seconds for location response from MPC/GMLC (regardless of interface type) before responding to PSAP query. Upon receipt of the information from the MPC/GMLC response, the ALI is transmitted.
- If PSAP receives cell sector (Phase 1 information) on initial location query, PSAP must re-bid no sooner than 15 seconds to receive caller latitude/longitude (Phase 2 information).

- ***PSAP Re-Bids For Updated Caller Location Information (Phase 2 only)***

  - PSAP must wait at least 15 seconds after receipt of initial Phase 2 caller location information before initiating a new query for updated location information.
  - ALI sends query to MPC/GMLC immediately.
  - PDE/SMLC has up to 30 seconds to respond. MPC/GMLC waits up to 8 seconds for response from PDE/SMLC before responding to ALI. MPC/GMLC responds to ALI with cell sector (Phase 1 information) or caller latitude/longitude (Phase 2 information), depending on timing of response from PDE/SMLC. MPC/GMLC gateway responds to ALI in up to 8 seconds.
  - ALI waits up to 10 seconds for location response from MPC/GMLC (regardless of interface type).

- PSAP should re-bid again (after first mid-call location query) no sooner than 15 seconds to get updated caller Phase 2 latitude and longitude.
- Subsequent mid-call location updates should be initiated no sooner than 15 seconds apart and can continue as long as the call is active.

4.4 Concentration Points, Metrics and Thresholds

4.4.1 Background

Technological advances and growth in some E9-1-1 network elements have increased concentration. The telecom industry has developed best practices for managing the challenges associated with the trade off between increased reliability versus the increase in concentration. Any recommendation made by NRIC FG 1A should support the advancement of technologies and mitigation of the impacts from those technology advancements.

4.4.2 Recommendations

Focus Group 1A wishes to emphasize that these recommendations are for concentration points and not congestion. The team reviewed the different points within the E9-1-1 network (see Appendix D) and identified the following major concentration points;

- Public Safety Answering Point (PSAP)
  The PSAP is a network element that receives the Emergency Service call from the E9-1-1 SR or through direct connection from the originating serving switch. With the delivery of the call the PSAP has voice contact with the calling party but does not have sufficient location information to assist in the handling of the call. The PSAP queries the ALI database for this information.

  The PSAP consists of multiple call taker positions. These call taker positions may be situated behind a PBX, ACD, multi-line hunt group or some other mechanism to distribute the call to a call taker position. These devices may generate concentration situations, depending upon the configuration. As the call is received the PSAP's CPE queries the ALI for location information that may aid in the dispatch to the incident. The information is then displayed visually on a screen at a call taker position. The call taker may dispatch to the 1st responders or may transfer call to a secondary dispatch center. Other points of concentration beyond the initial delivery of emergency service calls do occur, but are not within the scope of this report.

The PSAP has been determined to be a major concentration point due to its function and position within the emergency service telephone network. The PSAP function provides a destination for the aggregated 9-1-1/E9-1-1 routed traffic that originates from multiple network operators and multiple telecommunications technologies that are capable of appropriately routing 9-1-1 traffic to PSAPs. In addition, the loss of the entire PSAP will inhibit the dispatch of emergency services.

- Automatic Location Identification (ALI)
  The ALI database is a network element that may be involved in routing a call and receives a query from the PSAP to retrieve information that will be displayed at the PSAP. For wireline calls the ANI of the caller is contained in the query and the caller's name and location are returned to the PSAP.

  For wireless calls the query may contain a key (such as an Emergency Services Routing Key [ESRK]) for which the ALI must query the wireless network's ALI Database (MPC) to obtain location information, (e.g. Wireless Phase 2 location information.) When it receives a response from the wireless network the ALI database formats a response and returns the information to the PSAP.

  The ALI database has been determined to be a major concentration point due to its function and position within the emergency service data network. The ALI function allows the PSAP to query for data that provides the location identification information for E9-1-1 routed traffic that originates from multiple network operators and multiple telecommunications technologies that are capable of appropriately routing E9-1-1 traffic to PSAPs. The loss of an ALI may also impact the ability of an E9-1-1 SR to route the call in some technological designs. In addition, the loss of the ALI will prohibit the display of the location that may be used to dispatch emergency services.

- E9-1-1 Selective Router (SR)
  An E9-1-1 SR is a network element that routes 9-1-1 dialed calls to the appropriate public safety answering point based on the call's related Emergency Service Number. The E9-1-1 SR is a Public Switched Telephone Network circuit switch that serves a tandem function for 9-1-1/E9-1-1 voice traffic. The SR has been determined to be a major concentration point due to its function and position within the emergency service telephone network. The SR function allows for the aggregation and routing of 9-1-1/E9-1-1 traffic that originates from multiple network operators and multiple telecommunications technologies that are capable

of appropriately routing 9-1-1 traffic to the SR. The SR is considered a major concentration point since failure of an E9-1-1 SR could result in the lack of 9-1-1 / E9-1-1 service.

- Signaling System 7 (SS7) Elements
  For the purpose of the emergency service telephone network, SS7 (Signaling System 7) is an architecture and protocol consisting of several specific network elements that are used for performing out-of-band signaling in support of call establishment, routing and information exchange functions (e.g., SSPs, STPs, SCPs). Where SS7 signaling is used to support E9-1-1 call traffic, the signaling is imperative to provide the exchange of information between call elements and is required to provide and maintain service.

  The SS7 network's function allows for the aggregation and routing of out-of-band signaling for the transport of 9-1-1 / E9-1-1 traffic that originates from multiple network operators and multiple telecommunications technologies. Where the end to end signaling of 9-1-1 traffic may include only SS7 signaling or some portion of SS7 and MF signaling, unlike MF signaling, the aggregated use of SS7 networks by network operators and multiple telecommunications technologies makes the SS7 network a major concentration point. The SS7 network is considered a major concentration point since the loss of the SS7 network in the setup of 9-1-1 emergency calls will prevent the delivery of calls, between network switching elements, which are destined for the PSAPs.

- Mobile Positioning Center (MPC)
  The Mobile Positioning Center (MPC) is an ANSI-41 wireless network element that processes two way communications between the MSC, PDE and ESME (ALI) in order to determine location and call routing information. The MPC to MSC communications provides routing instructions to the MSC. The MPC to PDE communications facilitates the determination of location of the wireless handset. The MPC to ALI communications provides for the relay of wireless data to the PSAP.

  If any one of these MPC communications / processes fails, wireless E9-1-1 will either degrade or fail, such that all wireless calls will default to basic 9-1-1 at a default PSAP. The MPC often serves multiple carriers and typically serves the entire United States. The failure of the MPC could result in the loss of the expected data to allow effective routing and handling of the call. Therefore the "hub" functionality of the MPC in the wireless E9-1-1 process makes it a significant concentration point in the wireless E9-1-1 network.

- Position Determining Entity (PDE)
  The Position Determining Entity (PDE) is an ANSI-41 wireless network element that calculates the latitude and longitude of E9-1-1 calls. Some wireless carriers own and operate their own PDE. Other wireless carriers rely upon third party PDEs that serve multiple wireless carriers. Different PDEs use different technologies for calculating the caller's location. Regardless of technology, the failure of a PDE can result in the loss of Phase 2 data for all calls generated by one or more wireless carriers.

  To the extent that the PDE serves multiple carriers' facilities or aggregates data from multiple MSCs, it should be considered a major concentration point. Although the failure of the PDE does not impact 9-1-1 call completion, the failure of a PDE would result in the loss of the expected data to allow effective handling of the call.

- Gateway Mobile Location Center (GMLC)
  The Gateway Mobile Location Center (GMLC) is a GSM/UMTS wireless network element that processes two way communications between the MSC, SMLC and ESME (ALI) in order to determine location and call routing information. The GMLC to MSC communications provides routing instructions to the MSC. The GMLC to MSC communications facilitates the determination of location of the wireless handset. The GMLC to ALI communications provides for the relay of wireless data to the PSAP.

  If any one of these GMLC communications / processes fails, wireless E9-1-1 will either degrade or fail, such that all wireless calls will default to basic 9-1-1 at an appropriate or default PSAP. The GMLC often serves multiple carriers and typically serves the entire United States. The failure of the GMLC could result in the loss of the expected data to allow effective routing and handling of the call. Therefore the "hub" functionality of the GMLC in the wireless E9-1-1 process makes it a significant concentration point in the wireless E9-1-1 network.

- Serving Mobile Location Center (SMLC)
  The Serving Mobile Location Center ("SMLC") is a GSM/UMTS wireless network element that calculates the latitude and longitude of E9-1-1 calls. Some wireless carriers own and operate their own SMLC. Other wireless carriers rely upon third party SMLCs that serve multiple wireless carriers. Different SMLCs use different technologies for calculating the caller's

location. Regardless of technology, the failure of a SMLC can result in the loss of Phase 2 data for all calls generated by one or more wireless carriers.

To the extent that the SMLC serves multiple carriers' facilities or aggregates data from multiple areas of the networks, it should be considered a major concentration point. Although the failure of the SMLC does not impact 9-1-1 call completion, the failure of a SMLC would result in the loss of the expected data to allow effective handling of the call.

4.5 Best Practices

4.5.1 Background

Given a variety of implementations of E9-1-1 Phase II Network Elements, it is appropriate to identify instances in which the deployed elements exhibit superior performance, robustness, or other aspects supporting the Phase II solution. Best Practices will be described for each of the Network Elements identified above in Section 4.4.2.

4.5.2 Recommendations

A total of 20 near-term emergency communications network Best Practices were identified by Focus Group 1A. The Best Practices fall into the following categories:

4.5.2.1 Public Safety Answering Point (PSAP)

- **7-P-3214:** Thresholds of Database Queries / Rebids

  Public Safety Answering Points should avoid deploying an automatic ALI rebid function for wireless E-9-1-1 calls. However, where deemed necessary, an automatic ALI rebid function should only be deployed for the initial bid to retrieve the Phase II location.

  Reference Info: In addition to unnecessarily adding to network congestion when a location update is not needed, an automatic rebid can confuse the call taker in some situations. Currently, some wireless handsets will interrupt voice contact when they are polled for updated location. If the call taker controls when this occurs, it can be anticipated and expected rather than seeming arbitrary. Additionally, the location of the incident may be at the original location though the caller is moving (i.e., someone calling about an accident they are passing). Instead of the map intermittently updating itself to the caller's location, it is best to let

the call taker manage the rebid process. Though each carrier has their own rebid interval, waiting at least 30 seconds between rebids will work for all carriers.

- **7-P-3215:** Mobile Switching Center("MSC") Default Route Operational Standard Recommendation

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

- **7-P-3216:** Default Routing

  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.

- **7-P-3217:** E9-1-1 Service Provider Contact Information

  Network Operators and Service Providers should provide and maintain current 24 / 7 / 365 contact information accessible to Public Safety Answering Points ("PSAPs") so that PSAPs may obtain additional subscriber information as appropriate.

4.5.2.2 Automatic Location Identification (ALI)

- **7-P-3218**: Training on Obtaining E9-1-1 Phase II Data

  PSAPs should provide Training to educate PSAP personnel as to the process to obtain E9-1-1 Phase II data.

- **7-P-3219:** Training on E9-1-1 Phase II ALI Display

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

4.5.2.3 E9-1-1 Selective Router ("SR")

- **7-P-3220:** E9-1-1 Selective Router Database ("SRDB") Diversity

Network Operators and Service Providers that operate E9-1-1 Selective Router Databases (SRDBs) should deploy SRDBs with redundancy and geographic diversity.

Reference info: Selective Routing is a fundamental element of any Enhanced 9-1-1 (E9-1-1) system. Without Selective Routing, calls (with very few exceptions) would not be able to reliably be directed to the most appropriate Public Safety Answering Point (PSAP).

This can be accomplished in several ways, two of which are cited here as examples. Redundant and geographically diverse SRDBs can be located on two geographically diverse E9-1-1 Selective Routers (SR), as indicated in BP #6-5-0571, or by locating the SRDB tables on two separate remote network platforms that are able to be queried by each E9-1-1 SR within their span of control. An example of such could be a remotely located data storage / retrieval device such as a highly intelligent PC, or an SS7 network element such as a Signaling Transfer Point (STP) or Signaling Control Point (SCP). Such devices may be thought of as 'off-board' to the actual E9-1-1 SR switch that is otherwise handling the call on its way to the designated PSAP.

- **7-P-3221**: Selective Router Database ("SRDB") Update Frequency

  Network Operators and Service Providers that operate E9-1-1 Selective Router Databases (SRDBs) should maintain SRDBs with as current E9-1-1 routing information as is feasible.

- **7-P-3222:** E9-1-1 Selective Router (SR) to Public Safety Answering Point (PSAP) Trunking Architecture

  Network Operators, Service Providers and Public Safety Answering Points (PSAPs) should provide, where appropriate, at least one additional trunk between the E9-1-1 Selective Router (SR) and the PSAP than the switching entity source with the largest total number of trunks serving that PSAP.

- **7-P-3223:** Originating Source to E9-1-1 Selective Router Trunking Architecture

  Network Operators and Service Providers should implement dedicated trunk groups 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).

This should be done rather than aggregating traffic from centralized switching architectures serving wide spread geographic areas onto a single trunk group to the E9-1-1 Selective Router. This should be done in conjunction with the local PSAP jurisdictional authorities to ensure that correct choices are made.

4.5.2.4 Signaling System 7 (SS7) Elements

- **7-P-3224:** E9-1-1 Dedicated Trunking

  Network Operators and Service Providers should use dedicated Signaling System 7 (SS7) or Multi Frequency (MF) controlled trunk groups for the normal routing of E9-1-1 calls from originating switching entities to E9-1-1 Selective Routers rather than using shared Public Switched Telephone Network trunking.

4.5.2.5 Mobile Positioning Center (MPC)

- **7-P-3225:** Mobile Positioning Center (MPC) Capacity Reserve

  Network Operators and Service Providers that deploy geographically diverse 9-1-1 Mobile Positioning Centers (MPC) with dual load sharing nodes should ensure that the utilization on either node is less than half of each node's capacity so that if one node fails the other node will absorb the load.

- **7-P-3226:** Mobile Positioning Center (MPC) 9-1-1 Network Operations Support

  Network Operators and Service Providers operating Mobile Positioning Centers (MPC) should provide 24x7 network operations support.

4.5.2.6 Position Determining Entity (PDE), Gateway Mobile Location Center (GMLC) and Serving Mobile Location Center (SMLC)

- **7-P-3227:** 9-1-1 Voice Traffic and Location Data Concurrency

  Network Operators, Service Providers and Equipment Suppliers should deploy location solutions such that the E9-1-1 related data traffic between the Position Determining Entity (PDE) and the mobile subscriber

associated with location determination should not interfere with the voice traffic, when feasible.

- **7-P-3228:** Global Positioning System (GPS) Location Accuracy for E9-1-1

  Network Operators, Service Providers and Equipment Suppliers that use Global Positioning System (GPS) enabled Phase II location solutions should ensure that the GPS satellite location information (e.g., GPS ephemeris, almanac, etc.) is as current as is feasible to assist the handset in providing improved accuracy of the GPS fix, aiding in the reduction of the time of database responses and reduction of the number of database query rebids.

- **7-P-3229:** 9-1-1 Performance Statistics and Logging

  Network Operators and Service Providers that operate Mobile Positioning Centers (MPC)/ Gateway Mobile Location Centers (GMLC) should maintain local storage of record logs for a minimum of 7 days showing incoming successful requests from Emergency Services Message Entity (ESME) and outgoing responses to ESME.

- **7-P-3230:** Data Log Storage Intervals

  Network Operators and Service Providers that produce location event records that include time-stamped call detail transactions should store these records for a minimum of 3 days.

- **7-P-3231:** Satellite Location Identification information Transfer Delay

  Network Operators and Service Providers that use Global Positioning System (GPS) enabled Phase II location solutions should ensure that the GPS satellite location identification information (e.g., GPS ephemeris, almanac, etc.) is transmitted to the Phase II Mobile Subscriber or Position Determining Entities (PDE) as soon as is feasible after the E9-1-1 call commences in order to reduce the number of database query rebids.

- **7-P-3232:** Handsets that use a Global Positioning System (GPS) Algorithm for E9-1-1

  Equipment suppliers should ensure that the Phase II handsets commence Global Positioning System (GPS) acquisition before the GPS satellite location identification information is received so that GPS acquisition time is minimized and to reduce the number of database query rebids.

- **7-P-3233:** E9-1-1 Phase II Accuracy Optimization Reporting and Resolution Process

  Service Providers deploying wireless Phase II should work to ensure that Phase II accuracy is optimized and the performance trouble resolution process is followed as needed.

  Reference information: See "E9-1-1 PHASE II Accuracy Optimization Reporting and Resolution Process" document. (Appendix E– NRIC VII 1A Final Report)

4.6 NRIC VII Focus Group 1A Recommendations for Future NRIC Subject Matter

Focus Group 1A identified additional Near Term 9-1-1 issues that were not within the NRIC VII Focus Group 1A Charter, but require serious consideration for future NRIC Charters. Those issues include:

- 9-1-1 Network Congestion Control Management
- PSAP Network Reliability, Survivability and Interoperability with Communications Networks
- 9-1-1/VoIP Mobility Location Determination
- Evaluation of CC Docket 94-102 and its applicability to current technologies and trends
- Communications Providers Role in disaster preparedness and recovery of 9-1-1/E9-1-1 systems

5 Appendix A - Key Definitions

- **Accuracy Testing**
  Accuracy testing, as applied to FCC compliance reporting, whether through empirical and/or predictive test methods, consists of generating location data to gauge the accuracy performance of the system. Location data, typically significant in volume, involves the location infrastructure of the carrier's network. The primary objective is to verify location accuracy and correct any location system errors. Limiting the test to the carrier's location network minimizes impact to the rest of the Phase 2 network and maximizes the capability of the carriers to optimize their system.[9]
- **Certification and Reporting Area**
  Geographical areas related to where accuracy is assessed and reported. For the purpose of NRIC VII in which we focus on policy rather than technical issues, the term "certification and reporting" area shall be used to refer to geographical areas related to how accuracy is certified and reported to government agencies.
- **Compliance Testing**
  The performance of accuracy testing, per the ESIF Technical Report 'High Level Requirements for Accuracy Test Methodologies Technical Report' (ATIS-0500001), required to verify that a Carrier's Phase II location accuracy is within the requirements established by the Commission (reference CC Docket No. 94-102).
  These requirements are:
  * For handset-based solutions: 50 meters for 67 percent of calls, 150 meters for 95 percent of calls.
  * For network-based solutions: 100 meters for 67 percent of calls, 300 meters for 95 percent of calls.
- **Confidence Factor**
  The likelihood that the caller lies within the associated geographic shape description (uncertainty shape). Expressed as a percentage, with 0% indicating 'no information'.
- **Empirical Testing**
  An empirical location accuracy test consists of measuring the difference between a location established by typical surveying techniques or by a differential GPS receiver or similar means and the location estimate provided by the wireless carrier.

[9] This definition was taken from ESIF TECHNICAL REPORT - ATIS-0500001, High Level Requirements for Accuracy Testing Methodologies, and modified slightly to fit the purposes of this NRIC VII FG1A Report.

- **End-to-End Testing (aka: Functionality Testing)**
  Functionality testing consists of testing the delivery of the location data from the carrier to the PSAP. The objective of this testing activity is to ensure interoperability between the carrier and the Emergency Service Network. This testing activity requires tight coordination among the involved parties, which normally includes the Emergency Service Network, the carrier and the technology vendors. [10]
- **Indoor Location Testing**
  Testing location accuracy inside permanent structures.
- **Maintenance Testing**
  Maintenance testing may be conducted after a system has been turned up with the Emergency Service Network. Like all network systems, maintenance testing will be conducted as needed to ensure functionality and performance. This testing activity may include functionality and/or accuracy testing and the participation of the Emergency Service Network may or may not be required. Maintenance testing can be a condensed version of the original accuracy and functionality testing.[11]
- **Predictive Testing**
  A predictive test method consists of utilizing a predictive model to compute the expected accuracy of a location determining technology within a wireless carrier's service area. The predictive model takes into account the physical elements of the location determining system for network or handset based solutions as well as the relevant terrain and RF propagation characteristics.[12]
- **PSAP (Public Safety Answering Point)**
  A Communications Center to which 9-1-1 calls are routed, answered and directed for dispatch by local public safety departments. This definition also includes Administrative entities associated with the PSAP, which can be at the Federal, State, County or City governmental level.
- **Standard Deviation**
  The standard deviation, often denoted as ? in statistics textbooks, is a measure of the spread of data in any scenario involving random data. It is computed as the square root of the variance ? ? . For any random variable x, the variance is given as ? ? = E{ x^2}- m_x^2, where m_x is the mean or average value of x, and E{ x^2}is the "expected", or average value of x^2. The measured Phase 2 location data has some random component due to noise, multipath, timing jitter, etc.

[10] This definition was taken from ESIF TECHNICAL REPORT - ATIS-0500001, High Level Requirements for Accuracy Testing Methodologies.
[11] This definition was taken from ESIF TECHNICAL REPORT - ATIS-0500001, High Level Requirements for Accuracy Testing Methodologies.
[12] This definition was taken from ESIF TECHNICAL REPORT - ATIS-0500001, High Level Requirements for Accuracy Testing Methodologies.

Reference: A. Papoulis, Probability, Random Variables, and Stochastic Processes, McGraw Hill, 1965

- **Test Entity**
  The group, organization, or individual conducting the test
- **Test Area**
  Test area is the geographical area designated by the Test Entity for performance of the Phase 2 positioning technology testing and verification.
  Any required network hardware or software modifications necessary to enable the Phase 2 location technology will have been previously completed for the area defined.

  The definition of each 'test area' shall be determined and clearly documented by the Test Entity. Areas delineated for compliance testing should not overlap.

  The test area should be a polygon selected from the portion of the wireless network to be tested, where Phase 2 E9-1-1 service is available, regardless of PSAP boundary.[13] It is understood that there is a relationship between the size of the test area and the number of test points required.
- **Tier 1 Carrier**
  Carrier with enough spectrum to offer nationwide service with over 2.5 million in subscribers as of year-end 2001.
- **Tier 2 Carrier**
  Non-nationwide carrier that had over 500,000 subscribers as of year-end 2001.
- **Tier 3 Carrier**
  All other non-nationwide carriers not included in Tier 1 or Tier 2.
- **Uncertainty Estimate**
  A call-by-call indication of the quality of the associated location estimate. Expressed as a geographic shape (circle, ellipse, arc, polygon, etc). The uncertainty estimate (uncertainty shape) is delivered real-time along with the location estimate itself.

  The E_2 interface to the Emergency Services Network is defined in J-STD-036. The following geometric shape descriptions for use with E9-1-1 Phase 2 are included (see also ANSI T1.628), as a minimum:

  - Ellipsoid Point. This represents a point on the surface of the earth, with no associated uncertainty estimate, i.e., a simple latitude/longitude.

[13] This definition was taken from ESIF TECHNICAL REPORT - ATIS-0500001, High Level Requirements for Accuracy Testing Methodologies.

- Ellipsoid Point with Uncertainty (Circle). This represents a point on the surface of the earth (latitude/longitude) along with an uncertainty circle of radius r, in meters, where r ranges between 1 and 1,800,000.

6 Appendix B - Abbreviations and Acronyms

Acronym	Meaning
9-1-1	Basic 9-1-1 service. Voice traffic
E9-1-1	Enhanced 9-1-1 service. Voice and Data traffic
ACD	Automatic Call Distributor
ALI	Automatic Location Identification
ALI-DB	Automatic Location Identification Data Base
ANSI	American National Standards Institute
A-GPS	Assisted-Global Positioning System
APCO	Association of Public-Safety Communications Officials, International
ATIS	Alliance for Telecommunications Industry Solutions
CMOS	Complementary Metal Oxide Semiconductor
CoS	Class of Service
CPE	Customer Premises Equipment
dB	Decibel
DTx	Discontinuous Transmission
E2	Reference Point between the GMLC and ESME
E9-1-1	Enhanced 9-1-1
E9-1-1SSP	E9-1-1 System Service Provider
E-OTD	Enhanced Observed Time Difference of Arrival
ESIF	Emergency Services Interconnection Forum
ESME	Emergency Services Message Entity
ESRK	Emergency Services Routing Key
FCC	Federal Communications Commission
FG1A	Focus Group 1A
GMLC	Gateway Mobile Location Center
GPS	Global Positioning System
GSM	Global Systems for Mobile Communications
HDTV	High Definition Television
IC	Integrated Circuit
L1/L2/L5	Various channels within the GPS signal
LEC	Local Exchange Carrier
LMU	Location Measurement Unit
MHz	Megahertz
MLTS	Multi Line Telephone System

MPC	Mobile Positioning Center
MF	Multi Frequency
MS	Mobile Subscriber
MSC	Mobile Switching Center
MSAG	Master Street Address Guide
MTA	Metropolitan Trading Area
NASNA	National Association of State Nine-One-One Administrators
NENA	National Emergency Number Association
NPRM	Notice of Proposed Rule Making
NRIC	Network Reliability Interoperability Council
OET-71	FCC Office of Engineering and Technology Bulletin No. 71
PAM	PSAP ALI Messaging
PBX	Private Branch Exchange
PDE	Position Determining Entity
Phase 1	FCC mandate that wireless E9-1-1 calls be delivered with call back number and cell site identification
Phase 2	FCC mandate that wireless E9-1-1 calls be delivered with Phase 1 data plus latitude/longitude estimate of where the caller was when they dialed 9-1-1
PSAP	Public Safety Answering Point
RF	Radio Frequency
SatNav	Satellite Navigation
SCP	Signaling Control Point
SMLC	Serving Mobile Location Center
S/N	Signal to Noise ratio
SR	Selective Router
SRDB	Selective Routing Databases
SS7	Signaling System 7
SSP	Signaling Switching Point
STP	Signaling Transfer Point
TDOA	Time Difference of Arrival
U-TDOA	Uplink TDOA
UMTS	Universal Mobile Telecommunications System
VoIP	Voice over Internet Protocol
WAAS	Wide Area Augmentation System
WiFi	Wireless Fidelity
WLAN	Wireless Local Area Network
WLS	Wireless Location Signatures
Z-height	Location coordinate indicating altitude

7 Appendix C - Sources and Documentation

- *NENA 02-010 NENA Standard Formats & Protocols For ALI Data Exchange, ALI Response & GIS Mapping – Revised November 9, 2004*: A copy of NENA 02-010 may be accessed at http://www.nena9-1-1.org/9-1-1TechStandards/nena_standards.htm

- *"Enhanced Wireless 9-1-1 Phase 2", PN-3890-RV2, J-STD-036-B, Rev B v9., October 2004*

- *OET BULLETIN No. 71* - www.fcc.gov

- *ESIF Technical Report - ATIS-0500001: High Level Requirements for Accuracy Testing Methodologies (7/23/04)*
  The FCC has established accuracy requirements for network and handset based location solutions for Enhanced 9-1-1 emergency call services (found in the Commission's Third Report and Order, adopted September 15, 1999). As a result, ESIF identified the need for industry-accepted requirements for testing the accuracy performance of Wireless E-9-1-1 Phase 2 systems. This document provides a common frame of reference that individual stakeholders can use to validate the accuracy methodology of 9-1-1 location technologies.

  The ATIS-0500001 document can be located at
  http://www.atis.org/esif/docs.asp

8 Appendix D - Network Topology Diagram

Network Topology Diagram., found in file:
"NRICVII_FG1A_AppendixD_December_2005.PDF"

9 Appendix E - E9-1-1 PHASE II Accuracy Optimization Reporting and Resolution Process

E9-1-1 PHASE II
Accuracy Optimization Reporting and Resolution Process

Executive Summary

Since the development and adoption of the NRIC FG-1A Report #1 (15 Feb 2005), which established recommendations addressing wireless location accuracy compliance testing, wireless carriers, vendors and members of the public safety community have worked through a cooperative process to refine and supplement this report. The goal was to increase the breadth of support for the approach, and to eliminate or reduce ambiguity in the interpretation and implementation of the NRIC recommendations.

The resulting proposal set out below would require carriers to optimize the performance of their deployed location technology at the Public Safety Answering Point (PSAP) level, to the extent technologically feasible and commercially reasonable, but retains the original NRIC FG1A recommendation that compliance be measured at the State level. This approach captures the best commercial efforts of the carriers and maximizes performance in under-performing areas, while taking into account the physical limitations of existing location technology. It also recognizes the long-term goal of all parties working together to achieve the FCC standard of location accuracy at the PSAP level, as this becomes possible through future network expansion and as the carrier's deployed location technology advances. It is recommended that future NRIC Charters include the study and recommendations for improving location accuracy to meet the ultimate service delivery goals. This approach encourages mutual cooperation and communication between the carriers and the PSAPs throughout the E9-1-1 Phase II deployment process.

Finally, additional details regarding the mitigation process to be followed in cases of a dispute between a carrier and a PSAP are provided.

General Information - Phase II Deployment Process

In accordance with the Federal Communications Commission (FCC) Docket 94-102, the implementation of Wireless Phase II service is initiated by a PSAP through a formal request for service to each wireless carrier providing service in the local area. Carriers are obligated to deploy the service within time frames

specified within the FCC rule, and PSAPs should work in concert with the wireless carriers to establish a mutually acceptable process for the deployment of Phase II service and verification that the Phase II system is operating as designed.

Recommendation

Compliance with the FCC accuracy standards should require:

1) Certification through OET 71/ESIF testing at the statewide level, and

2) Best efforts to meet the accuracy levels specified in the FCC rules at the PSAP level to the extent technologically feasible and commercially reasonable. Such best efforts shall include adherence to trouble resolution and mitigation procedures as specified in the Performance Trouble Reporting and Resolution Process defined below.

All parties agree that it is not technically possible today for every carrier to meet the FCC location accuracy requirement at every PSAP, but we jointly share the ultimate goal of working toward the FCC location accuracy standard at all PSAPs, and improving the accuracy of E9-1-1 Phase II data provided to the PSAP as the carrier's deployed location technology and other factors advance.

NASNA, NENA, RCA and CTIA acknowledge that the implementation of Phase II requires maximum effort and cooperation between the PSAP and the wireless carrier communities. The organizations pledge that during and following the implementation of Phase II, they will work with PSAPs and with carriers to promote an environment wherein PSAPs and carriers work cooperatively to achieve implementation of Phase II in the best interests of the wireless calling public. These efforts will include regular and effective communication, education, work plans and procedures for Phase II implementation and testing.

Performance testing methods to be applied during carrier post-deployment maintenance testing processes will meet or exceed the guidelines developed by ESIF, and will include ground truth comparison, as agreed in the NRIC FG 1A recommendations. Carriers are not required to conduct OET 71/ESIF compliance testing at each PSAP.

Phase II Deployment

Upon receipt of a request for Phase II Service, a carrier and the requesting PSAP or public safety authority will initiate dialog and develop a mutually agreeable plan for deployment and performance validation within the guidelines stated herein. Performance validation methods to be applied in conjunction with the

Phase II deployment will meet or exceed the end-to-end / functional testing guidelines developed by ESIF, unless modified by mutual consent.

Carriers will, in cooperation with the requesting PSAP or public safety authority, test the E9-1-1 Phase II wireless service to reasonably assure that the carrier's location system is performing as optimally as possible for given terrains and deployment characteristics within the service area. This is not to be interpreted as requiring OET 71 / ESIF compliance testing at the local level, but will allow for a variety of testing methods to assess performance.

Upon completion of the Phase II deployment and performance validation, and if requested by the PSAP, the carrier will review the results with representatives of the PSAP jurisdiction and both the PSAP or public safety authority, and the carrier will address outstanding issues. When the implementation is complete, it is recommended that a 'notice of completion' be issued by the carrier.

Post-Deployment Process

Subsequent to implementation, the jurisdiction requesting Phase II service may at any time conduct independent tests to determine the effectiveness of a carrier's location determination technology. If the PSAP determines through thorough testing based on an appropriate methodology, supported by adequate documentation[14] that the carrier's accuracy performance in their PSAP jurisdiction is substantially less than the performance identified in FCC rules, and believes that the carrier has not made a good faith effort to optimize performance at the local level, then the PSAP may make notification to the carrier and initiate the performance trouble reporting and resolution process.

The Performance Trouble Reporting and Resolution Process is intended to ensure that the wireless location technology is properly deployed and optimized at the local level, and includes the following steps (as a minimum):

> **Notification.** PSAPs should notify the affected wireless carrier, via the carrier's trouble reporting procedures, of the perceived inadequacy.
>
> **Acknowledgement.** The carrier will acknowledge receipt of notification within five (5) business days and provide the PSAP a reference or log number which will be used for tracking and documentation.

[14] Includes data gathered from PSAP per-call location comparisons between actual caller location versus displayed location, and/or results from carrier maintenance-based accuracy testing. PSAP also should be able to provide documentation that verifies base map is regularly tested for accuracy.

Documentation. PSAPs should provide sufficient information and documentation to substantiate the alleged performance problems.

Response. Carriers will respond to the overall Mitigation Process within a reasonable period of time.

Mitigation

Upon receiving a report from a PSAP, the carrier shall acknowledge receipt to the PSAP within five business days and provide the PSAP with a written plan within 30 calendar days that includes the specific actions and timelines that the carrier intends to take to respond to the specific issues raised in the reported deficiency.

In responding to a report from a PSAP, the following steps are representative (but not exclusive) of the specific actions and timelines that carriers may undertake, depending upon the technology used, to optimize the performance of the location accuracy of the carrier's network:

- Review the test data provided by the PSAP
- Pull PDE and MPC data for PSAP test calls - review location fixes staged in MPC, fixes delivered to ALI, number and timing of re-bids
- Check PDE/MPC data for messaging/network errors - investigate with PDE vendors/suppliers with goal to resolve as quickly as possible
- Check the BSA for completeness and accuracy
- Update BSA, if information not complete or accurate
- Review/share (under non-disclosure) empirical test data for test area that contains PSAP
- Communicate results of above steps with PSAP
- End-to-end/Functionality testing was successfully completed
- Identify whether accuracy measured within the service area is in line with predicted levels
- Review most recent maintenance testing (if applicable)
- All outdoor BTS sites in an isolated service area are equipped with LMUs
- LMUs and other location network equipment are functional and performing properly
- System configuration parameters are correct
- Proper site coordinates are loaded (lat/long of site antennas, etc.)
- The 9-1-1-call distribution (weighting) data is correct (if applicable)

When the carrier has fulfilled all the steps pledged in its response, the carrier shall provide documentation to the PSAP that all reasonable steps have been taken to respond to the service discrepancy within the jurisdiction, taking into

consideration the parameters of existing technology for given terrain(s) and deployment characteristics within the service area.

If the PSAP asserts that the carrier has not made best efforts to adequately mitigate the problem, then the PSAP may file a complaint before the FCC.