                Next-Generation Vehicle-Initiated Emergency Calls
                      draft-ietf-ecrit-car-crash-07.txt

Abstract

   This document describes how to use IP-based emergency services
   mechanisms to support the next generation of emergency calls placed
   by vehicles (automatically in the event of a crash or serious
   incident, or manually invoked by a vehicle occupant) and conveying
   vehicle, sensor, and location data related to the crash or incident.
   Such calls are often referred to as "Automatic Crash Notification"
   (ACN), or "Advanced Automatic Crash Notification" (AACN), even in the
   case of manual trigger. The "Advanced" qualifier refers to the
   ability to carry a richer set of data.

   This document also registers a MIME Content Type and an Emergency
   Call Additional Data Block for the vehicle, sensor, and location data
   (often referred to as "crash data" even though there is not
   necessarily a crash). An external specification for the data format,
   contents, and structure are referenced in this document.

   This document reuses the technical aspects of next-generation pan-
   European eCall (a mandated and standardized system for emergency
   calls by in-vehicle systems within Europe and other regions).
   However, this document specifies a different set of vehicle (crash)
   data, specifically, the Vehicle Emergency Data Set (VEDS) rather than
   the eCall Minimum Set of Data (MSD). This document is an extension
   of the eCall document, with the differences being that this document
   makes the MSD data set optional and VEDS mandatory. This document
   also discusses legacy (curcuit-switched) ACN systems and their
   migration to next-generation emergency calling.

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[1](#). Terminology

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT",
"SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this
document are to be interpreted as described in [[RFC2119](#)].

This document re-uses terminology defined in [Section 3 of [RFC5012]](#).

Additionally, we use the following abbreviations:

```
+--------+----------------------------------------------------------+
| Term   | Expansion                                                |
+--------+----------------------------------------------------------+
| 3GPP   | 3rd Generation Partnership Project                       |
| AACN   | Advanced Automatic Crash Notification                    |
| ACN    | Automatic Crash Notification                             |
| APCO   | Association of Public-Safety Communications Officials    |
| EENA   | European Emergency Number Association                    |
| ESInet | Emergency Services IP network                            |
| GNSS   | Global Satellite Navigation System (which includes the   |
|        | various such systems including the Global Positioning    |
|        | System or GPS)                                           |
| IVS    | In-Vehicle System                                        |
```

```
| MNO     | Mobile Network Operator                               |
| NENA    | National Emergency Number Association                 |
| TSP     | Telematics Service Provider                           |
| VEDS    | Vehicle Emergency Data Set                            |
+--------+-------------------------------------------------------+
```

2. Introduction

Emergency calls made by in-vehicle systems (e.g., in the event of a
crash) assist in significantly reducing road deaths and injuries by
allowing emergency services to respond quickly and often with better
location.

Drivers often have a poor location awareness, especially outside of
major cities, at night and when away from home (especially abroad).
In the most crucial cases, the victim(s) might not be able to call
because they have been injured or trapped.

For more than a decade, some vehicles have been equipped with
telematics systems that, among other features, place an emergency
call automatically in the event of a crash or manually in response to
an emergency call button. Such systems generally have on-board
location determination systems that make use of satellite-based
positioning technology, inertial sensors, gyroscopes, etc., to
provide a fairly accurate position for the vehicle. Such built-in
systems can take advantage of the benefits of being integrated into a
vehicle, such as more reliable power, ability to have larger or
specialized antenna, ability to be engineered to avoid or minimise
degradation by vehicle glass coatings, interference from other
vehicle systems, etc. Thus, the PSAP can be provided with a good
estimate of where the vehicle is during an emergency. Vehicle
manufacturers are increasingly adopting such systems, both for the
safety benefits and for the additional features and services they
enable (e.g., remote engine diagnostics, remote door unlock, stolen
vehicle tracking and disabling, etc.).

The general term for such systems is Automatic Crash Notification
(ACN) or "Advanced Automatic Crash Notification" (AACN). "ACN" is
used in this document as a general term. ACN systems transmit some
amount of data specific to the incident, referred to generally as
"crash data" (the term is commonly used even though there might not
have been a crash). While different systems transmit different

amounts of crash data, standardized formats, structures, and
mechanisms are needed to provide interoperability among systems and
PSAPs.

As of the date of this document, currently deployed in-vehicle
telematics systems are circuit-switched and lack a standards-based
ability to convey crash data directly to the PSAP (generally relying
on either a human call taker or an automated system to provide the
PSAP call taker with some crash data orally, or possibly a
proprietary mechanism). The PSAP call taker needs to first realize
that the call is related to a vehicle incident, and in most cases
must then listen to the data and transcribe it.

The transition to next-generation calling in general, and emergency
calling in particular, provides an opportunity to vastly improve the
scope, breadth, reliability and usefulness of crash data during an
emergency by allowing it to be presented alongside the call, and to
be automatically processed by the PSAP and made available to the call
taker in an integrated, automated way. In addition, vehicle

manufacturers are provided an opportunity to take advantage of the
same standardized mechanisms for data transmission for internal use
if they wish (such as telemetry between the vehicle and a service
center for both emergency and non-emergency uses, including location-
based services, multi-media entertainment systems, and road-side
assistance applications).

Next-generation ACN provides an opportunity for such calls to be
recognized and processed as such during call set-up, and optionally
routed to an upgraded PSAP where the vehicle data is available to
assist the call taker in assessing and responding to the situation.

An ACN call can be either occupant-initiated or automatically
triggered. (The "A" in "ACN" does stand for "Automatic," but the
term is often used to refer to the class of calls that are placed by
an in-vehicle system (IVS) and that carry incident-related data as
well as voice.) Automatically triggered calls indicate a car crash
or some other serious incident (e.g., a fire) and carry a greater
presumption of risk of injury. Manually triggered calls are often
reports of serious hazards (such as impaired drivers or roadway
debris) and might require different responses depending on the
situation. Manually triggered calls are also more likely to be false

(e.g., accidental) calls and so might be subject to different
operational handling by the PSAP.

This document describes how the IETF mechanisms for IP-based
emergency calls, including [RFC6443] and
[I-D.ietf-ecrit-additional-data], are used to provide the realization
of next-generation ACN.

This document reuses the technical aspects of next-generation pan-
European eCall (a mandated and standardized system for emergency
calls by in-vehicle systems within Europe and other regions), as
described in [I-D.ietf-ecrit-ecall]. However, this document
specifies a different set of vehicle (crash) data, specifically, the
Vehicle Emergency Data Set (VEDS) rather than the eCall Minimum Set
of Data (MSD). This document is an extension of
[I-D.ietf-ecrit-ecall], with the differences being that this document
makes the MSD data set optional and VEDS mandatory.

The Association of Public-Safety Communications Officials (APCO) and
the National Emergency Number Association (NENA) have jointly
developed a standardized set of incident-related vehicle data for ACN
use, called the Vehicle Emergency Data Set (VEDS) [VEDS]. Such data
is often referred to as crash data although it is applicable in
incidents other than crashes.

VEDS provides a standard data set for the transmission, exchange, and
interpretation of vehicle-related data. A standard data format
allows the data to be generated by an IVS, and interpreted by PSAPs,
emergency responders, and medical facilities (including those capable
of providing trauma level patient care). It includes incident-
related information such as airbag deployment, location of the
vehicle, if the vehicle was involved in a rollover, various sensor
data that can indicate the potential severity of the crash and the
likelihood of severe injuries to the vehicle occupants, etc. This
data better informs the PSAP and emergency responders as to the type
of response that might be needed. This information was recently
included in the federal guidelines for field triage of injured
patients. These guidelines are designed to help responders at the
accident scene identify the potential existence of severe internal
injuries and to make critical decisions about how and where a patient

needs to be transported.

This document registers the 'application/EmergencyCallData.VEDS+xml'
MIME content-type, and registers the 'VEDS' entry in the Emergency
Call Additional Data registry.

VEDS is an XML structure (see [VEDS]). The 'application/
EmergencyCallData.VEDS+xml' MIME content-type is used to identify it.
The 'VEDS' entry in the Emergency Call Additional Data registry is
used to construct a 'purpose' parameter value for conveying VEDS data
in a Call-Info header (as described in
[I-D.ietf-ecrit-additional-data]).

VEDS is a versatile structure that can accomodate varied needs.
However, if additional sets of data are determined to be needed
(e.g., in the future or in different regions), the steps to enable
each data block are very briefly summarized below:

o   A standardized format and encoding (such as XML) is defined and
    published by a Standards Development Organization (SDO)

o   A MIME Content-Type is registered for it (typically under the
    'Application' media type) with a sub-type starting with
    'EmergencyCallData.'

o   An entry for the block is added to the Emergency Call Additional
    Data Blocks sub-registry (established by
    [I-D.ietf-ecrit-additional-data]); the registry entry is the root
    of the MIME sub-type (not including the 'EmergencyCallData' prefix
    and any suffix such as '+xml')

A next-generation In-Vehicle System (IVS) transmits crash data by
encoding it in a standardized and registered format (such as VEDS)

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and attaching it to an INVITE as a MIME body part. The body part is
identified by its MIME content-type (such as 'application/
EmergencyCallData.VEDS+xml') in the Content-Type header field of the
body part. The body part is assigned a unique identifier which is
listed in a Content-ID header field in the body part. The INVITE is
marked as containing the crash data by adding a Call-Info header
field at the top level of the INVITE. This Call-Info header field
contains a CID URL referencing the body part's unique identifier, and

a 'purpose' parameter identifying the data as the crash data per the
registry entry; the 'purpose' parameter's value is
'EmergencyCallData.' and the root of the MIME type (the
'EmergencyCallData' prefix is not repeated), omitting any suffix such
as '+xml' (e.g., 'purpose=EmergencyCallData.VEDS').

These mechanisms are thus used to place emergency calls that are
identifiable as ACN calls and that carry one or more standardized
crash data objects in an interoperable way.

3. Document Scope

This document is focused on the interface to the PSAP, that is, how
an ACN emergency call is setup and incident-related data (including
vehicle, sensor, and location data) is transmitted to the PSAP using
IETF specifications. (The goal is to re-use specifications rather
than to invent new.) For the direct model, this is the end-to-end
description (between the vehicle and the PSAP). For the TSP model,
this describes the right-hand side (between the TSP and the PSAP),
leaving the left-hand side (between the vehicle and the TSP) up to
the entities involved (i.e., IVS and TSP vendors) who are then free
to use the same mechanism as for the right-hand side (or not).

Note that while ACN systems in the U.S. and other regions are not
currently (as of the date of this document) mandated, Europe has a
mandated and standardized system for emergency calls by in-vehicle
systems. This pan-European system is known as "eCall" and is the
subject of a separate document, [I-D.ietf-ecrit-ecall], which this
document build on. Vehicles designed to operate in multiple regions
might need to support eCall as well as the ACN described here. If
other regions devise their own specifications or data formats, a
multi-region vehicle might need to support those as well. This
document adopts the call set-up and other technical aspects of
[I-D.ietf-ecrit-ecall], which uses [I-D.ietf-ecrit-additional-data],
which makes it easy to substitute a different data set while keeping
other technical aspects unchanged. Hence, both NG-eCall and the NG-
ACN mechanism described here are fully compatible, differing only in
the specific data block that is sent (the eCall MSD in the case of
NG-eCall, and the APCO/NENA VEDS used in this document). If other

regions adopt their own data set, this can be similarly accomodated

without changing other technical aspects.

4. Overview of Legacy Deployment Models

    Legacy (circuit-switched) systems for placing emergency calls by in-
    vehicle systems, including automatic crash notification systems,
    generally have some ability to convey at least location and in some
    cases telematics data to the PSAP. Most such systems use one of
    three architectural models, which are described here as: "Telematics
    Service Provider" (TSP), "direct", and "paired". These three models
    are illustrated below.

    In the TSP model, both emergency and non-emergency calls are placed
    to a Telematics Service Provider (TSP); a proprietary technique is
    used for data transfer (such as proprietary in-band modems) to the
    TSP.

    In an emergency, the TSP call taker bridges in the PSAP and
    communicates location, crash data (such as impact severity and trauma
    prediction), and other data (such as the vehicle description) to the
    PSAP call taker verbally. Since the TSP knows the location of the
    vehicle (from on-board GNSS), location-based routing is usually used
    to route to the appropriate PSAP. In some cases, the TSP is able to
    transmit location automatically, using similar techniques as for
    wireless calls. Typically, a three-way voice call is established
    between the vehicle, the TSP, and the PSAP, allowing communication
    between the PSAP call taker, the TSP call taker, and the vehicle
    occupants (who might be unconscious).

```
   ///----\\\  proprietary  +------+    911 trunk      +------+
  ||| IVS |||-------------->+ TSP  +----------------->+ PSAP |
   \\\----///  crash data   +------+                   +------+
```
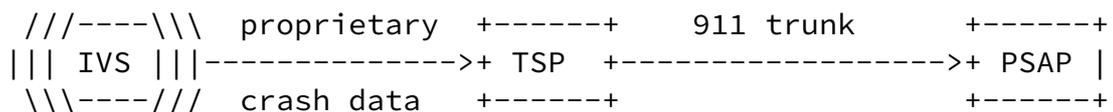
                     Figure 1: Legacy TSP Model.

    In the paired model, the IVS uses a Bluetooth link with a previously-
    paired handset to establish an emergency call with the PSAP (by
    dialing a standard emergency number such as 9-1-1), and then
    communicates location data to the PSAP via text-to-speech; crash data
    might or might not be conveyed also using text-to-speech in an
    initial voice greeting. Some such systems use an automated voice
    prompt menu for the PSAP call taker (e.g., "this is an automatic
    emergency call from a vehicle; press 1 to open a voice path to the
    vehicle; press 2 to hear the location read out") to allow the call
    taker to request location data via text-to-speech.

```
                    +---+
     ///----\\\    | H |   911/etc voice call via handset  +------+
     ||| IVS |||-->| S +-------------------------------->+ PSAP |
     \\\----///    +---+   location via text-to-speech      +------+
```
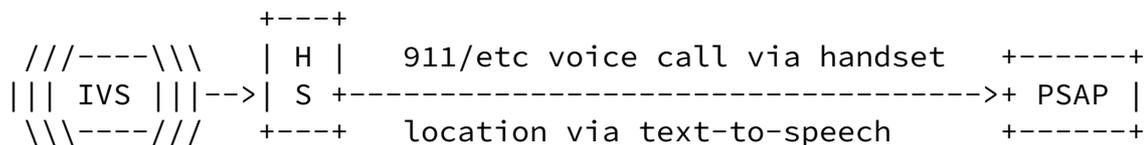
Figure 2: Legacy Paired Model

In the direct model, the IVS directly places an emergency call with
the PSAP by dialing a standard emergency number such as 9-1-1. Such
systems might communicate location data to the PSAP via text-to-
speech; crash data might or might not be conveyed using text-to-
speech in an initial voice greeting. Some such systems use an
automated voice prompt menu (e.g., "this is an automatic emergency
call from a vehicle; press 1 to open a voice path to the vehicle;
press 2 to hear the location read out") to allow the call taker to
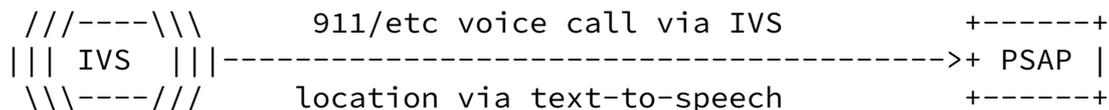request location data via text-to-speech.

```
     ///----\\\        911/etc voice call via IVS          +------+
     ||| IVS  |||------------------------------------->+ PSAP |
     \\\----///        location via text-to-speech        +------+
```

Figure 3: Legacy Direct Model

5. Migration to Next-Generation

   Migration of emergency calls placed by in-vehicle systems to next-
   generation (all-IP) technology provides a standardized mechanism to
   identify such calls and to present crash data with the call, as well
   as enabling additional communications modalities and enhanced
   functionality. This allows ACN calls and crash data to be
   automatically processed by the PSAP and made available to the call
   taker in an integrated, automated way. Because the crash data is
   carried in the initial SIP INVITE (per
   [I-D.ietf-ecrit-additional-data]) the PSAP can present it to the call
   taker simultaneously with the appearance of the call.

   Origination networks, PSAPs, emergency services networks, and other
   telephony environments are all migrating to next-generation. This
   provides opportunities for significant enhancement to
   interoperability, especially for emergency calls carrying additional
   data such as vehicle crash data. Note that in the U.S., a network
   specifically for emergency responders is being developed. This
   network, FirstNet, will be next-generation from the start, enhancing
   the ability for data exchange between PSAPs and responders.

Migration to next-generation (NG) thus provides an opportunity to
significantly improve the handling and response to vehicle-initiated
emergency calls. Such calls can be recognized as originating from a
vehicle, routed to a PSAP equipped both technically and operationally
to handle such calls, and the vehicle-determined location and crash
data can be made available to the call taker simultaneously with the
call appearance.

Vehicle manufacturers using the TSP model can choose to take
advantage of the same mechanism to carry telematics data between the
vehicle and the TSP for both emergency and non-emergency calls as are
used to convey this data to the PSAP.

A next-generation IVS establishes an emergency call using the
emergency call solution as described in [RFC6443] and [RFC6881], with
the difference that the Request-URI indicates an ACN type of
emergency call and a Call-Info header field indicates that vehicle
crash data is attached. When an ESInet is deployed, the MNO only
needs to recognize the call as an emergency call and route it to an
ESInet. The ESInet can recognize the call as an ACN with vehicle
data and can route the call to an NG-ACN capable PSAP. Such a PSAP
can interpret the vehicle data sent with the call and make it
available to the call taker.

Because of the need to identify and specially process Next-Generation
ACN calls (as discussed above), [I-D.ietf-ecrit-ecall] registers new
service URN children within the "sos" subservice. These URNs provide
a mechanism by which an NG-ACN call is identified, and differentiate
between manually and automatically triggered NG-ACN calls, which
might be subject to different treatment depending on policy. (The
two service URNs registered in [I-D.ietf-ecrit-ecall] are
urn:service:sos.ecall.automatic and urn:service:sos.ecall.manual.)

Note that in North America, routing queries performed by clients
outside of an ESInet typically treat all sub-services of "sos"
identically to "sos" with no sub-service. However, the Request-URI
header field retains the full sub-service; route and handling
decisions within an ESInet or PSAP can take the sub-service into
account. For example, in a region with multiple cooperating PSAPs,

an NG-ACN call might be routed to a PSAP that is NG-ACN capable, or
one that specializes in vehicle-related incidents.

Migration of the three architectural models to next-generation (all-
IP) is described below.

In the TSP model, the IVS transmits crash and location data to the
TSP using either a protocol that is based on a proprietary design or
one that re-uses the mechanisms and data objects described here. In

an emergency, the TSP call taker bridges in the PSAP and the TSP
transmits crash and other data to the PSAP using the mechanisms and
data objects described here. There is a three-way call between the
vehicle, the TSP, and the PSAP, allowing communication between the
PSAP call taker, the TSP call taker, and the vehicle occupants (who
might be unconscious).

```
                   proprietary
   ///----\\\  or standard         +------+      standard        +------+
   ||| IVS |||  ------------------>+ TSP +------------------>+ PSAP |
   \\\----/// crash + other data +------+ crash + other data +------+
```
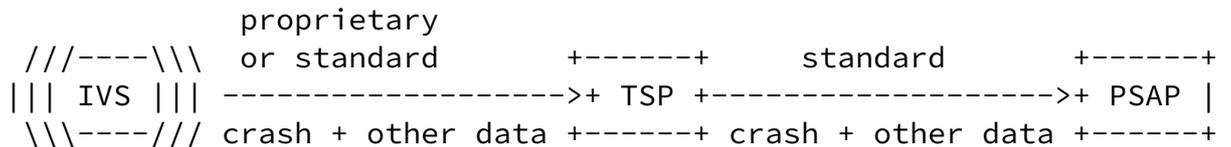
                Figure 4: Next-Generation TSP Model

The vehicle manufacturer and the TSP can choose to use the same
mechanisms and data objects to transmit crash and location data from
the vehicle to the TSP as are described here to transmit such data
from to the PSAP.

In the direct model, the IVS communicates crash data to the PSAP
directly using the mechanisms and data objects described here.

```
   ///----\\\              NG emergency call               +------+
   ||| IVS |||------------------------------------->+ PSAP |
   \\\----///            crash + other data               +------+
```
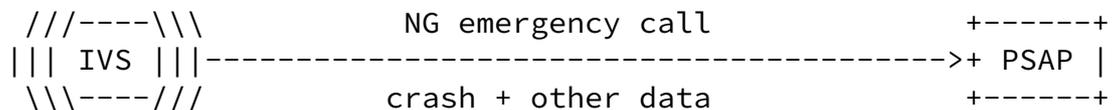
                Figure 5: Next-Generation Direct Model

In the paired model, the IVS uses a Bluetooth link to a previously-
paired handset to establish an emergency call with the PSAP; it is
undefined what facilities are or will be available for transmitting
crash data through the Bluetooth link to the handset for inclusion in

an NG emergency call. Hence, manufacturers that use the paired model
for legacy calls might choose to adopt either the direct or TSP
models for next-generation calls.

```
                                  +---+
     ///----\\\     (undefined)   | H |      standard        +------+
    ||| IVS |||------------------>| S +------------------->+ PSAP |
     \\\----///     (undefined)   +---+ crash + other data +------+
```
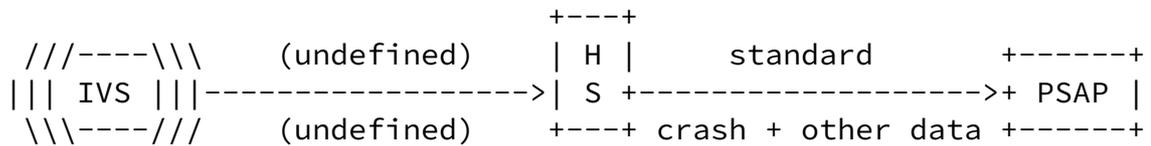
Figure 6: Next-Generation Paired Model

If the call is routed to a PSAP that is not capable of processing the
vehicle data, the PSAP ignores (or does not receive) the vehicle
data. This is detectable by the IVS or TSP when it receives a 200 OK
to the INVITE which lacks an eCall control structure acknowledging
receipt of the data [I-D.ietf-ecrit-ecall]. The IVS or TSP then

proceeds as it would for a non-NG ACN call (e.g., verbal conveyance
of data)

6. Profile

In the context of emergncy calls placed by an in-vehicle system it is
assumed that the car is equipped with a built-in GNSS receiver. For
this reason only geodetic location information will be sent within an
emergency call. The following location shapes MUST be implemented:
2d and 3d Point (see Section 5.2.1 of [RFC5491]), Circle (see
Section 5.2.3 of [RFC5491]), and Ellipsoid (see Section 5.2.7 of
[RFC5491]). The coordinate reference systems (CRS) specified in
[RFC5491] are also mandatory for this document. The <direction>
element, as defined in [RFC5962] which indicates the direction of
travel of the vehicle, is important for dispatch and hence it MUST be
included in the PIDF-LO [RFC4119]. The <heading> element specified
in [RFC5962] MUST be implemented and MAY be included.

Calls by in-vehicle systems are placed via cellular networks, which
might ignore location sent by an originating device in an emergency
call INVITE, instead attaching their own location (often determined
in cooperation with the originating device). Standardized crash data
structures often include location as determined by the IVS. A
benefit of this is that it allows the PSAP to see both the location
as determined by the cellular network (often in cooperation with the

originating device) and the location as determined by the IVS.

This specification inherits the ability to utilize test call
functionality from Section 15 of [RFC6881].

7. Call Setup

It is important that ACN calls be easily identifiable as such at all
stages of call handling, and that automatic versus manual triggering
be known. ACN calls differ from general emergency calls in several
aspects, including the presence of standardized crash data, the fact
that the call is known to be placed by an in-vehicle system (which
has implications for PSAP operational processes), and, especially for
automatic calls, information that can indicate a likelihood of severe
injury and hence need for trauma services. Knowledge that a call is
an ACN and further that it was automatically or manually invoked
carries a range of implications about the call, the circumstances,
and the vehicle occupants. Calls by in-vehicle systems can be
considered a specific sub-class of general emergency calls and are
optimally handled by a PSAP with the technical and operational
capabilities to serve such calls. (This is especially so in
environments such as the U.S. where there are many PSAPs and where
individual PSAPs have a range of capabilities.) Technical

capabilities include the ability to recognize and process
standardized crash data. Operational capabilities include training
and processes for assessing severe injury likelihood and responding
appropriately (e.g., dispatching trauma-capable medical responders or
those trained and equipped to extract occupants from crashed vehicles
and handle gasoline or other hazardous materials, transporting
victims to a trauma center, alerting the receiving facility, etc.).

Because ACN calls differ in significant ways from general emergency
calls, and because such calls typically generally are best handled by
PSAPs equipped technically to interpet and make use of crash data,
and operationally to handle emergency calls placed by in-vehicle
systems, [I-D.ietf-ecrit-ecall] registers SOS sub-services. Using a
sub-service allows the call to be treated as an amergency call and
makes it readily obvious that the call is an ACN; a further child
element distinguishes calls automatically placed due to a crash or
other serious incident (such as a fire) from those manually invoked
by a vehicle occupant (specifically, "SOS.ecall.automatic" and

"SOS.ecall.manual"). The distinction between automatic and manual
invocation is also significant; automatically triggered calls
indicate a car crash or some other serious incident (e.g., a fire)
and carry a greater presumption of risk of injury and hence need for
specific responders (such as trauma or fire). Manually triggered
calls are often reports of serious hazards (such as impaired drivers
or roadway debris) and might require different responses depending on
the situation. Manually triggered calls also have a greater chance
of being false (e.g., accidental) calls and might thus be subject to
different handling by the PSAP.

A next-generation In-Vehicle System (IVS) transmits crash data by
encoding it in a standardized and registered format and attaching it
to an INVITE as an additional data block as specified in Section 4.1
of [I-D.ietf-ecrit-additional-data]. As described in that document,
the block is identified by its MIME content-type, and pointed to by a
CID URL in a Call-Info header with a 'purpose' parameter value
corresponding to the block.

Specifically, the steps required during standardization are:

o A set of crash data is standardized by an SDO or appropriate
   organization

o A MIME Content-Type for the crash data set is registered with IANA

   * If the data is specifically for use in emergency calling, the
      MIME type is normally under the 'application' type with a
      subtype starting with 'EmergencyCallData.'

   * If the data format is XML, then by convention the name has a
      suffix of '+xml'

o The item is registered in the Emergency Call Additional Data
   registry, as defined in Section 9.1.7 of
   [I-D.ietf-ecrit-additional-data]

   * For emergency-call-specific formats, the registered name is the
      root of the MIME Content-Type (not including the
      'EmergencyCallData' prefix and any suffix such as '+xml') as
      described in Section 4.1 of [I-D.ietf-ecrit-additional-data]

When placing an emergency call:

o The crash data set is created and encoded per its specification

o The crash data set is attached to the emergency call INVITE as
   specified in Section 4.1 of [I-D.ietf-ecrit-additional-data], that
   is, as a MIME body part identified by its MIME Content-Type in the
   body part's Content-Type header field

o The body part is assigned a unique identifier label in a Content-
   ID header field of the body part

o A Call-Info header field at the top level of the INVITE is added
   that references the crash data and identifies it by its MIME root
   (as registered in the Emergency Call Additional Data registry)

   * The crash data is referenced in the Call-Info header field by a
      CID URL that contains the unique Content ID assigned to the
      crash data body part

   * The crash data is identified in the Call-Info header field by a
      'purpose' parameter whose value is 'EmergencyCallData.'
      concatenated with the specific crash data entry in the
      Emergency Call Additional Data registry

   * The Call-Info header field MAY be either solely to reference
      the crash data (and hence have only the one URL) or can also
      contain other URLs referencing other data

o Additional crash data sets MAY be included by following the same
   steps

The Vehicle Emergency Data Set (VEDS) is an XML structure defined by
the Association of Public-Safety Communications Officials (APCO) and
the National Emergency Number Association (NENA) [VEDS]. The
'application/EmergencyCallData.VEDS+xml' MIME content-type is used to

identify it. The 'VEDS' entry in the Emergency Call Additional Data
registry is used to construct a 'purpose' parameter value for
conveying VEDS data in a Call-Info header.

The VEDS data is attached as a body part with MIME content type
'application/EmergencyCallData.VEDS+xml' which is pointed at by a
Call-Info URL of type CID with a 'purpose' parameter of
'EmergencyCallData.VEDS'.

Entities along the path between the vehicle and the PSAP are able to
identify the call as an ACN call and handle it appropriately. The
PSAP is able to identify the crash data as well as any other
additional data attached to the INVITE by examining the Call-Info
header fields for 'purpose' parameters whose values start with
'EmergencyCallData.' The PSAP is able to access and the data it is
capable of handling and is interested in by checking the 'purpose'
parameter values.

This document extends [I-D.ietf-ecrit-ecall] by reusing the call set-
up and other normative requirements except that in this document,
support for the eCall MSD is OPTIONAL and support for VEDS in
REQUIRED.

8. Call Routing

An Emergency Services IP Network (ESInet) is a network operated by or
on behalf of emergency services authorities. It handles emergency
call routing and processing before delivery to a PSAP. In the
NG9-1-1 architecture adopted by NENA as well as the NG1-1-2
architecture adopted by EENA, each PSAP is connected to one or more
ESInets. Each originating network is also connected to one or more
ESInets. The ESInets maintain policy-based routing rules which
control the routing and processing of emergency calls. The
centralization of such rules within ESInets provides for a cleaner
separation between the responsibilities of the originating network
and that of the emergency services network, and provides greater
flexibility and control over processing of emergency calls by the
emergency services authorities. This makes it easier to react
quickly to unusual situations that require changes in how emergency
calls are routed or handled (e.g., a natural disaster closes a PSAP),
as well as ease in making long-term changes that affect such routing
(e.g., cooperative agreements to specially handle calls requiring
translation or relay services).

In an environment that uses ESInets, the originating network need
only detect that the service URN of an emergency call is or starts
with "sos", passing all types of emergency calls to an ESInet. The
ESInet is then responsible for routing such calls to an appropriate

PSAP. In an environment without an ESInet, the emergency services
authorities and the originating carriers would need to determine how
such calls are routed.

9. Test Calls

This document builds on [I-D.ietf-ecrit-ecall], which inherits the
ability to utilize test call functionality from Section 15 of
[RFC6881].

A service URN starting with "test." indicates a request for an
automated test. Per [I-D.ietf-ecrit-ecall],
"urn:service:test.sos.ecall.automatic" indicates such a test feature.
This functionality is defined in [RFC6881].

Note that since test calls are placed using "test" as the parent
service URN and "sos" as a child, such calls are not treated as an
emergency call and so some functionality will not apply (such as
preemption or service availability for devices lacking service ("non-
service-initialized" or "NSI") if those are available for emergency
calls); this is by design. MNOs can recognize test calls and treat
them in a way that tests as much functionality as desired, but this
is outside the scope of this document.

10. Example

Figure 7 shows an emergency call placed by a vehicle whereby location
information and VEDS crash data are both attached to the SIP INVITE
message. The INVITE has a request URI containing the
'urn:service:sos.ecall.automatic' service URN and is thus recognized
as an ACN type of emergency call, and is also recognizable as an
emergency call because the request URI starts with 'urn:service:sos'.
The mobile network operator (MNO) routes the call to an Emergency
services IP Network (ESInet), as for any emergency call. The ESInet
processes the call as an ACN and routes the call to an appropriate
ACN-capable PSAP (using location information and the fact that that
it is an ACN). The call is processed by the Emergency Services
Routing Proxy (ESRP), as the entry point to the ESInet. The ESRP
routes the call to an appropriate ACN-capable PSAP, where the call is
received by a call taker. (In deployments where there is no ESInet,
the MNO itself routes the call directly to an appropriate ACN-capable
PSAP.)

```
                        +---------------------------------------+
                        |                                       |
          +-----------+ |              +-------+                |
          |           | |              | PSAP2 |                |
          |           | |              +-------+                |
          | Originating| |                                      |
          |  Mobile   | |  +------+     +-------+               |
  Vehicle-->| Network  |--+->| ESRP |---->| PSAP1 |--> Call-Taker |
          |           | |  +------+     +-------+               |
          |           | |                                       |
          +-----------+ |              +-------+                |
                        |              | PSAP3 |                |
                        |              +-------+                |
                        |                                       |
                        |                                       |
                        |                                       |
                        |              ESInet                   |
                        +---------------------------------------+
```
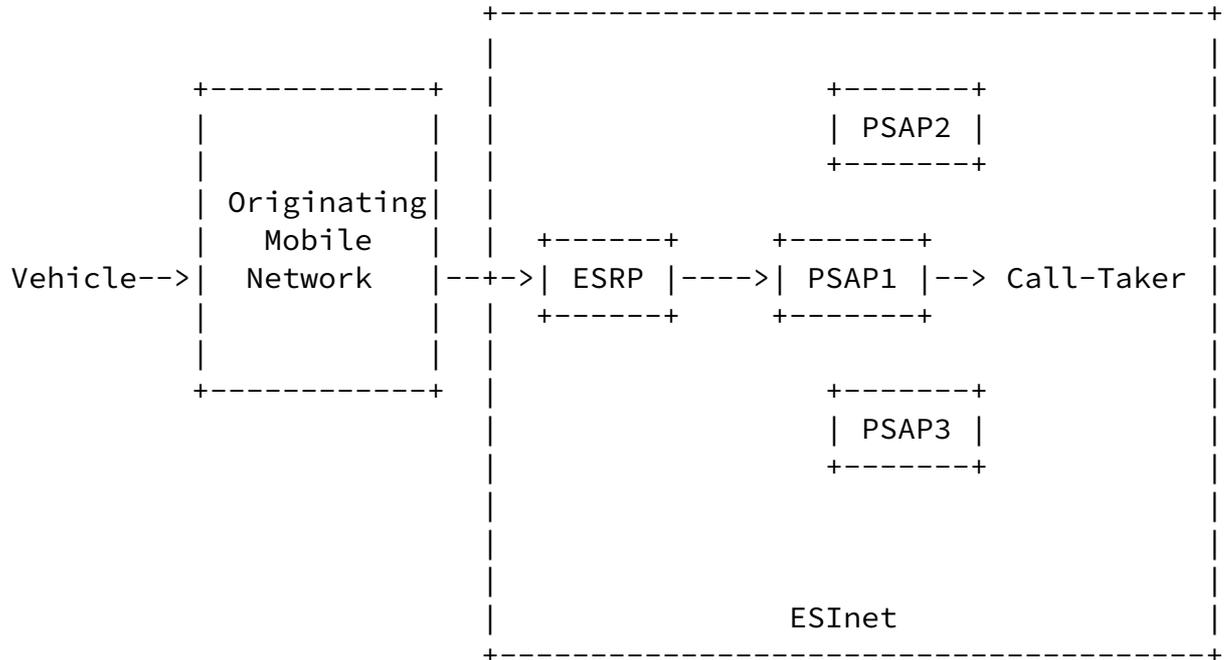
        Figure 7: Example of Vehicle-Placed Emergency Call Message Flow

   The example, shown in Figure 8, illustrates a SIP emergency call
   INVITE that is being conveyed with location information (a PIDF-LO)
   and crash data (as VEDS data).

   The example VEDS data structure shows information about about a
   crashed vehicle. The example communicates that the car is a model
   year 2015 Saab 9-5 (a car which does not exist). The front airbag
   deployed as a consequence of the crash. The
   'VehicleBodyCategoryCode' indicates that the crashed vehicle is a
   passenger car (the code is set to '101') and that it is not a
   convertible (the 'ConvertibleIndicator' value is set to 'false').

   The 'VehicleCrashPulse' element provides further information about
   the crash, namely that the force of impact based on the change in
   velocity over the duration of the crash pulse was 100 MPH. The
   principal direction of the force of the impact is set to '12' (which
   refers to 12 O'Clock, corresponding to a frontal collision). This
   value is described in the 'CrashPulsePrincipalDirectionOfForceValue'
   element.

The 'CrashPulseRolloverQuarterTurnsValue' indicates the number of
quarter turns in concert with a rollover expressed as a number; in
our case 1.

No roll bar was deployed, as indicated in
'VehicleRollbarDeployedIndicator' being set to 'false'.

Next, there is information indicating seatbelt and seat sensor data
for individual seat positions in the vehicle. In our example,
information from the driver seat is available (value '1' in the
'VehicleSeatLocationCategoryCode' element), that the seatbelt was
monitored ('VehicleSeatbeltMonitoredIndicator' element), that the
seatbelt was fastened ('VehicleSeatbeltFastenedIndicator' element)
and the seat sensor determined that the seat is occupied
('VehicleSeatOccupiedIndicator' element).

Finally, information about the weight of the vehicle, which is 600
kilogram in our example.

In addition to the information about the vehicle, further indications
are provided, namely the presence of fuel leakage
('FuelLeakingIndicator' element), an indication whether the vehicle
was subjected to multiple impacts ('MultipleImpactsIndicator'
element), the orientation of the vehicle at final rest
('VehicleFinalRestOrientationCategoryCode' element) and an indication
that there are no parts of the vehicle on fire (the
'VehicleFireIndicator' element).

```
INVITE urn:service:sos.ecall.automatic SIP/2.0
To: urn:service:sos.ecall.automatic
From: <sip:+13145551111@example.com>;tag=9fxced76sl
Call-ID: 3848276298220188511@atlanta.example.com
Geolocation: <cid:target123@example.com>
Geolocation-Routing: no
Call-Info: cid:1234567890@atlanta.example.com;
           purpose=EmergencyCallData.VEDS
Accept: application/sdp, application/pidf+xml
CSeq: 31862 INVITE
Content-Type: multipart/mixed; boundary=boundary1
Content-Length: ...
```

```
     --boundary1
     Content-Type: application/sdp

     ...Session Description Protocol (SDP) goes here

     --boundary1
      Content-Type: application/pidf+xml
      Content-ID: <target123@atlanta.example.com>

      <?xml version="1.0" encoding="UTF-8"?>
      <presence
         xmlns="urn:ietf:params:xml:ns:pidf"
         xmlns:dm="urn:ietf:params:xml:ns:pidf:data-model"
         xmlns:gp="urn:ietf:params:xml:ns:pidf:geopriv10"
```

```
         xmlns:dyn="urn:ietf:params:xml:ns:pidf:geopriv10:dynamic"
         xmlns:gml="http://www.opengis.net/gml"
         xmlns:gs="http://www.opengis.net/pidflo/1.0"
         entity="sip:+13145551111@example.com">
         <dm:device id="123">
             <gp:geopriv>
                 <gp:location-info>
                     <gml:Point srsName="urn:ogc:def:crs:EPSG::4326">
                        <gml:pos>-34.407 150.883</gml:pos>
                     </gml:Point>
                      <dyn:Dynamic>
                         <dyn:heading>278</dyn:heading>
                         <dyn:direction><dyn:direction>
                      </dyn:Dynamic>
                 </gp:location-info>
                 <gp:usage-rules/>
                 <method>gps</method>
             </gp:geopriv>
             <timestamp>2012-04-5T10:18:29Z</timestamp>
             <dm:deviceID>1M8GDM9A_KP042788</dm:deviceID>
         </dm:device>
    </presence>

     --boundary1
      Content-Type: application/EmergencyCallData.VEDS+xml
      Content-ID: 1234567890@atlanta.example.com
```

```
Content-Disposition: by-reference;handling=optional

<?xml version="1.0" encoding="UTF-8"?>
<AutomatedCrashNotification xmlns="http://www.veds.org/acn/1.0"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"

<Crash>
    <CrashVehicle>
        <ItemMakeName xmlns="http://niem.gov/niem/niem-core/2.0">
            Saab
        </ItemMakeName>
        <ItemModelName xmlns="http://niem.gov/niem/niem-core/2.0">
            9-5
        </ItemModelName>
        <ItemModelYearDate
            xmlns="http://niem.gov/niem/niem-core/2.0">
            2015
        </ItemModelYearDate>
        <Airbag>
            <AirbagCategoryCode>FRONT</AirbagCategoryCode>
            <AirbagDeployedIndicator>true
            </AirbagDeployedIndicator>
```

```
        </Airbag>
        <ConvertibleIndicator>false</ConvertibleIndicator>
        <PowerSourceCategoryCode>MAIN</PowerSourceCategoryCode>
        <VehicleBodyCategoryCode
            xmlns="http://niem.gov/niem/domains/jxdm/4.1">
            101
        </VehicleBodyCategoryCode>
        <VehicleCrashPulse>
            <CrashPulseChangeInVelocityMeasure>
                <MeasurePointValue
                    xmlns="http://niem.gov/niem/niem-core/2.0">
                    100
                </MeasurePointValue>
                <MeasureUnitText
                    xmlns="http://niem.gov/niem/niem-core/2.0">
                    MPH</MeasureUnitText>
            </CrashPulseChangeInVelocityMeasure>
                    <CrashPulsePrincipalDirectionOfForceValue>12
                    </CrashPulsePrincipalDirectionOfForceValue>
```

```
                <CrashPulseRolloverQuarterTurnsValue>1
                </CrashPulseRolloverQuarterTurnsValue>
            </VehicleCrashPulse>
            <VehicleRollbarDeployedIndicator>false
            </VehicleRollbarDeployedIndicator>
            <VehicleSeat>
                <VehicleSeatLocationCategoryCode>1
                </VehicleSeatLocationCategoryCode>
                <VehicleSeatOccupiedIndicator>true
                </VehicleSeatOccupiedIndicator>
                <VehicleSeatbeltFastenedIndicator>true
                </VehicleSeatbeltFastenedIndicator>
                <VehicleSeatbeltMonitoredIndicator>true
                </VehicleSeatbeltMonitoredIndicator>
            </VehicleSeat>
            <VehicleUnladenWeightMeasure
                xmlns="http://niem.gov/niem/niem-core/2.0">
                <MeasurePointValue
                    xmlns="http://niem.gov/niem/niem-core/2.0">
                    600
                    </MeasurePointValue>
                <MeasureUnitText
                    xmlns="http://niem.gov/niem/niem-core/2.0">
                    kilogram
                </MeasureUnitText>
            </VehicleUnladenWeightMeasure>
        </CrashVehicle>
        <FuelLeakingIndicator>true</FuelLeakingIndicator>
        <MultipleImpactsIndicator>false</MultipleImpactsIndicator>
```

```
        <SevereInjuryIndicator>true</SevereInjuryIndicator>
        <VehicleFinalRestOrientationCategoryCode>Driver
        </VehicleFinalRestOrientationCategoryCode>
        <VehicleFireIndicator>false</VehicleFireIndicator>
    </Crash>
  </AutomatedCrashNotification>


    --boundary1--
```

   Figure 8: SIP INVITE indicating a Vehicule-Initated Emergency Call

11. Security Considerations

Since this document relies on [I-D.ietf-ecrit-ecall] and
[I-D.ietf-ecrit-additional-data], the security considerations
described there and in [RFC5069] apply here. Implementors are
strongly cautioned to read and understand the discussion in those
documents.

As with emergency service systems where location data is supplied or
determined with the assistance of an end host, there is the
possibility that that location is incorrect, either intentially (in
case of an a denial of service attack against the emergency services
infrastructure) or due to a malfunctioning device. The reader is
referred to [RFC7378] for a discussion of some of these
vulnerabilities.

12. Privacy Considerations

Since this document builds on [I-D.ietf-ecrit-ecall], which itself
builds on [I-D.ietf-ecrit-additional-data], the data structures
specified there, and the corresponding privacy considerations
discussed there, apply here as well. The VEDS data structure
contains optional elements that can carry identifying and personal
information, both about the vehicle and about the owner, as well as
location information, and so needs to be protected against
unauthorized disclosure, as discussed in
[I-D.ietf-ecrit-additional-data]. Local regulations may impose
additional privacy protection requirements.

13. IANA Considerations

13.1. MIME Content-type Registration for 'application/ EmergencyCall.VEDS+xml'

This specification requests the registration of a new MIME type
according to the procedures of RFC 4288 [RFC4288] and guidelines in

RFC 3023 [RFC3023].

    MIME media type name: application

    MIME subtype name: EmergencyCallData.VEDS+xml

    Mandatory parameters: none

    Optional parameters: charset

    Indicates the character encoding of enclosed XML.

    Encoding considerations: Uses XML, which can employ 8-bit
    characters, depending on the character encoding used. See
    Section 3.2 of RFC 3023 [RFC3023].

    Security considerations:

       This content type is designed to carry vehicle crash data
       during an emergency call.

       This data can contain personal information including vehicle
       VIN, location, direction, etc. Appropriate precautions need to
       be taken to limit unauthorized access, inappropriate disclosure
       to third parties, and eavesdropping of this information.
       Please refer to Section 7 and Section 8 of
       [I-D.ietf-ecrit-additional-data] for more information.

       When this content type is contained in a signed or encrypted
       body part, the enclosing multipart (e.g., multipart/signed or
       multipart/encrypted) has the same Content-ID as the data part.
       This allows an entity to identify and access the data blocks it
       is interested in without having to dive deeply into the message
       structure or decrypt parts it is not interested in. (The
       'purpose' parameter in a Call-Info header field identifies the
       data, and the CID URL points to the data block in the body,
       which has a matching Content-ID body part header field).

    Interoperability considerations: None

    Published specification: [VEDS]

    Applications which use this media type: Emergency Services

Additional information: None

       Magic Number: None

       File Extension: .xml

       Macintosh file type code: 'TEXT'

       Person and email address for further information: Hannes
       Tschofenig, Hannes.Tschofenig@gmx.net

       Intended usage: LIMITED USE

       Author: This specification is a work item of the IETF ECRIT
       working group, with mailing list address <ecrit@ietf.org>.

       Change controller: The IESG <ietf@ietf.org>

13.2. Registration of the 'VEDS' entry in the Emergency Call Additional
       Data registry

   This specification requests IANA to add the 'VEDS' entry to the
   Emergency Call Additional Data registry, with a reference to this
   document. The Emergency Call Additional Data registry has been
   established by [I-D.ietf-ecrit-additional-data].

14. Contributors

   We would like to thank Ulrich Dietz for his help with earlier
   versions of the original version of this document.

15. Acknowledgements

   We would like to thank Michael Montag, Arnoud van Wijk, Ban Al-Bakri,
   Wes George, Gunnar Hellstrom, and Rex Buddenberg for their feedback.

16. Changes from Previous Versions

16.1. Changes from draft-ietf-05 to draft-ietf-06

   o Added clarifying text regarding signed and encrypted data
   o Additional informative text in "Migration to Next-Generation"
      section
   o Additional clarifying text regarding security and privacy.

16.2. Changes from draft-ietf-04 to draft-ietf-05

   o Reworded security text in main document and in MIME registration
      for the VEDS object

16.3. Changes from draft-ietf-03 to draft-ietf-04

   o Added example VEDS object
   o Additional clarifications and corrections
   o Removed references from Abstract
   o Moved Document Scope section to follow Introduction

16.4. Changes from draft-ietf-02 to draft-ietf-03

   o Additional clarifications and corrections

16.5. Changes from draft-ietf-01 to draft-ietf-02

   o This document now refers to [I-D.ietf-ecrit-ecall] for technical
      aspects including the service URN; this document no longer
      proposes a unique service URN for non-eCall NG-ACN calls; the same
      service URN is now used for all NG-ACN calls including NG-eCall
      and non-eCall
   o Added discussion of an NG-ACN call placed to a PSAP that doesn't
      support it
   o Minor wording improvements and clarifications

16.6. Changes from draft-ietf-00 to draft-ietf-01

   o Added further discussion of test calls
   o Added further clarification to the document scope
   o Mentioned that multi-region vehicles may need to support other
      crash notification specifications such as eCall
   o Minor wording improvements and clarifications

16.7. Changes from draft-gellens-02 to draft-ietf-00

   o Renamed from draft-gellens- to draft-ietf-
   o Added text to Introduction to clarify that during a CS ACN, the
      PSAP call taker usually needs to listen to the data and transcribe
      it

16.8. Changes from draft-gellens-01 to -02

   o Fixed case of 'EmergencyCallData', in accordance with changes to
      [I-D.ietf-ecrit-additional-data]

16.9. Changes from draft-gellens-00 to -01

   o Now using 'EmergencyCallData' for purpose parameter values and
      MIME subtypes, in accordance with changes to
      [I-D.ietf-ecrit-additional-data]
   o Added reference to RFC 6443
   o Fixed bug that caused Figure captions to not appear

17. References

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