Enhanced Emergency Data

Fast, secure location for emergency calls

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Contents

Overview **3**

Hybridized Emergency Location (HELO) 3

Enhanced Emergency Data (EED) 3

EED in Detail **4**

Background 4

Location Performance 4

Technical Details 5

Timing 5

Data contents 5

Network support 6

Privacy and Security 6

Accessibility 7

PSAP Integration 7

Telecommunicator Training 8

Frequently Asked Questions **9**

Overview

Enhanced Emergency Data uses Apple's Hybridized Emergency Location technology to make precise, high-integrity location data available to 9-1-1 centers when users make emergency calls.

Hybridized Emergency Location (HELO)

Apple devices contain a variety of location sensors. When a user initiates an emergency call, supported Apple devices can "fuse" information from various sensors, such as Global Navigation Satellite Systems (GNSSs) and Wi-Fi. This process takes advantage of proprietary methods and network-provided assistance data (if available), to quickly calculate a low-uncertainty, high-integrity estimate of the device's location. Apple calls this capability "Hybridized Emergency Location" or "HELO." Technologies such as HELO are often referred to as "Device-Based Hybrid" or "DBH."

Since 2015, Apple has offered wireless carriers free access to HELO in response to traditional Network-Initiated Location Requests (NILR). HELO + NILR is available on iPhone 5s or later running iOS 9.0 or later and on Apple Watch. However, some networks cannot or do not support HELO via NILR, and network conditions may sometimes delay or impair the delivery of HELO data to Automatic Location Identification (ALI) servers, even when a good location estimate is available.

Enhanced Emergency Data (EED)

EED brings the benefits of HELO to more users by making HELO data available to Public Safety Answering Points ("PSAPs") via an alternate data path. Every call made with EED continues to support traditional NILR transport, and to provide the serving carrier with the best location data available on the device and supported by the network. At the same time, EED provides another fast and secure means for location data to reach PSAPs. HELO + EED has the potential to deliver fast, frequent, and high-integrity location data to PSAPs today, and to expand capabilities over time.

Support for HELO + EED functionality will be available on iPhones running iOS 12 later this year. EED is a "best effort" service, and depends on the availability of a data connection and local PSAP support. While Apple makes every attempt to ensure the accuracy and integrity of EED fixes, PSAPs should always cross-verify EED locations with NILR-provided location data and verbally with the caller.

EED in Detail

EED makes precise location data available faster, more frequently, and with greater NG9-1-1 compatibility. It puts users' privacy, security, and safety first, and integrates directly with existing software in many 9-1-1 centers.

Background

EED extends the functionality of the existing carrier-based location transport by providing an alternative data path for HELO-based location estimates. When a user makes a 9-1-1 call from an EED enabled device, the device will use HELO to estimate the user's location. If the user is located in a jurisdiction that has established service with the RapidSOS NG911 Clearinghouse, Apple will forward the HELO estimate to the clearinghouse. When a call arrives at a local 9-1-1 center, call-taking, mapping, or computer-aided dispatching software may query the clearinghouse using the caller's mobile telephone number. In response, the clearinghouse will provide the caller's HELO-estimated location, along with other data to assist the telecommunicator or dispatcher in processing the call (e.g., estimated location uncertainty). Apple is providing EED service free of charge to all 9-1-1 centers in the United States on a "best effort" basis, as a means of improving the availability, reliability, and speed of HELO service for our users.

Location Performance

Apple conducts extensive internal testing to verify the performance of our devices and software. Before launching HELO, we verified that its performance meets or exceeds all regulatory requirements applicable to wireless carriers for 9-1-1 location accuracy. Additionally, Apple participated in a location accuracy testbed operated by CTIA: The Wireless Association in early 2018. The testbed subjected shipping hardware and software to indoor testing in a variety of environments in San Francisco and Atlanta. These included Dense Urban, Urban, Suburban, and Rural morphologies, and a mix of building types.

Our testbed results show that iPhone 7 and iPhone 8 already exceed the FCC's 2021 horizontal location accuracy requirements when using HELO. As shown in the table below, this result holds for all testbed morphologies. The first column indicates the "yield", i.e. the percentage of calls for which a HELO fix was returned in a given morphology. The second column shows the percentage of those calls that produced a fix within 50 meters of the device's actual position,

Network-Initiated Location Request
NILR is a 3GPP-standardized transport mechanism that allows 2G and later mobile networks to securely acquire location data, like HELO fixes, from user devices during an emergency call, and route that data to local 9-1-1 centers. Networks that support NILR can also supply user devices with assistance data that may improve the speed and accuracy of location estimates. NILR is the current standard for carrier-based location delivery in the United States. All Apple devices with cellular capability support NILR.

Advanced Mobile Location
AML is an alternative transport mechanism for emergency location data in countries that lack NILR support. AML uses the "Short Message Service" or "SMS" to send location data, like HELO fixes, in the clear, to a single national endpoint.

Estimation versus transport
HELO is a measurement and estimation technology, and its availability is unrelated to the choice of transport mechanism (NILR or EED or AML). Because of its security, integrity, speed, and routing advantages, Apple's preferred carrier location transport is NILR.

as determined by a precise survey. Finally the third column shows the average measured error (in meters) for all HELO calls within a given morphology.[1]

HELO Performance - CTIA Testbed

Morphology	Yield %	% calls with Error ≤ 50m	Avg. Error (meters)
Dense Urban	89.1	85.2	32.7
Urban	96.7	87.9	30.7
Suburban	97.6	93.8	22.3
Rural	99.9	90.4	22.3

Technical Details

Timing
Apple devices begin trying to compute a location fix as soon as an emergency call attempt is detected. Once a call is established, devices send an initial EED message with either a location payload or an indication that no location is available. EED location payloads may not appear immediately upon PSAP trunk seizure. This occurs because the HELO process typically requires 8 - 22 seconds to produce a high-integrity fix, while 9-1-1 calls typically connect in 6 seconds or fewer.

After the first EED message, subsequent messages are automatically sent to the clearinghouse at regular intervals. For some PSAP software, these updates may appear automatically on a telecommunicator's or dispatcher's display(s). For other software, automatic or manual "re-bid" or "re-transmit" requests may be required to retrieve data from the clearinghouse.

If a user makes two or more 9-1-1 calls in rapid succession, a PSAP may retrieve location data from a prior call when a subsequent call connects. PSAPs should carefully check the time stamp of each EED fix, and, as with any location technology, verify the caller's location verbally to ensure that field responders are dispatched to the correct location. In the overwhelming majority of cases, the user's location will not change significantly between calls. Additionally, new EED payloads should begin arriving soon after a subsequent call connects.

Data contents
EED will deliver at least the following data elements to the clearinghouse, which may perform interworking required to accommodate differing representations in PSAP software:

- Mobile telephone number of the caller's device in E.123 format.
- Signed latitude & longitude in decimal degrees, referenced to the WGS-84 ellipsoid (1 meter resolution).
- Uncertainty in meters with 0.1 meter resolution, calculated at 95% confidence.

[1] Average error statistics were not provided in the CTIA Testbed final report. Apple calculated these figures based on the raw call records provided by the testbed administrator for each test point.

Network support

Native EED support will become available to compatible Apple devices via a free software update later in 2018. However, some network technologies may block or impair EED service. For example, some networks do not support simultaneous voice and data sessions. When a user makes an emergency call from such a network, their Apple device may still provide EED payloads, but only if a Wi-Fi connection is available. Similarly, networks that have implemented a Mobile Station - Assisted ("MSA") location architecture may block or degrade EED service by placing the device in a "receive only" mode for GNSS signals, limiting the GNSS signals available for use on the device, or providing no assistance data. In these cases, the device may still send a location estimate via EED if the remaining measurement sources (e.g., Wi-Fi) yield a sufficiently high-integrity fix, or if MSA-blocked measurement sources become available later in the call. Apple will continue working with carrier partners to improve HELO + NILR availability in the traditional location path, and to expand availability of full-featured HELO + EED.

Privacy and Security

For Apple and our users' privacy and security are core values. Because emergency contexts are especially sensitive, Apple takes extra steps to ensure that our products and services protect the confidentiality, integrity, and availability of our users' data during an emergency call. Among other means, EED protects user privacy and security using geofiltering, authentication, encryption, redundancy, data retention policies, and audits. A user may also opt-out of EED service at any time from the Settings app.[1]

Geofiltering minimizes the potential for disclosure of users' emergency data even to trusted third parties. The user's location is available to the clearinghouse only if the call is handled by a 9-1-1 center enabled to accept EED; if not, the data is dropped.[2] Geofiltering also controls 9-1-1 center access to clearinghouse data: Only a center whose jurisdiction covers the caller's location is able to retrieve EED information from the clearinghouse.

Authentication ensures that EED messages will only be transmitted between systems that have established their identity using strong credentials. EED messages travel from user devices to the RapidSOS clearinghouse, and finally to local 9-1-1 centers. Authentication is accomplished between the user devices and the clearinghouse using publicly-trusted certificates signed with strong ciphers. RapidSOS authenticates (and periodically re-authenticates) local 9-1-1 centers or 9-1-1 authorities using individually-issued access credentials.

Encryption protects the confidentiality and integrity of users' data by preventing unauthorized third parties from viewing or altering it without detection. Apple devices and RapidSOS encrypt EED information using strong ciphers with long keys, and exchange keys using mechanisms that prevent the

[2] This behavior does not affect NILR sessions. Location estimates or measurement data will *always* be provided in response to an NILR during an emergency call.

recovery of earlier information, even if later information is subsequently compromised. Apple encrypts data both in transit and at rest, and requires that RapidSOS do so as well.

Redundancy ensures that EED service will have a high likelihood of being available when a user makes a 9-1-1 call from a supported jurisdiction. Apple devices can use any available data path to transmit EED messages, meaning that EED delivery may succeed, even if no carrier-network data path is available. Apple also requires RapidSOS to maintain "public safety grade" availability of 99.999%. In practical terms, this means that the total expected "down time" in a single year is five minutes and sixteen seconds.

Data retention policies govern the handling and storage of all EED before it reaches a local 9-1-1 center. EED messages originate on the calling device and are never logged in Apple servers. RapidSOS is likewise required to immediately discard data that fails its geofilter, and to delete *all* data received from Apple users no later than 12 hours after it is received. Once an EED payload reaches a 9-1-1 center, state and local records retention laws may apply.

Audits verify that a party has implemented required and appropriate controls, and may verify that controls work as intended, and are adhered-to in practice. Apple conducts its own internal audits and requires RapidSOS to undergo periodic control reviews and third-party audits. These ensure that an appropriate information security management system is in place, and that its prescribed controls are effectively and consistently applied.

Opt-out capability ensures that a user provides consent to the use of EED during their emergency calls. Although enabled by default, EED can be disabled in the Settings app of an iOS device at any time. Disabling EED will not affect the regular NILR process: Emergency location data requested by the user's carrier network will still be shared in accordance with the technology and policies of the network operator, and as required by law.

Accessibility

Apple is committed to providing accessible technologies to all. Many individuals who are deaf, hard-of-hearing, or speech impaired access telecommunications services using character-by-character calling services such as the legacy TeleTYpe / Telecommunications Device for the Deaf ("TTY/TDD") or more modern Real-Time Text ("RTT"). EED is integrated directly into the iOS platform, and includes support for both TTY/TDD and RTT calls at launch, offering users fast, accurate location data using the conversational text flow that many prefer.

PSAP Integration

RapidSOS, makes EED available to 9-1-1 centers via an i3-compliant HELD/ PIDF-LO interface (preferred), or direct integration with major call-taking, computer-aided dispatching, and mapping systems. For 9-1-1 centers that lack compatible NG9-1-1 service or software, a browser-based solution is also available on a temporary basis. Apple is committed to bringing integrated HELO

+ EED service to all U.S. PSAPs as quickly as possible. PSAPs interested in establishing EED service should contact RapidSOS at http://info.rapidsos.com/request-access-clearinghouse.

Telecommunicator Training

Apple requires RapidSOS to make available PSAP training materials that cover how to establish secure EED service, how to interpret and use location data, and how to de-conflict location data from multiple sources (e.g., caller interrogation, the NILR path, and EED). PSAPs interested in starting the training process should contact their existing RapidSOS representative or submit a request for new service at http://info.rapidsos.com/request-access-clearinghouse.

Frequently Asked Questions

Most PSAP and 9-1-1 authority questions should be directed to RapidSOS. Answers to a few of the most frequent questions are shown below.

Does EED replace Automatic Location Identification (ALI)?
No. EED operates independently of the traditional 9-1-1 location process. Carrier-integrated location process will continue to receive the highest priority on Apple devices. EED simply provides an alternate path for location data. PSAPs should continue to query their existing Automatic Location Identification database at least twice during every call: Once at call connection and at least once after the call has been active for 30 seconds.

Is HELO or EED an implementation of Advanced Mobile Location (AML)?
No. HELO is a measurement and estimation technology, not a location transport. Apple began offering HELO to wireless carriers using the traditional Network-Initiated Location Request transport and "Mobile Station - Based" (MSB) location determination in 2015.

AML is a transport protocol that conveys HELO data via a specially-formatted SMS text message to one end-point for each AML country. Support for AML transport was added in 2018 (iOS 11.3) in countries that lack NILR support.

EED is a new location transport that uses a secure internet-protocol data connection to convey HELO data to RapidSOS, and standards-compliant NG9-1-1 methods to make that data available to PSAPs.

Is HELO available via the traditional NILR / ALI path?
Yes. Apple makes HELO available to carriers with compatible network technology. For networks that support MSB NILR and have chosen to enable it, HELO fixes should be available via the Phase 2 process. PSAPs should enable automatic "re-bid" or "re-transmit" functions in their CPE or call taking software to ensure that available HELO fixes are retrieved. Because Phase 2 availability is dependent on many carrier-network and ALI-provider deployment choices and architecture details, PSAPs should consult with their ALI provider to determine the optimal timing for initial and subsequent automatic re-bids.

Does EED require the user to install an app?
No. EED is an inherent feature of iOS. Once a user updates their device to iOS 12, EED will automatically be enabled.

Won't it take a long time for users to update?
No. Apple users tend to update quickly. For example, iOS 11 was released to users on September 19th, 2017. As of March 31st, 2018, 81% of active iOS devices were running iOS 11 or later.

Does EED provide a civic or "dispatchable" address?
No. EED provides a high-accuracy, high-integrity geodetic or "latitude / longitude / uncertainty" location estimate.

Why is "uncertainty" important?
All practical location estimation technologies, including HELO, estimate user location by measuring noisy real-world signals. Estimates based on such measurements are limited in their accuracy and precision. Uncertainty is a numerical measure of this limitation - specifically, it represents an estimate of the expected errors that may affect the position estimate provided by HELO.

In its simplest form, horizontal uncertainty is expressed as the radius of a circle centered on the estimated location of the caller. Expressed this way, uncertainty can be thought of as a "search area" in which to locate a caller. A larger uncertainty implies a larger search area, or a larger chance for the caller to be found further away from the reported location. Conversely, a smaller uncertainty implies a smaller search area, or a higher likelihood of finding the caller near the reported location.

Apple reports uncertainty at 95% confidence. This means that the caller should be located *outside* the uncertainty circle no more than 1 out of 20 times, on average. Uncertainty allows a telecommunicator or dispatcher to visually compare location estimates received from multiple sources to cross-check their reasonableness, and to evaluate, in conjunction with caller interrogation, where to dispatch field responders.

What logging, recording, privacy, or open-records requirements apply to EED?
PSAPs should consult with their state, territorial, or tribal authorities and local counsel to determine which laws may require EED retention. Local policies may require more action than applicable laws, and should also be reviewed for consistency.

Does Apple or RapidSOS log EED?
No. Apple never stores user location data for EED purposes. RapidSOS may retain Apple user data in its PSAP-facing database for up to 12 hours after an EED call begins. This allows a PSAP to conduct queries for location data received during a 9-1-1 call, even if a dropped-call record remains active in a CPE or ACD queue. (No new location data will become available after a call disconnects, unless the user calls 9-1-1 again.) Apple's prohibits RapidSOS from any other logging or recording of user data, and limits the access of RapidSOS employees to that data during the time it is available to PSAPs.

How can I get more information about EED?
PSAPs interested in establishing EED service should contact RapidSOS using the form available at: http://info.rapidsos.com/request-access-clearinghouse. PSAPs with existing RapidSOS integrations should contact their RapidSOS representative for assistance with setup, training, or troubleshooting. General questions may also be referred to PSAPsupport@RapidSOS.com.

Apple-specific questions may be referred to helo@group.apple.com, however this mailbox is not monitored 24x7, and responses may be delayed.