



# A Look into the Periscope Live Streaming Service



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## Introduction

Periscope® is a new live video streaming service and mobile application that was acquired by Twitter® in March 2015.<sup>1</sup> The Periscope iOS® app was released in the iTunes® App Store in late March 2015. An Android® version of the Periscope app was released in late May 2015.

Periscope allows anyone with a Twitter account or mobile phone number to easily live stream from their iOS or Android devices. Using a built-in smartphone microphone and camera, a user can broadcast uncensored audio and video to anyone who decides to view the broadcast. Periscope also gives the broadcaster an option to share their location with viewers using the device's GPS capabilities.

Because of Twitter's acquisition of Periscope, the two services are very tightly integrated. Anyone with a Twitter account (302 million active monthly users) can quickly set up a Periscope account and start broadcasting and/or viewing broadcasts. Because of the pervasive nature of social media in our culture today, Periscope is currently a very hot trend. In August 2015, Periscope was ranked number 9 in the free social networking category via the iTunes App Store. *Business Insider* reports that over 10 million Periscope users watch over 40 years of video daily.<sup>2</sup> Hollywood celebrities, athletes, reporters, social media celebrities, and normal everyday people are flocking to Periscope to live stream their activities.

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<sup>1</sup> Shontell, Alyson. "Twitter quietly bought a video startup that hasn't launched yet, Periscope" *Business Insider*. March 9, 2015. Retrieved from <http://www.businessinsider.com/twitter-acquires-periscope-for-a-sizable-amount-2015-3>

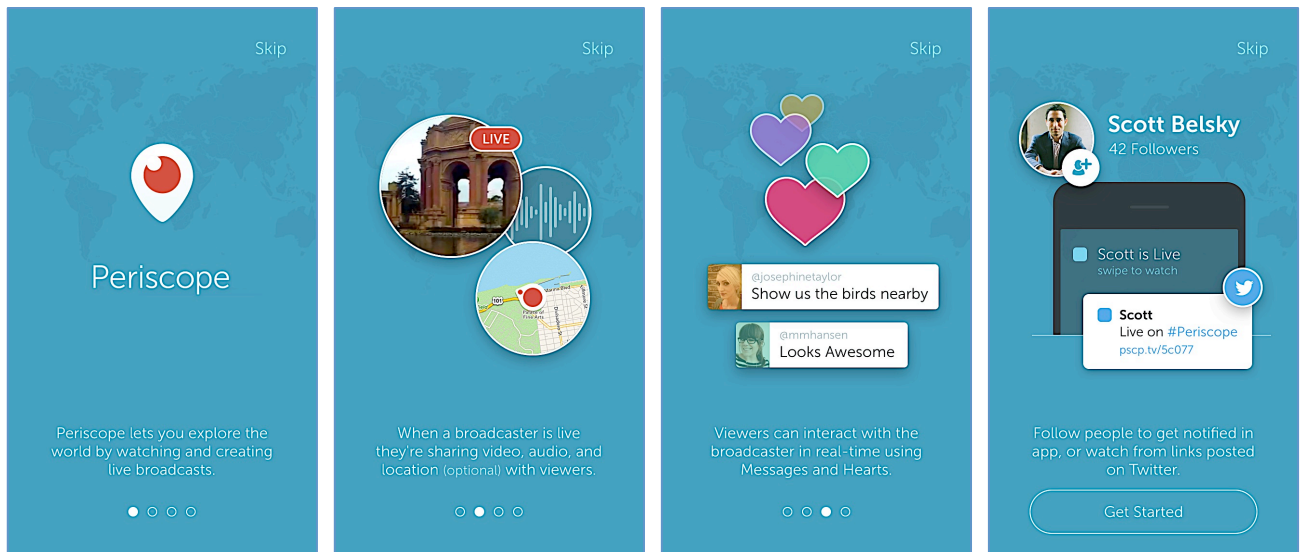
<sup>2</sup> Heber, Alex. "This incredible chart shows Periscope's rapid growth" *Business Insider*. August 13, 2015. Retrieved from <http://www.businessinsider.com/this-chart-shows-periscopes-staggering-growth-2015-8?r=UK&IR=T>

## Using Periscope

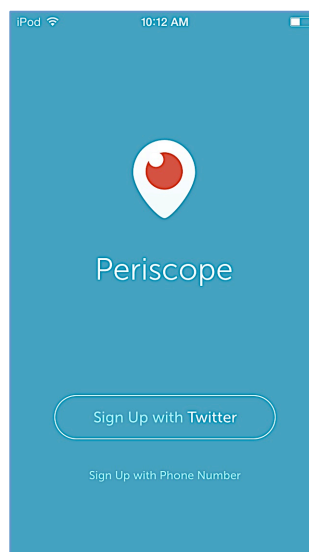
While other streaming applications (Meerkat®, Skeegle®, Stre.am®, etc.) provide similar capabilities, Periscope has made creating an account and building a viewer base a simple process. Anyone with a Twitter account or mobile phone number can be up and running within a matter of minutes.

### Setting Up Periscope

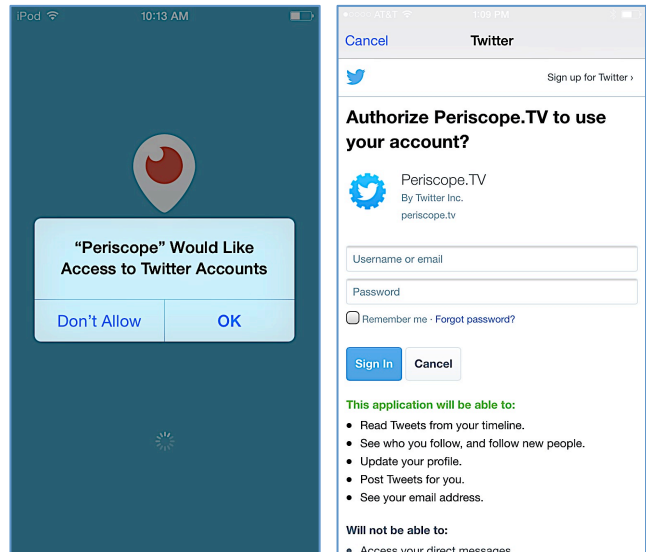
When the user launches Periscope for the first time they are presented with a tutorial describing the features at a very high level.



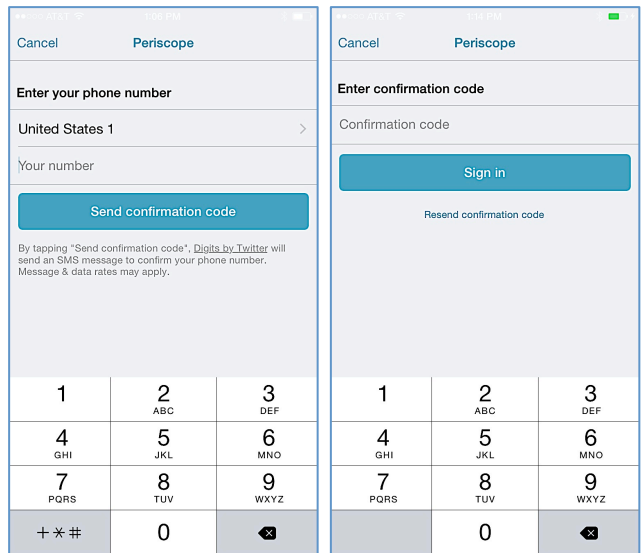
Once a user completes the tutorial, they need to sign up with Periscope using either a Twitter account or phone number.



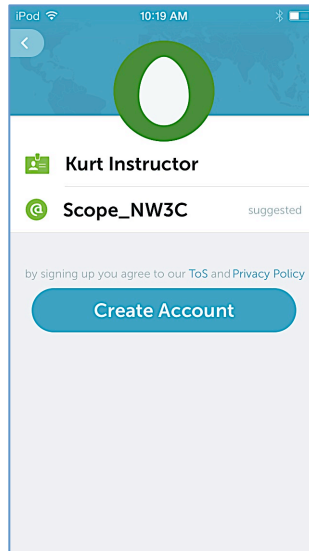
If “Sign Up with Twitter” is selected, the user must authorize Periscope.TV to access their Twitter account.



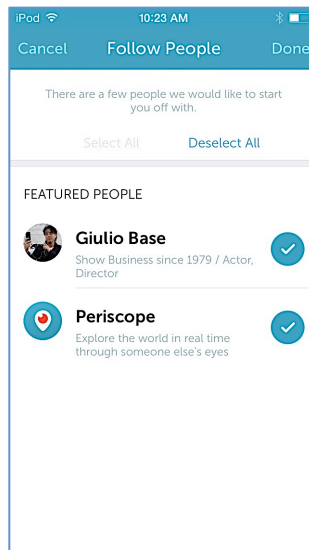
If the “Sign Up with Phone Number” option is selected, the user is prompted to provide their phone number. Periscope then sends a confirmation code via text message to complete the phone number sign-up process.



Once signed into Periscope, the user is prompted to populate their account information by providing a name, Periscope ID, and choosing an avatar image. If the “Sign Up with Twitter” option is used, Periscope suggests their Twitter name, ID, and avatar image by default.



After the account is created, Periscope then suggests people to follow based on the user’s Twitter network. Users can decide to follow all of the suggested people, none of the suggested people, or selectively choose which people they would like to follow.



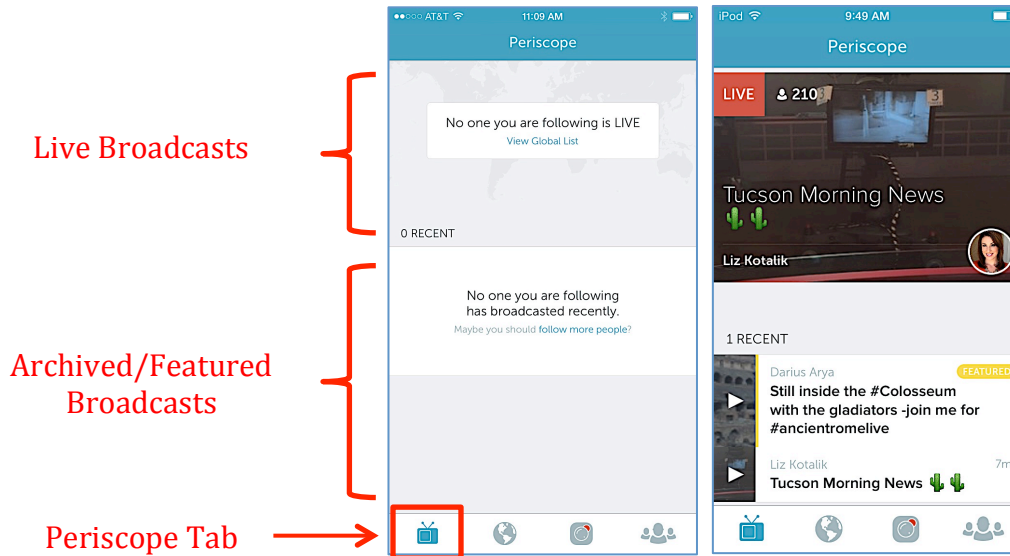
At this point, the Periscope account is set up and the user can view broadcasts or start broadcasting.

## Finding Periscope Broadcasts

There are numerous ways to find broadcasts to view from inside the Periscope app as well as from links posted on Twitter.

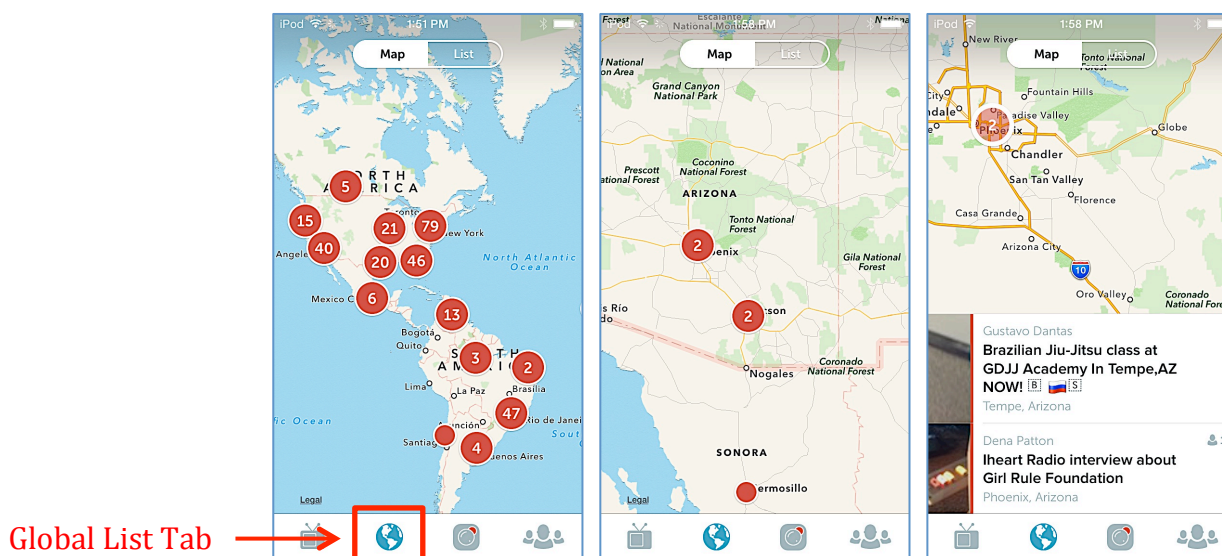
### Periscope Tab

From this tab the user can see any live or recently archived broadcasts from accounts they follow. The Periscope tab can also list featured archived broadcasts, which are determined by Periscope and not the user.



### Global List Tab

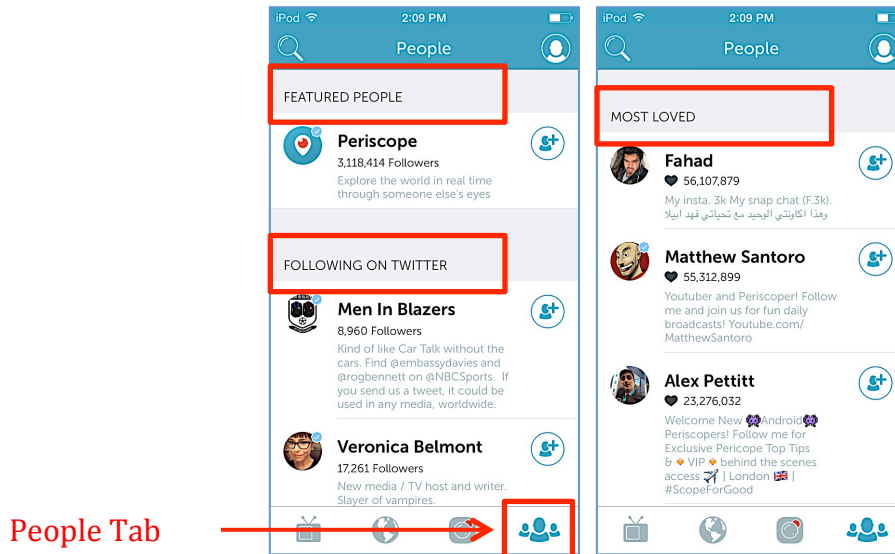
With the release of v1.1, Periscope added a map view to this tab, allowing for the selection of broadcasts based on location. The user can zoom in and see live broadcasts available in a given area.



The Map View shows only live streams from broadcasters who have elected to share their location. Users can also view available broadcasts in List View. This view gives a short list, generated by Periscope, of live broadcasts.

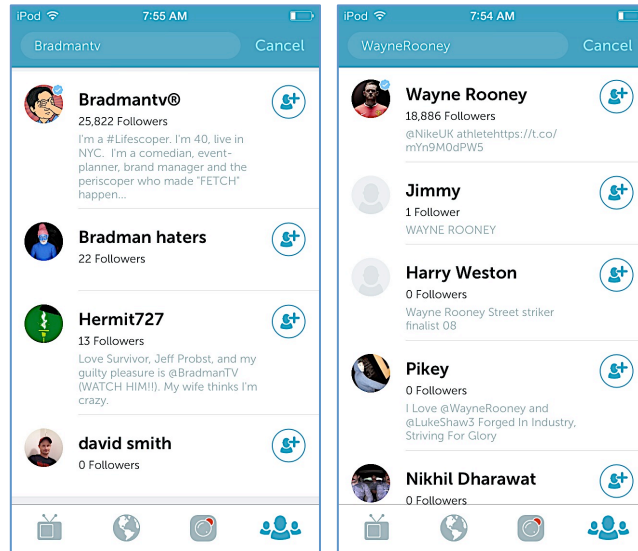
## People Tab

This tab functions as the interface to find and follow accounts in Periscope. Initially, the People tab suggests accounts to follow using three different groupings: Featured People, Following on Twitter, and Most Loved.

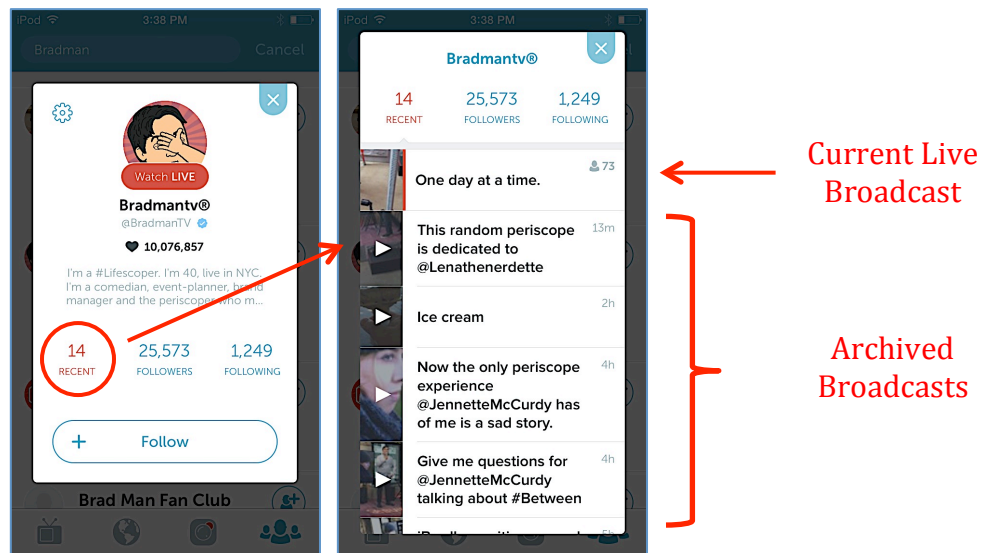


The accounts found in the Featured People list are determined by Periscope. The accounts found in the Following on Twitter list are accounts that the user follows on Twitter whom also have a Periscope account. Finally, the accounts found in the Most Loved list are the accounts that have accumulated the most hearts during their broadcasts.

From this tab, users can search for accounts by using the magnifying glass icon in the upper left corner. When a search is performed, accounts that have the name or keyword in their username, Periscope ID, or description are returned.

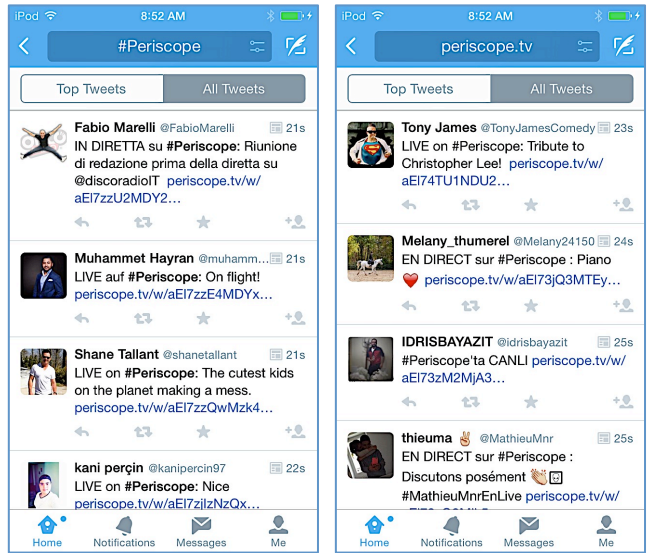


If an account is selected from anywhere in the app, their current live broadcast and/or archived broadcast(s) can be accessed.



Another place to find broadcasts to view is via Twitter. Because of Periscope's integration with Twitter, users have the option to automatically tweet links to new broadcasts.

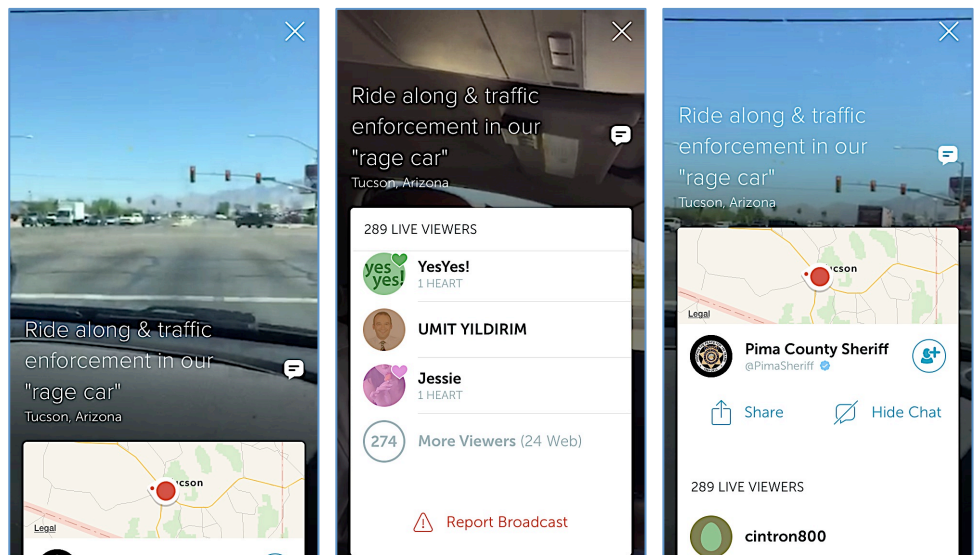
Users can easily find broadcasts to view by searching for the hashtag *#Periscope* or the keyword *periscope.tv* within a Twitter app. This is also the only way to find and view broadcasts from a desktop or laptop computer.



## Viewing Periscope Broadcasts

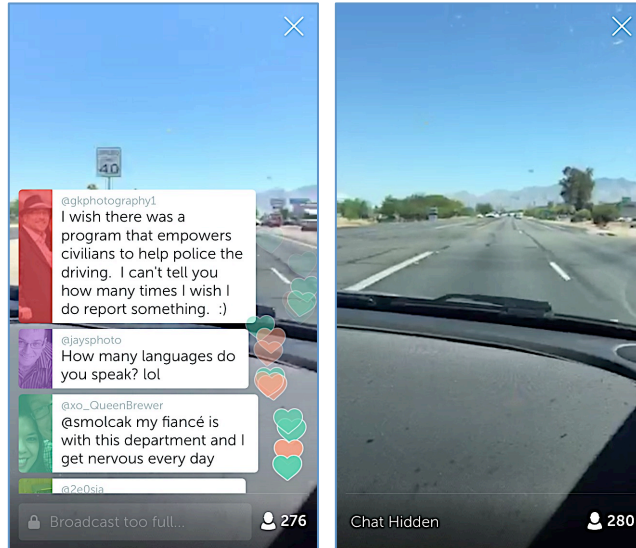
### Summary View

From this view the user can see the title of the broadcast; the user account and location of the broadcaster (if they have enabled location); a short list of the other users viewing the broadcast; and options to follow/unfollow the account, share a link to the broadcast, and hide/unhide chat.

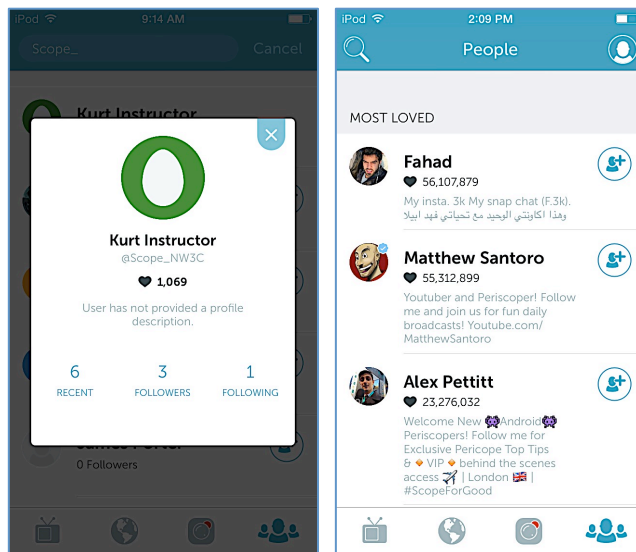


## Chat View

Swiping to the left takes the user to chat view, where they can see the chat conversation that is happening and (depending on the number of viewers and/or broadcast settings) also engage in the chat.

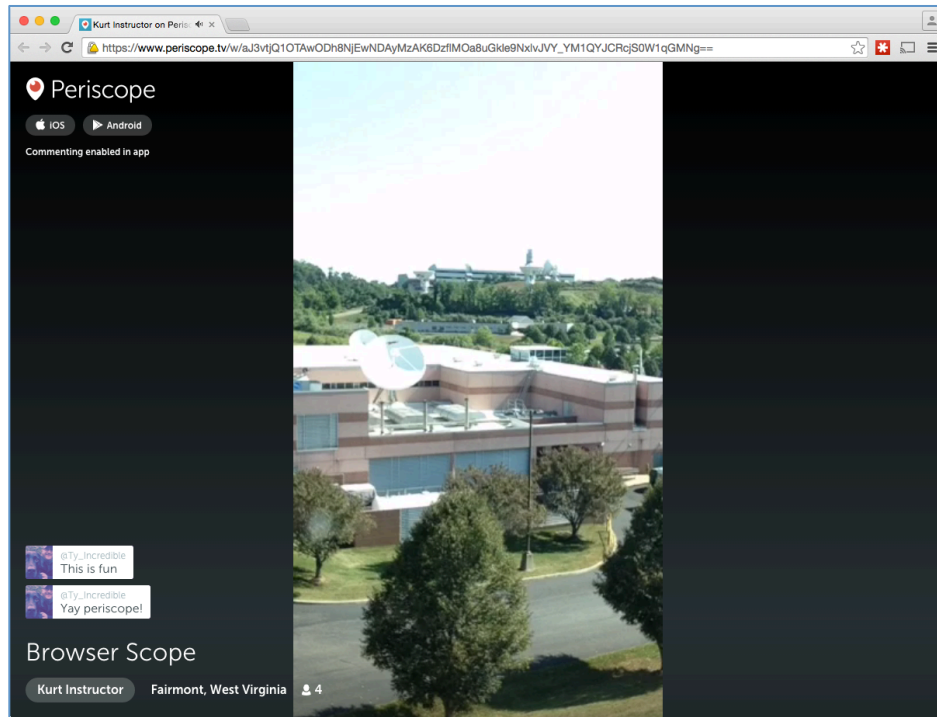


From this view, viewers can tap the screen to give hearts to broadcasters. A broadcaster's heart total is the cumulative number of hearts received during all of their broadcasts. The Most Loved list on the People tab is based on their heart total.



## Web Browser

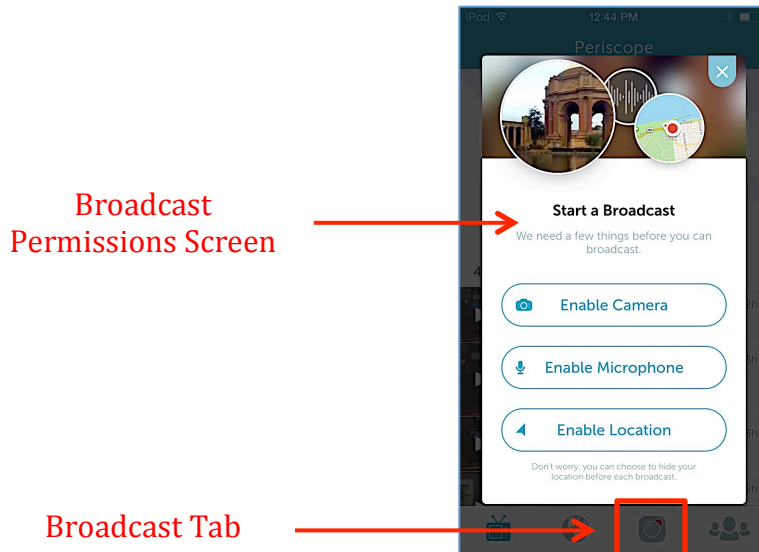
Broadcasts can also be viewed in a web browser from a computer running Microsoft® Windows® or Apple® OS X®, and can be found by searching Twitter using a desktop client or web browser. Clicking the Periscope.tv URL in the tweet launches the broadcast in the computer's default web browser.



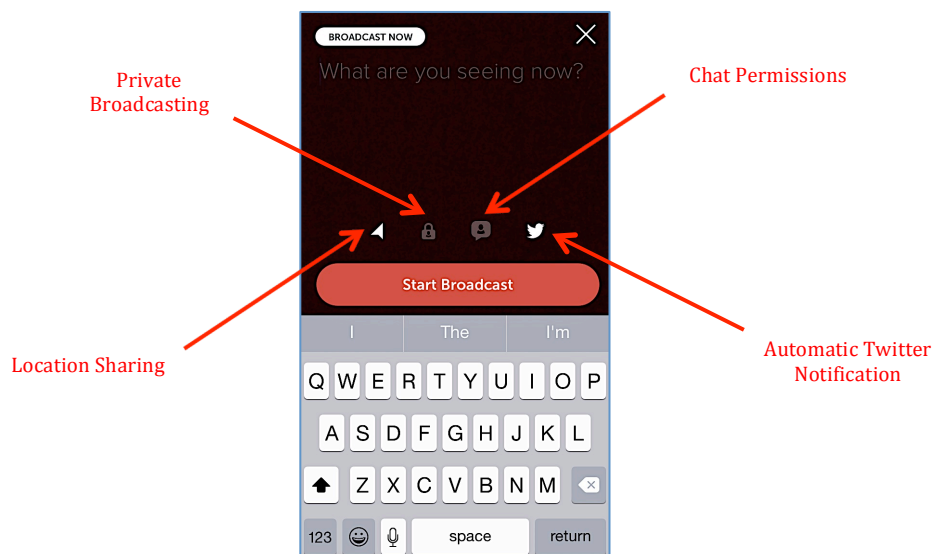
***Tip:*** Investigators can use screen recording utilities like Microsoft Expression Encoder® (Win), Apple Quicktime® (OS X), and TechSmith® Camtasia® (Win, OS X) to capture the audio and video of a Periscope broadcast running in a web browser.

## Broadcasting with Periscope

The first time a user goes to the Broadcast tab they are presented with the Broadcast Permissions screen. Periscope requires access to the device's camera and microphone. Location access is optional and can be configured before each broadcast.



Once Periscope has the necessary access, the user is presented with the Initialize Broadcast screen. From this screen the user configures the broadcast settings, which include location sharing, private broadcasting, chat permissions, and automated tweet.



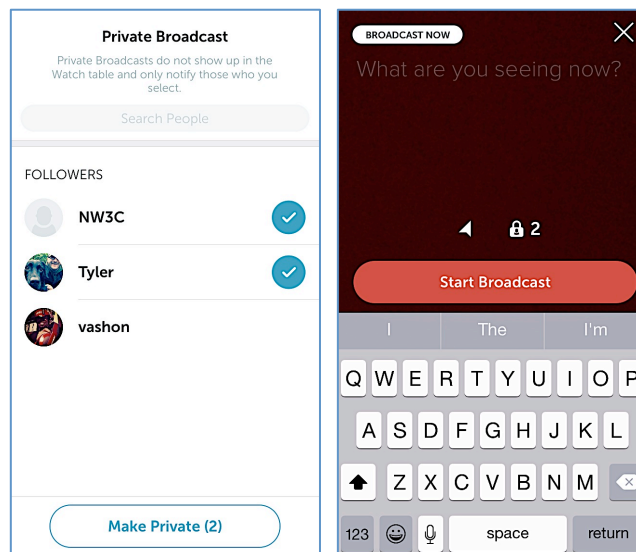
The broadcaster can decide whether or not to share their location and/or send out an automated tweet by tapping the appropriate icon. The automated tweet contains the title and a link to view broadcast.



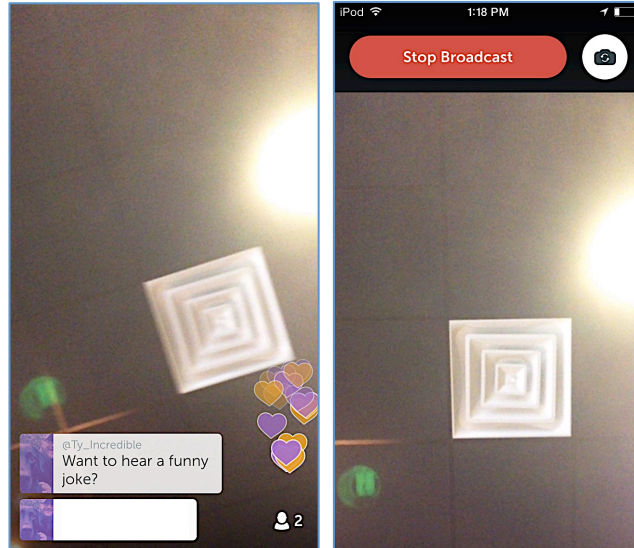
The Chat Permissions icon allows the broadcaster to decide if all viewers or just those viewers that the broadcaster follows can engage in the chat conversation.

In Private Broadcasting mode, broadcasters must individually select which of their followers are allowed to view the private broadcast. Also, Private Broadcasting disables the chat permissions and automated tweet options.

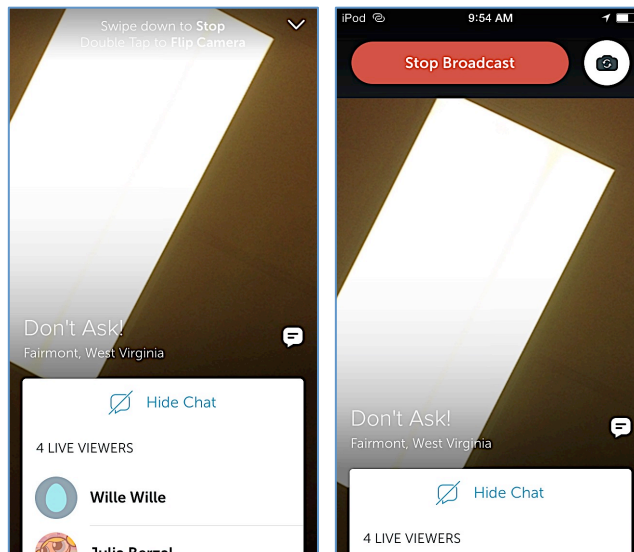
If Private Broadcasting is not selected, all Periscope users can view the public broadcast. The broadcast begins when the user selects Start Broadcast.



When the broadcast starts, the broadcaster is presented with chat view. The broadcaster's chat view is very similar to that of the viewer, but the broadcaster cannot engage in the text chat conversation or give out hearts. By swiping down, the broadcaster can stop the broadcast or change the camera being used.

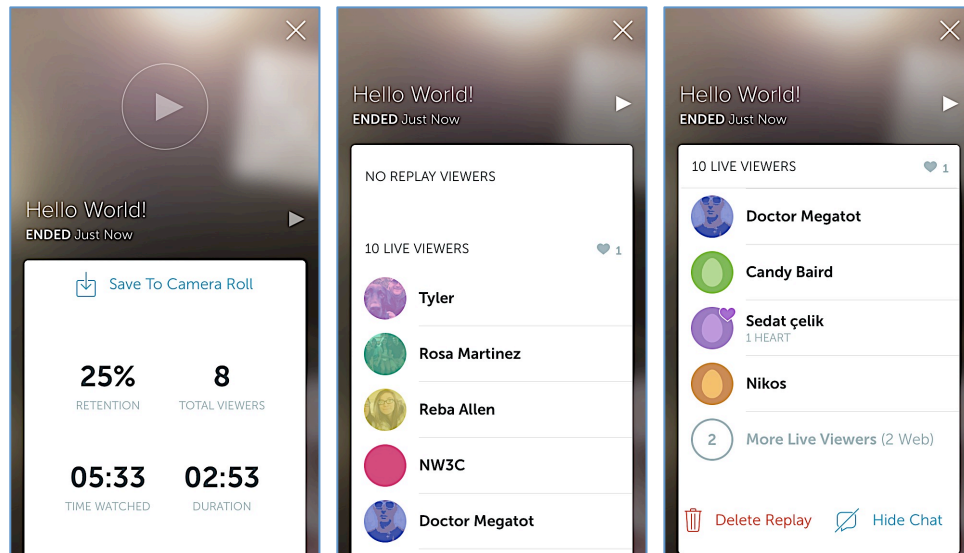


Swiping to the right takes the broadcaster to their broadcast view. From this view the broadcaster can see the title and location of the broadcast (if they have enabled location), a short list of the users currently viewing the broadcast, and the option to hide/unhide chat. As in chat view, swiping down from this view also allows the broadcaster to stop or change the camera being used.



Stop Broadcast ends the live broadcast and present the broadcaster with a summary of the completed broadcast. From the broadcast summary view, the broadcaster can see the stats for the broadcast and decide how to handle the archived broadcast.

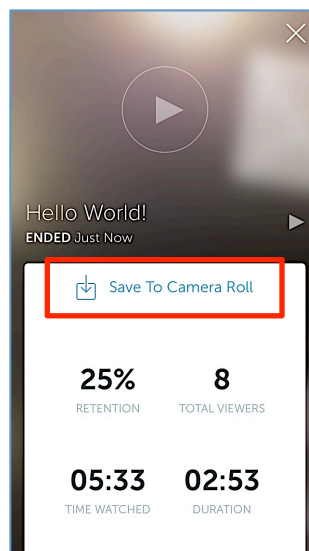
The stats include the viewer retention percentage, total viewers, total time viewers watched the broadcast, the total duration of the broadcast, and complete list of all of the live and replay viewers.



### Archived Broadcasts

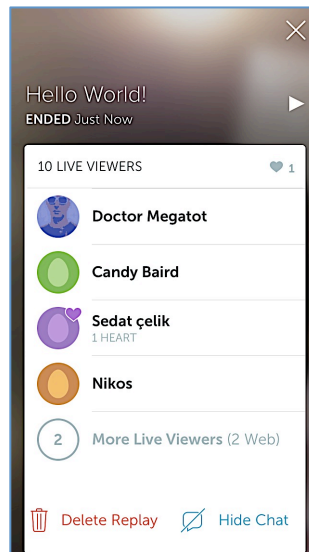
The broadcaster has two options for handling the archived broadcast.

The first option is to save the broadcast to the Camera Roll on their device. Saving the broadcast to the device's Camera Roll saves the audio and video but not the chat conversation or hearts given.



By default, live broadcasts are archived for viewing in Periscope for 24 hours. If the live broadcast was restricted using Private Broadcast mode, these same restrictions will apply to the archived broadcast.

Users can disable archived viewing by choosing Delete Replay at the end of a broadcast. By choosing to delete the replay, Periscope users will not be able to view an archive version of the broadcast.



## Importance to Law Enforcement

Periscope and other live streaming applications are not immune from being used for unintended and/or unlawful purposes. The ability to broadcast live and uncensored audio and video with just a few taps makes the potential nefarious uses almost limitless.

Because broadcasts can be private (restricted to just select viewers) any number of illegal acts could be broadcast to vetted viewers. These could include child exploitation and other illegal sexual acts, human trafficking, or terrorist training and/or planning activities. The ability to save the archived broadcast provides another means of distribution after the live event has ended.

Two recent incidents in Ohio highlight how Periscope can be used in nefarious ways. In the first incident, the Columbus Police say a pair of men got on Periscope, made threats, and reported that if they received 100 viewers they would take an AR-15 and 30 rounds of ammo and begin randomly shooting in the city. Viewers in the area took notice and proactively notified law enforcement leading to no shots being fired and arrests being made.<sup>3</sup> In the second incident, the Franklin County Prosecuting Attorney stated that an 18-year-old and a 17-year old female were socializing with a 29-year-old male. It is alleged in this case that the male forced sexual

<sup>3</sup> Wells, Rob "Shooting threat live streamed on Periscope leads to arrests". February 22, 2016. Retrieved from <http://myfox28columbus.com/news/local/shooting-threat-live-streamed-on-periscope-leads-to-arrests>

intercourse with the 17-year-old victim; all the while the 18-year-old female began broadcasting the rape on Periscope. It was reported that a follower of the Periscope stream in another state then reported the incident to the authorities upon which the 29-year-old male and 18-year-old female were apprehended and now awaiting trial and each could face in excess of forty years in prison.<sup>4,5</sup>

The rapid adoption of Periscope raises numerous privacy concerns. Anyone can start a live broadcast at any time, from any location, without the permission of those being filmed.

Users of applications such as Periscope could also be linked to copyright infringement. Live broadcasts of sporting events, movies, or pay-per-view events can be started quickly and may be impossible to control or shut down. Just in the few months since the release of Periscope, events like Floyd Mayweather vs Manny Pacquiao and the Apple Watch event were both heavily streamed.<sup>6</sup>

Periscope can also be used by law enforcement agencies for positive and proactive purposes like public service announcements, AMBER alerts, and community awareness and education. Periscope could also be used to monitor crowd activity from a safe distance at sporting events, concerts, protests, and even riots.

Map View could be used to find live broadcasts in the area around an incident to help get eyes on the situation before first responders arrive on scene.

## Analyzing iOS Artifacts

The Periscope artifacts available for examination vary significantly based on the version of iOS installed on the device. With the release of iOS v8.3, Apple made significant changes to the handling of access to third party application data.

*“The most important iOS 8.3 change in terms of potential impact on investigations is the discontinuation of access to app data containers. This change, which Apple presumably made to increase security, means that the user’s app data cannot be directly accessed or acquired by forensics tools. User preferences, documents, and other primary data will still be acquired by an iTunes backup, but certain transitory data and caches, including web content and media, is not included in backups and thus is no longer available for examination.”<sup>7</sup>*

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<sup>4</sup> Melendez, Pilar. “Ohio woman accused of live-streaming rape on Periscope” *CNN*. April 15, 2016. Retrieved from <http://www.cnn.com/2016/04/14/us/ohio-periscope-rape-case/>

<sup>5</sup> “Woman indicted for using Periscope App to live stream rape of friend by man who has also been indicted for that rape” *Franklin County Prosecuting Attorney*. April 13, 2016. Retrieved from <http://prosecutor.franklincountyohio.gov/media/press-release.cfm?pressID=456>

<sup>6</sup> Pagliery, Jose. “Mayweather-Pacquiao fight made Periscope the new Napster” *CNNMoney*. May 4, 2015. Retrieved from <http://money.cnn.com/2015/05/04/technology/live-stream-mayweather-pacquiao/>

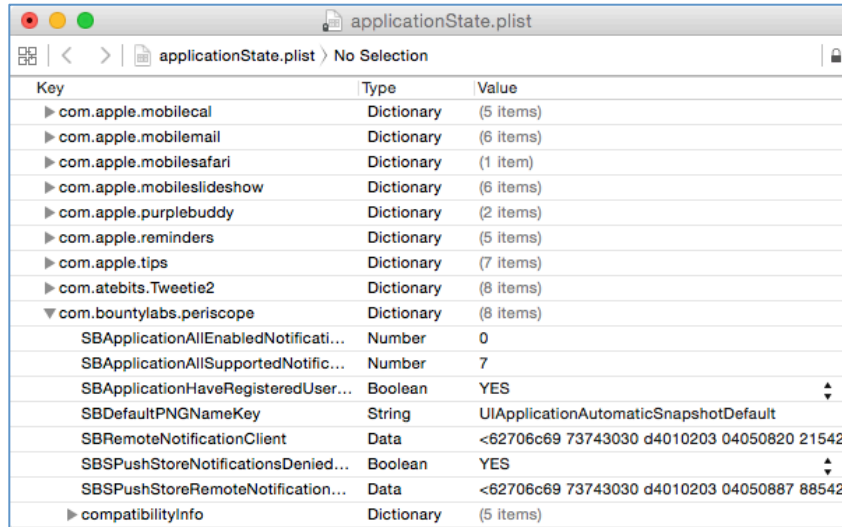
<sup>7</sup> BlackBag Training Team. “Changes Examiners Face with iOS 8.3” *BlackBag Technologies*. May 6, 2015. Retrieved from <https://www.blackbagtech.com/blog/2015/05/06/changes-examiners-face-with-ios-8-3/>

Because of these changes, devices running iOS v8.3 or later provide significantly fewer artifacts for examination compared to devices running iOS v8.2 and prior.

NW3C tested numerous automated forensic tools to attempt to extract data from iOS devices and to identify the artifacts that could be analyzed in relation to the Periscope application. Data included, but was not limited to: Periscope account information, Periscope settings, follower information, broadcasts viewed, broadcasts performed, and archived broadcast content.

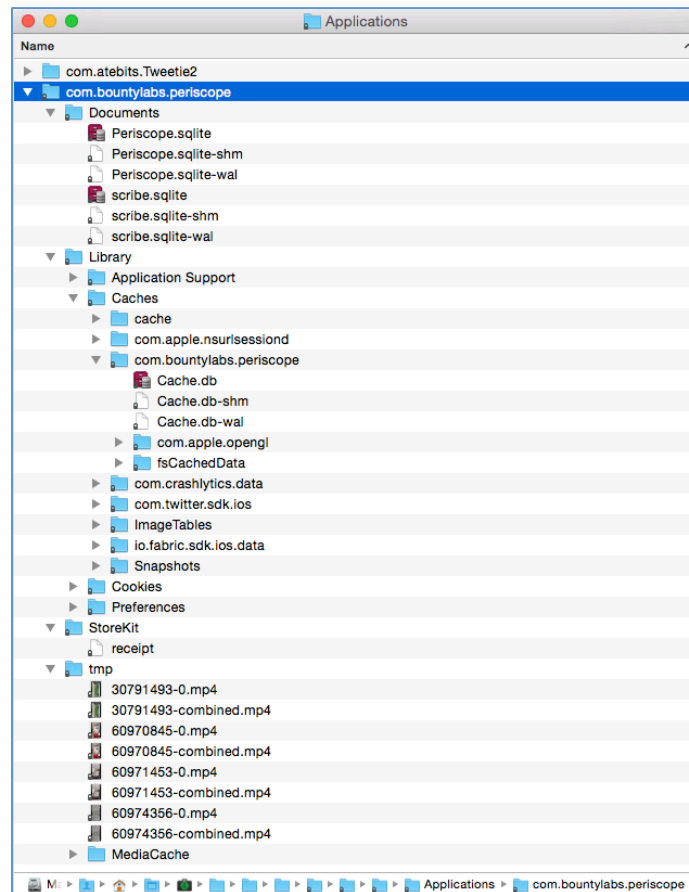
## iOS v8.2 and Prior

The first step in analysis is to identify whether or not the Periscope application is installed. This is done by examining the iOS system artifact `applicationState.plist`. This property list maintains a list of the applications installed on the iOS device.



Key	Type	Value
▶ com.apple.mobilecal	Dictionary	(5 items)
▶ com.apple.mobilemail	Dictionary	(6 items)
▶ com.apple.mobilesafari	Dictionary	(1 item)
▶ com.apple.mobileslideshow	Dictionary	(6 items)
▶ com.apple.purplebuddy	Dictionary	(2 items)
▶ com.apple.reminders	Dictionary	(5 items)
▶ com.apple.tips	Dictionary	(7 items)
▶ com.atebits.Tweetie2	Dictionary	(8 items)
▼ com.bountylabs.periscope	Dictionary	(8 items)
SBApplicationAllEnabledNotificati...	Number	0
SBApplicationAllSupportedNotific...	Number	7
SBApplicationHaveRegisteredUser...	Boolean	YES
SBDefaultPNGNameKey	String	UIApplicationAutomaticSnapshotDefault
SBRemoteNotificationClient	Data	<62706c69 73743030 d4010203 04050820 21542
SBSPushStoreNotificationsDenied...	Boolean	YES
SBSPushStoreRemoteNotification...	Data	<62706c69 73743030 d4010203 04050887 88542
▶ compatibilityInfo	Dictionary	(5 items)

Once it is determined that Periscope is installed, the next step is to examine the Periscope application container.

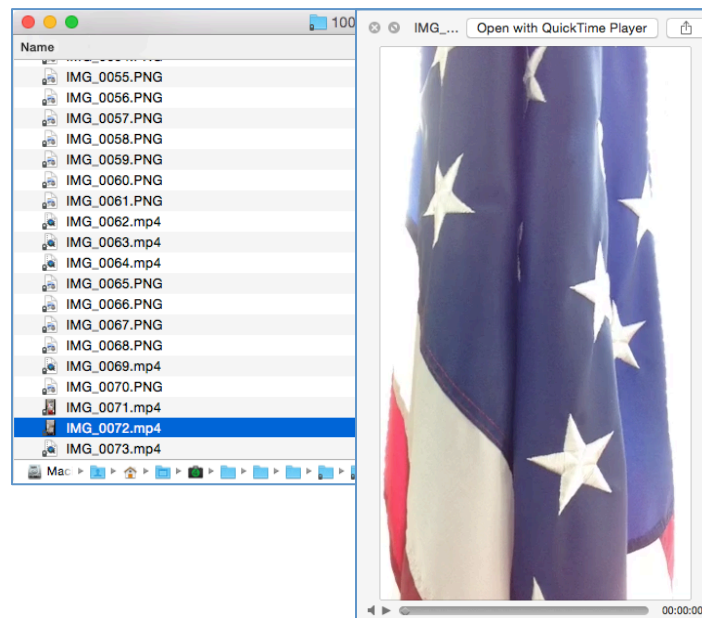


In the Periscope application container the SQLite database periscope.sqlite can be examined to determine the user's display name, username, profile image, as well as the number of followers, following, and hearts received.

The tmp folder inside Periscope's application container stores the recordings of previous broadcasts that were left available for archived viewing. No recording was found in the tmp folder for broadcasts where the replay was deleted (not available for archived viewing in Periscope).

The saved recording is only the audio and video portion of the broadcast and does not include the broadcast chat conversation. The .mp4 files in the tmp folder were still present after the 24-hour replay period had expired. However, the .mp4 files were no longer present when a subsequent extraction was conducted approx. 12 days later.

Periscope artifacts can also be found in the Camera Roll. The Camera Roll is the central location where all pictures and videos taken or saved by the iOS device are stored. If the broadcaster saved the finished broadcast to the Camera Roll, a recording of the broadcast can be found there.



Just like the broadcasts saved to the tmp folder, these recordings include only the audio and video portion of the broadcast - not the broadcast chat conversation. However, no markers identify the .mp4 file saved to the Camera Roll as a Periscope broadcast. Based on the similarities of most broadcasts and the interaction of the broadcaster with the chat conversation, one could easily identify it as a Periscope broadcast by viewing the recording.

### iOS v8.3

The iOS system artifacts extracted from v8.2 (applicationState.plist and Camera Roll) are still available in v8.3. However, the artifacts from the Periscope application container are greatly limited by the changes made to third party application access in v8.3 by Apple.

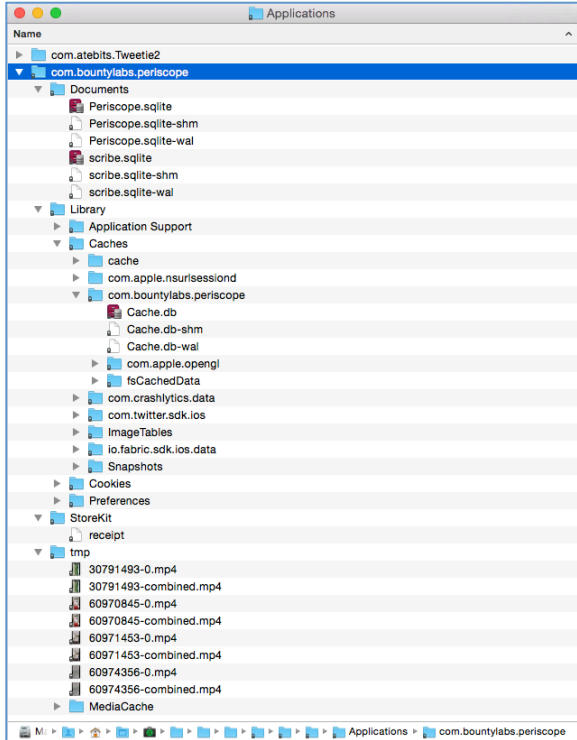


Figure 2 - Periscope Application Container iOS v8.2

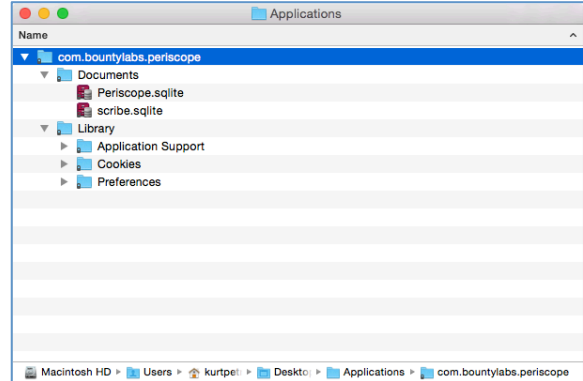
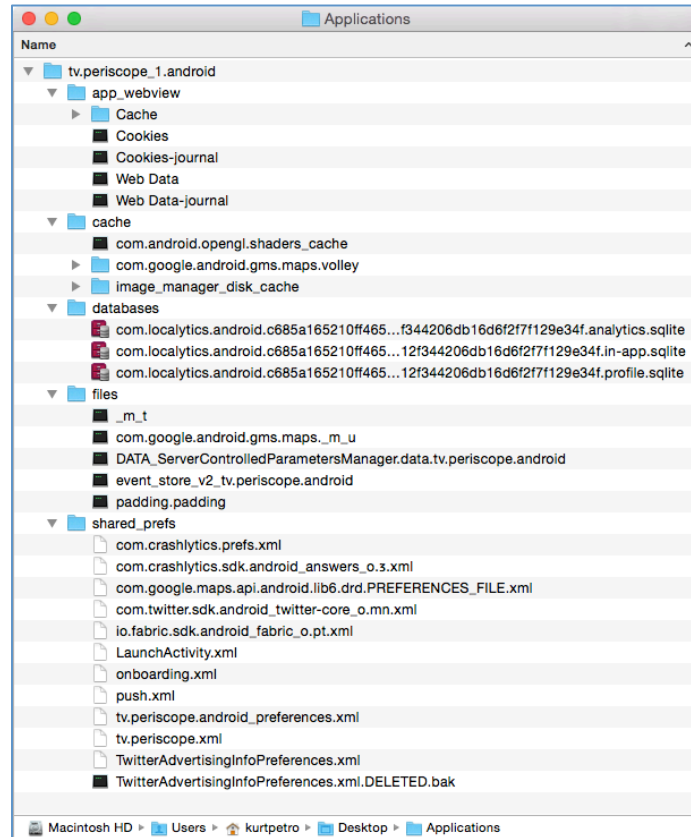


Figure 1 - Periscope Application Container iOS v8.3

The only artifact discussed above that is still available from a v8.3 extraction was the periscope.sqlite database. Access to the tmp folder is no longer available in v8.3.

## Analyzing Android Artifacts

If Periscope is installed, an examination of the Periscope application container can be performed to identify information related to the user's account.

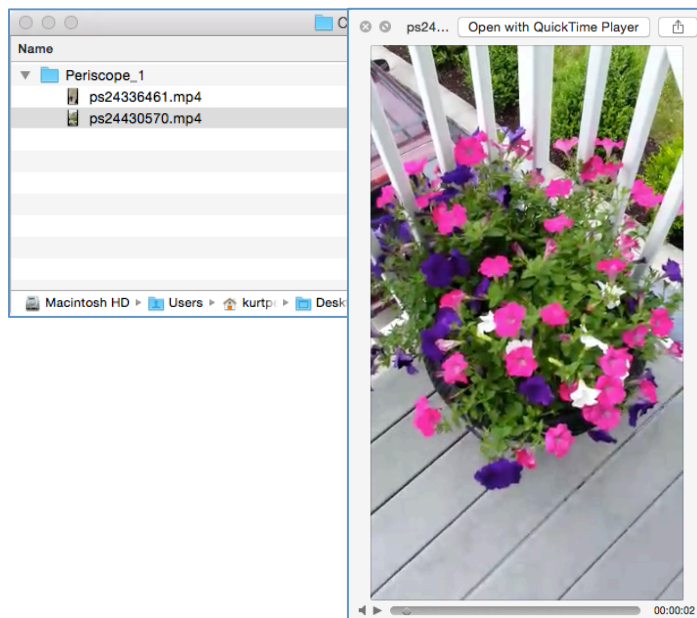


The XML file `tv.periscope.android_preferences.xml` contains the user's Periscope username, display name, profile ID, profile image, and the number followers, following, and hearts received. The SQLite database `com.localytics.android.[guid].analytics.sqlite` stores the last date and time a session was opened and closed. These date/time values are stored in Unix Epoch format.<sup>8</sup>

Periscope broadcasts are not stored by default. However, when a broadcast ends, an option is presented to the broadcaster to save the stream to the Android Gallery. The Android Gallery is the central location where all pictures and videos taken or saved by the Android device are stored.

<sup>8</sup> <http://www.unixtimestamp.com/>

The saved broadcasts are stored to the Android Gallery in a subfolder named Periscope\_1. The saved recording includes only the audio and video portion of the broadcast - not the broadcast chat conversation.



## Law Enforcement Information Requests

Although Periscope is a standalone application and service it is owned by Twitter. Any requests for user account information should be submitted to Twitter, Inc. in San Francisco, California or Twitter International Company in Dublin, Ireland.

A full list of guidelines for law enforcement can be found on Twitter's Help Center, including data retention information, preservation requests, emergency disclosure requests, and much more.

**Twitter's Guidelines for Law Enforcement**  
<https://support.twitter.com/articles/41949>

One key item identified in the guidelines that all law enforcement agencies need to be aware of prior to requesting information from Twitter is how they handle user notification when a request for information is received.

### Will Twitter Notify Users of Requests for Account Information?

Yes. Twitter's policy is to notify users of requests for their account information, which includes a copy of the request, prior to disclosure unless we are prohibited from doing so (e.g., an order under [18 U.S.C. § 2705\(b\)](#)). Exceptions to prior notice may include exigent or counterproductive circumstances (e.g., emergencies; account compromises). We may also provide post-notice to affected users when prior notice is prohibited.