Exposure Notification

iOS Framework Documentation

(API)

Preliminary — Subject to Modification and Extension

April 2020

v1.1

Contents

Overview

The ExposureNotification framework is designed to help you implement a privacy-preserving solution. It covers two user roles:

- *Affected User*. A user who has a confirmed or suspected diagnosis of COVID-19, the disease caused by the coronavirus pathogen.
- *Exposed User*. A user who has a potential exposure.

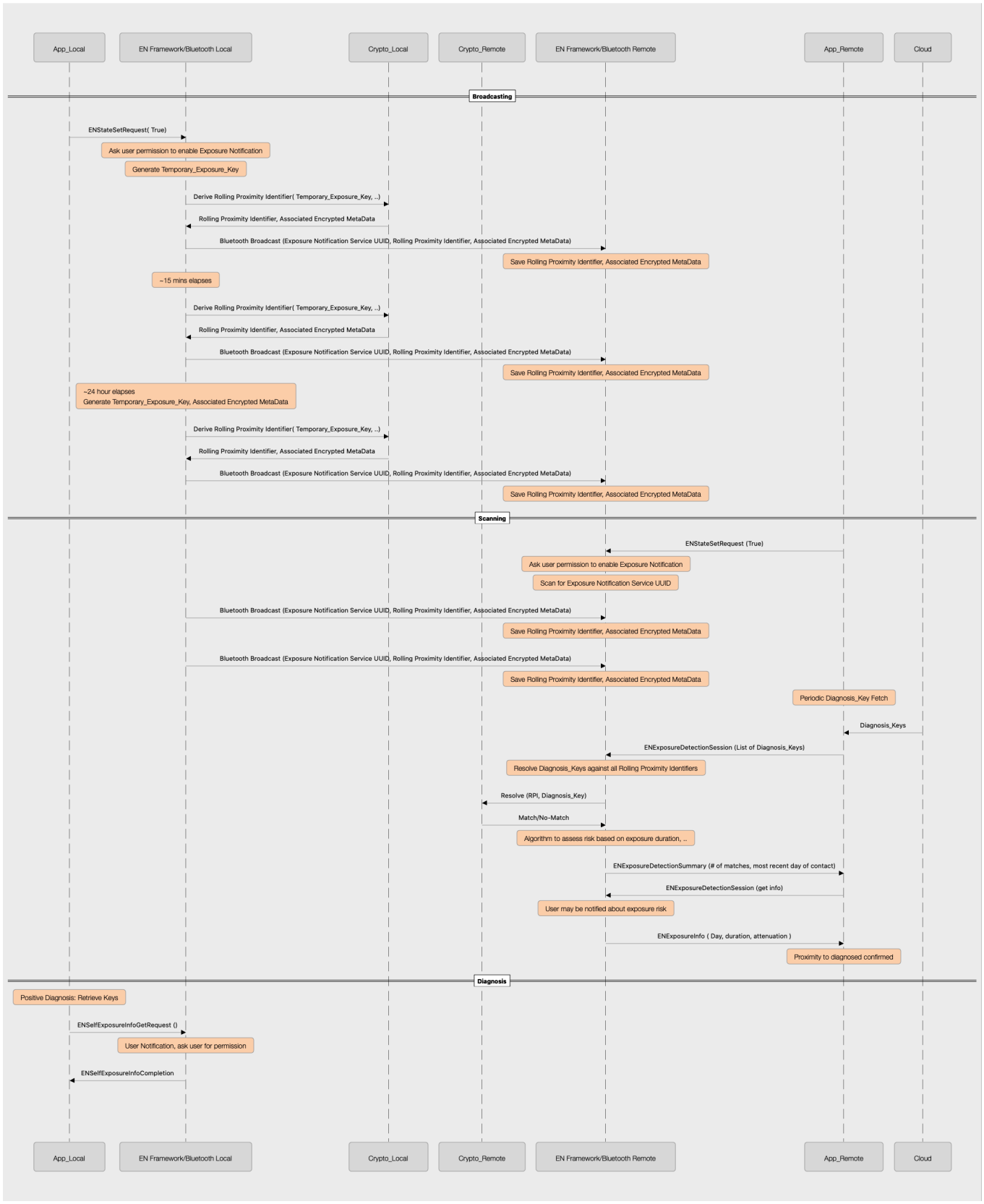
Affected User

When a user is diagnosed as positive, their Temporary Exposure Keys should be shared with other users to alert them to potential exposure. These Temporary Exposure Keys are retrieved using `ENSelfExposureInfoRequest`.

Exposed User

Given a set of Temporary Exposure Keys that indicate a positive diagnosis, the framework allows you to determine whether those Temporary Exposure Keys were observed locally by the user. If so, additional information such as date and duration may also be retrieved using `ENExposureDetectionFinishHandler`.

The following diagram outlines the flow of the ExposureNotification Framework for iOS.



ENErrorCode

Overview

A typedef that represents the error codes in the framework.

ENErrorCodeSuccess

Operation succeeded.

ENErrorCodeUnknown

Underlying failure with an unknown cause.

ENErrorCodeBadParameter

Missing or incorrect parameter.

ENErrorCodeNotEntitled

Calling process doesn't have the correct entitlement.

ENErrorCodeNotAuthorized

User denied this process access to Exposure Notification functionality.

ENErrorCodeUnsupported

Operation is not supported.

ENErrorCodeInvalidated

Invalidate was called before the operation completed normally.

ENErrorCodeBluetoothOff

Bluetooth was turned off the by user.

ENErrorCodeInsufficientStorage

Insufficient storage space to enable exposure notification.

ENErrorCodeNotEnabled

Exposure Notification has not been enabled.

ENErrorCodeAPIMisuse

API was used incorrectly.

ENErrorCodeInternal

Internal error indicating a bug in this framework.

ENErrorCodeInsufficientMemory

Not enough memory to perform an operation.

ENAuthorizationMode

Overview

An enumeration that specifies the app's preference for authorization with Exposure Notification.

ENAuthorizationModeDefault

Let the system choose whether to prompt. This is the best option unless you have specific needs. For most cases, it will prompt the user to authorize (same as `ENAuthorizationModeUI`). This gives the system some flexibility, such as not to prompt if the app is in the background.

ENAuthorizationModeNonUI

Authorization will be checked, but it won't prompt the user if the app isn't authorized. If the app is authorized, the app is allowed to use the service. If the user hasn't been prompted or they denied the app, operations will fail with `ENErrorCodeNotAuthorized`.

ENAuthorizationModeUI

Authorization will be checked and it will prompt the user to authorize, if needed. If the app is authorized by the user, the app is allowed to use the service. If the user denies the app, operations will fail with `ENErrorCodeNotAuthorized`.

ENAuthorizationStatus

Overview

An enumeration that indicates the status of authorization for the app.

ENAuthorizationStatusUnknown

Authorization status has not yet been determined.

ENAuthorizationStatusRestricted

This app is not authorized to use Exposure Notification. The user cannot change this app's authorization status. This status may be due to active restrictions, such as parental controls being in place.

ENAuthorizationStatusNotAuthorized

The user denied authorization for this app.

ENAuthorizationStatusAuthorized

The user has authorized this app to use Exposure Notification.

ENActivatable

Overview

A protocol for objects that support asynchronous operations and cancellation.

Discussion

Classes conforming to this protocol follow a similar life-cycle pattern:

1. Create an instance of the class.

2. Set properties to configure it, if needed.

3. Call `activateWithCompletion`.

4. Wait for the activate completion handler to be invoked.

5. Use methods and properties of the class.

6. Call `invalidate` to stop any outstanding operations, release resources, and break any retain cycles.

7. Upon completion of invalidation, invoke an `invalidationHandler` if it was specified before activating.

8. Release the instance.

If `activateWithCompletion` is called, `invalidate` must always be called before the object is released.

Note: Invalidation is asynchronous, so it's possible for handlers to be invoked after calling `invalidate`. When invalidation is finished, the `invalidationHandler` is invoked exactly once, even if `invalidate` is called multiple times. No handlers are invoked after that. Once `invalidate` is called, the object cannot be reused. A new object must be created for subsequent use.

All strong references are cleared when invalidation finishes, in order to break potential retain cycles. You don't need to use weak references within your handlers to avoid retain cycles when using this protocol.

@property dispatch_queue_t dispatchQueue;

This property holds the dispatch queue used to invoke completion handlers. The default is the main queue.

@property dispatch_block_t invalidationHandler;

This property holds the invalidation handler. It is invoked exactly once: when invalidation completes. This property is cleared before it's invoked in order to break retain cycles.

- (void)activateWithCompletion:(ENErrorHandler) inCompletion;

Activates the object to prepare it for use. Properties may not be used until the completion handler reports success.

- (void)invalidate;

Stops any outstanding operations and invalidates the object.

ENAuthorizable

Overview

A protocol for objects that require authorization from the user before they can be used.

@property ENAuthorizationStatus authorizationStatus;

This property reports the current authorization status of the app and never prompts the user. It can be used by the app for preflight authorization to determine if the user may be prompted.

@property ENAuthorizationMode authorizationMode;

This property specifies the app's preference for authorization with Exposure Notification. It defaults to prompting the user to authorize, if needed.

ENSettings

Overview

Defines nonmodifiable settings for Exposure Notification.

@property ENMultiState enableState;

This property turns Exposure Notification on or off.

- (ENMutableSettings *)mutableCopy;

Returns a mutable copy of this object.

ENMutableSettings

Overview

Defines modifiable settings for Exposure Notification.

Discussion

Use with `ENSettingsChangeRequest` to apply changed settings to the system. All settings have default values that represent "not changed" to allow creating an empty object and setting only the properties that need to be changed, without affecting other properties.

@property ENMultiState enableState;

This property turns Exposure Notification on or off.

- (ENSettings *)copy;

Returns an immutable copy of this object.

ENSettingsGetRequest

Overview

Requests the current settings for Exposure Notification.

Discussion

Use this class as follows:

1. Create an instance of `ENSettingsGetRequest`.
2. Optionally set the dispatch queue if you want the completion handler to be invoked on something other than the main queue.
3. Call `activateWithCompletion` to asynchronously get settings from the system.
4. When the activation completes successfully, the settings property is valid to access.
5. Access the needed information in the `settings` object. You may retain it for use after invalidating the request, if needed.
6. Call `invalidate`.

@property ENSettings *settings;

This property is set with a snapshot of the settings if activation completes successfully.

ENSettingsChangeRequest

Overview

Changes settings for Exposure Notification after authorization by the user.

Discussion

Use this class as follows:

1. Create an instance of `ETMutableSettings` (or call `mutableCopy` on an immutable `ENSettings` instance).
2. Set properties of the settings instance to change any settings.
3. Create an instance of `ENSettingsChangeRequest`.
4. Set the settings property to the settings instance.
5. Optionally set the dispatch queue if you want the completion handler to be invoked on something other than the main queue.
6. Call `activateWithCompletion` to asynchronously change settings if authorized by the user. Authorization happens when `activateWithCompletion` is called. The user may be prompted at this point.
7. When the activation completes successfully, the new settings are applied.
8. Call `invalidate`.

@property ENSettings *settings;

This property specifies the settings to change. It must be set before calling `activateWithCompletion`.

ENExposureDetectionSession

Overview

Performs exposure detection based on previously collected proximity data and keys.

Discussion

Exposure detection sessions are rate-limited to prevent abuse.

Here are the steps to use this class:

1. Create an instance of `ENExposureDetectionSession`.
2. Optionally, set the dispatch queue if you want the completion handler to be invoked on something other than the main queue.
3. Call `activateWithCompletion` to asynchronously prepare the session for use.
4. Wait for the completion handler for `activateWithCompletion` to be invoked with a `nil` error.
5. Call `addDiagnosisKeys` with up to `maxKeyCount` keys.
6. Wait for the completion handler for `addDiagnosisKeys` to be invoked with a `nil` error.
7. Repeat the previous two steps until all keys are provided to the system or an error occurs.
8. Call `finishedDiagnosisKeysWithCompletion`.
9. Wait for the completion handler for `finishedDiagnosisKeysWithCompletion` to be invoked with a `nil` error.

If the summary indicates matches were found, notify the user of exposure. If the user is interested in sharing more details with the app:

1. Call `getExposureInfoWithMaxCount`. Use a reasonable maximum count, such as 100.
2. Wait for the completion handler for `getExposureInfoWithMaxCount` to be invoked with a `nil` error.
3. If the value of the completion handler's `inDone` parameter is `NO`, repeat the previous two steps until the value is `YES` or an error occurs.

When the app is done with the session, call `invalidate`.

@property uint8_t attenuationThreshold;

This property holds the largest amount of signal attenuation allowable when detecting matches. A value of 0 means there’s no limit.

Attenuation is calculated by subtracting the measured RSSI from the reported transmit power. Values larger than the attenuation limit aren’t checked for exposure matches.

Note: The attenuation value may be misleading because more attenuation doesn't necessarily mean the device is farther away. For example, two people could be physically very close and facing each other with their phones in their back pockets. In this case, a higher attenuation (a weaker signal) may be reported even though the individuals are very close together.

@property NSTimeInterval durationThreshold;

This property holds the minimum exposure duration to be considered an exposure incident. If a detected exposure duration is less than the value of this property, it's excluded from the results. The default is 0, indicating no filtering by duration.

@property NSInteger maxKeyCount;

This property contains the maximum number of keys to provide to this API at a time. This property's value updates after each operation completes and before the completion handler is invoked. Use this property to throttle the downloading of keys and avoid excessive buffering of keys in memory.

- (void)addDiagnosisKeys:(NSArray <ENTemporaryExposureKey *> *)inKeys completion:(ENErrorHandler)inCompletion;

Asynchronously adds the specified keys to the session to allow them to be checked for exposure. Each call to this method must not include more keys than specified by the current value of `maxKeyCount`.

typedef void (^ENExposureDetectionFinishCompletion) ENExposureDetectionSummary * _Nullable inSummary, NSError * _Nullable inError);

The type definition for the completion handler that's invoked when exposure detection finishes.

- (void)finishedDiagnosisKeysWithCompletion: (ENExposureDetectionFinishCompletion)inCompletion;

Indicates that all of the available keys have been provided. Any remaining detection is performed and the completion handler is invoked with the results.

typedef void (^ENExposureDetectionGetExposureInfoCompletion) (NSArray <ENExposureInfo *> * _Nullable inExposures, BOOL inDone, NSError * _Nullable inError);

The type definition for the completion handier that's invoked when an exposure information request completes.

- (void)getExposureInfoWithMaxCount:(uint32_t)inMaxCount completion:(ENExposureDetectionGetExposureInfoCompletion) inCompletion;

Plans to ensure user transparency in the use of this function are currently being evaluated. This method can only be called after the detector finishes.

The `inMaxCount` parameter indicates the maximum number of exposures the caller is prepared to obtain in a single call. Using this parameter helps you avoid excessive buffering by limiting the number of results.

The `inDone` parameter to the handler indicates whether more exposure incidents are available.

The handler may be invoked multiple times. An empty array indicates the final invocation of the handler.

ENExposureDetectionSummary

Overview

Provides a summary of exposures.

@property NSInteger daysSinceLastExposure;

Number of days since the most recent exposure: 0 = today, 1 = yesterday, and so on. Only valid if `matchedKeyCount` > 0.

@property uint64_t matchedKeyCount;

This property holds the number of keys that matched for an exposure detection.

ENSelfExposureInfoRequest

Overview

Requests the Temporary Exposure Keys used by this device to share with a server.

Discussion

This request is intended to be called when a user has received a positive diagnosis. Once the keys are shared with a server, other users can use the keys to check if their device has been in close proximity with any positively diagnosed users, enough to cause an exposure incident. Each request results in the user being notified by the operating system.

Keys are reported for the previous 14 days of exposure notification. The returned keys are at least 24 hours old.

The app must have previously enabled Exposure Notification through the settings API (which requires approval by the user). If the app hasn't done that, this request fails with `ENErrorCodeNotEnabled`.

How to use this class:

1. Create an instance of `ENSelfExposureInfoRequest`.
2. Optionally set the dispatch queue if you want the completion to be invoked on something other than the main queue.
3. Call `activateWithCompletion` to asynchronously start the request.
4. When the activation completes successfully, the `selfExposureInfo` property is valid to access.
5. Access information in the `selfExposureInfo` object. You may retain it for use after invalidating the request, if needed.
6. Call `invalidate`.

@property ENSelfExposureInfo selfExposureInfo;

This property is set to a snapshot of the results if activation completes successfully.

ENSelfExposureResetRequest

Overview

Deletes all collected exposure data and Temporary Exposure Keys.

Discussion

Note: This object eliminates the ability to detect exposure that may have occurred before the point of reset. Each request prompts the user to authorize the request.

ENExposureInfo

Overview

Contains information about a single contact incident.

@property uint8_t attenuationValue;

This property holds the attenuation value of the peer device at the time the exposure occurred. The attenuation is the Reported Transmit Power - Measured RSSI.

@property NSDate *date;

This property holds the date when the exposure occurred. The date may have reduced precision, such as within one day of the actual time.

@property NSTimeInterval duration;

This property holds the duration (in minutes) that the contact was in proximity of the user. The minimum duration is 5 minutes. Other valid values are 10, 15, 20, 25, and 30. The duration is capped at 30 minutes.

ENTemporaryExposureKey

Overview

The key used to generate Rolling Proximity Identifiers.

@property NSData *keyData;

This property contains the Temporary Exposure Key information.

@property ENIntervalNumber rollingStartNumber;

This property contains the interval number when the key's `TKRollingPeriod` started.

Revision History

v1.1 - April 23, 2020

- Renamed “Daily Tracing Keys” to “Temporary Exposure Keys.”
- Renamed the framework from “Contact Tracing” to “Exposure Notification”, along with all related terminology.
- Added `ENIntervalNumber` to indicate when “Temporary Exposure Key” started.
- Clarify that `ENSelfExposureInfoRequest` returns the previous 14 days of key.
- Added ability to filter by `attenuationThreshold` and `durationThreshold` in `ENExposureDetectionSession`.
- Added `daysSinceLastExposure` to `ENExposureDetectionSummary`.
- Added `attenuationValue` to `ENExposureInfo`, and modified the maximum duration value to 30 minutes.
- Added `ENSelfExposureResetRequest` to reset notification history and keys.
- Added a note about evaluating ways of ensuring user transparency when `getExposureInfoWithMaxCount` is invoked for more details on exposure event.
- Reformatted the title page and table of contents for consistency across documents.