iOS

This article is about Apple's mobile operating system. For the unrelated web desktop, see eyeOS. For other uses, see IOS (disambiguation).

iOS (formerly **iPhone OS**) is a mobile operating system created and developed by Apple Inc. exclusively for its hardware. It is the operating system that presently powers many of the company's mobile devices, including the iPhone, iPad, and iPod touch. It is the second most popular mobile operating system globally after Android by sales. iPad tablets are also the second most popular, by sales, against Android since 2013, when Android tablet sales increased by 127%.[6]

Originally unveiled in 2007 for the iPhone, it has been extended to support other Apple devices such as the iPod Touch (September 2007) and the iPad (January 2010). As of June 2016, Apple's App Store contained more than 2 million iOS applications,[7] 725,000 of which are native for iPads.[8] These mobile apps have collectively been downloaded more than 130 billion times.[7]

The iOS user interface is based upon direct manipulation, using multi-touch gestures. Interface control elements consist of sliders, switches, and buttons. Interaction with the OS includes gestures such as *swipe*, *tap*, *pinch*, and *reverse pinch*, all of which have specific definitions within the context of the iOS operating system and its multi-touch interface. Internal accelerometers are used by some applications to respond to shaking the device (one common result is the undo command) or rotating it in three dimensions (one common result is switching between portrait and landscape mode).

Major versions of iOS are released annually. The current version, iOS 10, was released on September 13, 2016.[9] It runs on the iPhone 5 and later, iPad (4th generation) and later, iPad Pro, iPad Mini 2 and later, and the 6th-generation iPod Touch. In iOS, there are four abstraction layers: the Core OS, Core Services, Media, and Cocoa Touch layers. iOS 10 dedicates around 1.8GB of the device's flash memory for itself.[10]

1 History

Original iOS logo, used until 2013 (left) and new logo from 2013 onwards (right)

In 2005, when Steve Jobs began planning the iPhone, he had a choice to either "shrink the Mac, which would be an epic feat of engineering, or enlarge the iPod". Jobs favored the former approach but pitted the Macintosh and iPod teams, led by Scott Forstall and Tony Fadell, respectively, against each other in an internal competition, with Forstall winning by creating the iPhone OS. The decision enabled the success of the iPhone as a platform for third-party developers: using a well-known desktop operating system as its basis allowed the many third-party Mac developers to write software for the iPhone with minimal retraining.[11] Forstall also was responsible for creating a software developer's kit for programmers to build iPhone apps, as well as an App Store within iTunes.[12][13]

The operating system was unveiled with the iPhone at the Macworld Conference & Expo, January 9, 2007, and released in June of that year.[14] At first, Apple marketing literature did not specify a separate name for the operating system, stating simply what Steve Jobs claimed: "iPhone runs OS X" and runs "desktop applications"[15][16] when in fact it runs a variant of [Mac] OS X, that doesn't run OS X software unless it has been ported to the incompatible operating system. Initially, third-party applications were not supported. Steve Jobs' reasoning was that developers could build web applications that "would behave like native apps on the iPhone".[17][18] On October 17, 2007, Apple announced that a native Software Development Kit (SDK) was under development and that they planned to put it "in developers' hands in February".[19] On March 6, 2008, Apple released the first beta, along with a new name for the operating system: "iPhone OS".

On September 5, 2007, Apple released the iPod Touch, which had most of the non-phone capabilities of the iPhone. Apple also sold more than one million iPhones during the 2007 holiday season.[20] On January 27, 2010, Apple announced the iPad, featuring a larger screen than the iPhone and iPod Touch, and designed for web brows-

ing, media consumption, and reading iBooks.[21]

In June 2010, Apple rebranded iPhone OS as "iOS". The trademark "IOS" had been used by Cisco for over a decade for its operating system, IOS, used on its routers. To avoid any potential lawsuit, Apple licensed the "IOS" trademark from Cisco.[22]

1.1   Software updates

Main article: iOS version history
See also: iPhone OS 1, iPhone OS 2, iPhone OS 3, iOS 4, iOS 5, iOS 6, iOS 7, iOS 8, iOS 9, and iOS 10
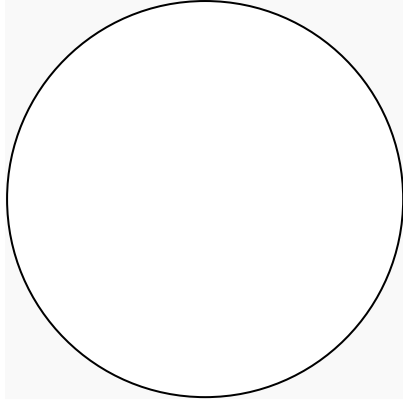
Platform usage as measured by the App Store on October 25, 2016.

iOS 10 (60%)
iOS 9 (32%)
Earlier (8%)

Apple provides major updates to the iOS operating system annually via iTunes and also, for iOS 5 and later, over the air. The latest version is iOS 10, which is available for the iPhone 5, iPhone 5C, iPhone 5S, iPhone 6 and 6 Plus, iPhone 6S and 6S Plus, iPhone SE, iPhone 7 and 7 Plus, the fourth generation iPad, the first and second generation iPad Air, the iPad Pro, the second, third and fourth generation iPad Mini, and the sixth generation iPod Touch. The OS update was released on September 13, 2016.[23]

Before the iOS 4 release in 2010, iPod Touch users had to pay for system software updates. Apple claimed that this was the case because the iPod Touch was not a 'subscription device' like the iPhone (i.e., it was a one-off purchase).[24] Apple said it had 'found a way' to deliver software updates for free to iPod Touch users at WWDC 2010 when iOS 4 was unveiled.[25]
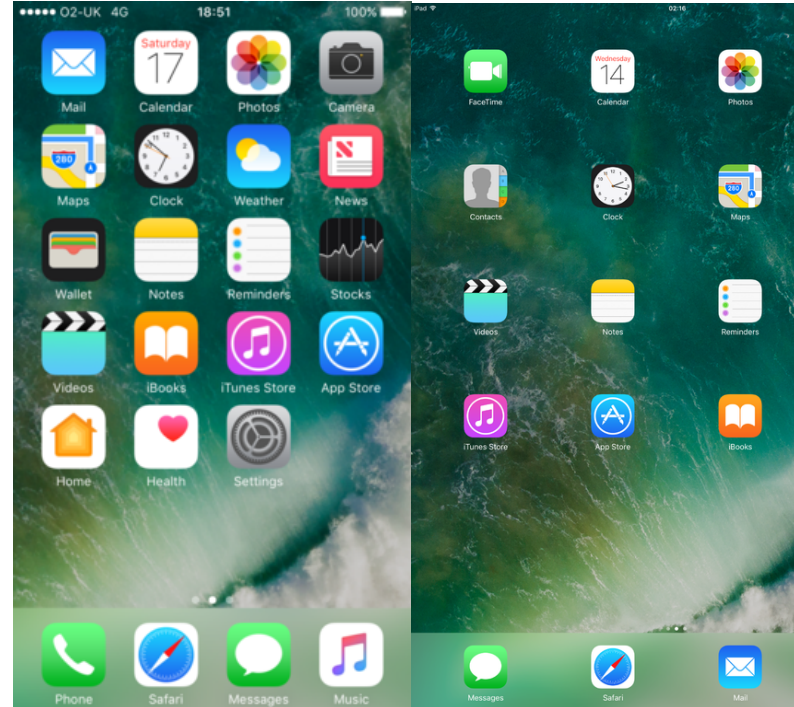
1.1.1   Platform usage

Charts in this section provide breakdowns of iOS versions, based on devices accessing the App Store as of October 25, 2016.[26]

2   Features

2.1   Home screen

Main article: SpringBoard

10 running on an iPhone (left) and on an iPad Pro (right)

The home screen, rendered by SpringBoard, displays application icons and a dock at the bottom where users can pin their most frequently used apps. The home screen appears whenever the user unlocks the device or presses the physical "Home" button whilst in another app.[27] Before iOS 4 on the iPhone 3GS+, the screen's background could be customized through jailbreaking, but can now be changed out-of-the-box. The screen has a status bar across the top to display data, such as time, battery level, and signal strength. The rest of the screen is devoted to the current application. When a passcode is set and a user switches on the device, the passcode must be entered at the Lock Screen before access to the Home screen is granted.[28]

In iPhone OS 3, Spotlight was introduced, allowing users to search media, apps, emails, contacts, messages, reminders, calendar events, and similar content. In iOS 7 and later, Spotlight is accessed by pulling down anywhere on the home screen (except for the top and bottom edges that open Notification Center and Control Center).[29][30] In iOS 9, there are two ways to access Spotlight. As with iOS 7 and 8, pulling down on any homescreen will show Spotlight. However, it can also be accessed as it was in iOS 3 – 6. This gives a Spotlight endowed with Siri suggestions, which include app suggestions, contact suggestions and news.[31] In iOS 10, Spotlight is at the top of the now-dedicated "Today" panel.[32]

Since iOS 3.2, users are able to set a background image for the Home screen. This feature is only available on third-generation devices or newer – iPhone 3GS+, iPod Touch 3rd generation+ (iOS 4.0+), and all iPad models (iOS 3.2+).

Researchers found that users organize icons on their homescreens based on usage-frequency and relatedness of the applications, as well as for reasons of usability and aesthetics.[33]

2.1.1 System font

iOS originally used Helvetica as the system font. With the release of the iPhone 4 and iOS 4, iOS switched to Helvetica Neue with Retina Displays, but retained Helvetica as the system font for older devices.[34] iOS 7 provided the ability to scale text or switch to Neue Bold as the default system font, as accessibility options. iOS 9 changed the font to San Francisco, a Apple-designed font for maximum legibility on computer and mobile displays, originally introduced as the system font for the Apple Watch.[35]

2.1.2 Folders

iOS 4 introduced folders, which were created when two applications are in "jiggle mode"(with the exception of Newsstand in iOS 5-6[36]) are dragged together to create it, and from then on, more can be added using the same procedure. It can be up to 12 on iPhone 4S and earlier and iPod Touch, 16 on iPhone 5, and 20 on iPad. A title for the folder is automatically selected by the category of applications inside, but the name can also be edited by the user. When apps inside folders receive badges, the numbers shown by the badges is added up and shown on the folder. Folders cannot be put into other folders, though an unofficial workaround exists that enables folders to be nested within folders.[37] iOS 7 updated the folders with pages like on the SpringBoard. Each page can hold nine apps, and the Newsstand app is now able to be placed into a folder.

2.1.3 Notification Center

Main article: Notification Center

Before iOS 5, notifications were delivered in a modal window and couldn't be viewed after being dismissed. In iOS 5, Apple introduced Notification Center, which allows users to view a history of notifications. The user can tap a notification to open its corresponding app, or clear it.[38] Notifications are now delivered in banners that appear briefly at the top of the screen. If a user taps a received notification, the application that sent the notification will be opened. Users can also choose to view notifications in modal alert windows by adjusting the application's notification settings. Introduced with iOS 8, widgets are now accessible through the Notification Center, defined by 3rd parties.

When an app sends a notification while closed, a red badge appears on its icon. This badge tells the user, at a glance, how many notifications that app has sent. Opening the app clears the badge.

2.2 Accessibility

Located in Settings > General > Accessibility. This allows the user to customize various aspects of iOS to assist the user if assistance is needed in the area of seeing or hearing, and allows the addition of accessibility shortcuts.[39]

2.3 Multitasking

Multitasking for iOS was first released in June 2010 along with the release of iOS 4.[40][41] Only certain devices— iPhone 4, iPhone 3GS, and iPod Touch 3rd generation— were able to multitask.[42] The iPad did not get multitasking until iOS 4.2.1 in November.[43] Currently, multitasking is supported on iPhone 3GS+, iPod Touch 3rd generation+, and all iPad models.[44]

Implementation of multitasking in iOS has been criticized for its approach, which limits the work that applications in the background can perform to a limited function set and requires application developers to add explicit support for it.[42][45]

Before iOS 4, multitasking was limited to a selection of the applications Apple included on the device. Users could, however "jailbreak" their device in order to unofficially multitask.[46] Starting with iOS 4, on third-generation and newer iOS devices, multitasking is supported through seven background APIs:[47]

1. Background audio – application continues to run in the background as long as it is playing audio or video content[48]

2. Voice over IP – application is suspended when a phone call is not in progress[48]

3. Background location – application is notified of location changes[48]

4. Push notifications

5. Local notifications – application schedules local notifications to be delivered at a predetermined time[48]

6. Task completion – application asks the system for extra time to complete a given task[48]

7. Fast app switching – application does not execute any code and may be removed from memory at any time[48]

In iOS 5, three new background APIs were introduced:

1. Newsstand – application can download content in the background to be ready for the user[48]

2. External Accessory – application communicates with an external accessory and shares data at regular intervals[48]

3. Bluetooth Accessory – application communicates with a bluetooth accessory and shares data at regular intervals[48]

In iOS 7, Apple introduced a new multitasking feature, providing all apps with the ability to perform background updates. This feature prefers to update the user's most frequently used apps and prefers to use WiFi networks over a cellular network, without markedly reducing the device's battery life.

2.3.1   Switching applications

In iOS 4.0 to iOS 6.x, double-clicking the home button activates the application switcher. A scrollable dock-like interface appears from the bottom, moving the contents of the screen up. Choosing an icon switches to an application. To the far left are icons which function as music controls, a rotation lock, and on iOS 4.2 and above, a volume controller.

With the introduction of iOS 7, double clicking the home button also activates the application switcher. However, unlike previous versions it displays screenshots of open applications on top of the icon and horizontal scrolling allows for browsing through previous apps, and it is possible to close applications by dragging them up, similar to how WebOS handled multiple cards.[49]

With the introduction of iOS 9, the application switcher received a significant visual change; whilst still retaining the card metaphor introduced in iOS 7, the application icon is smaller, and appears above the screenshot (which is now larger, due to the removal of "Recent and Favorite Contacts"), and each application "card" overlaps the other, forming a rolodex effect as the user scrolls. Now, instead of the home screen appearing at the leftmost of the application switcher, it appears rightmost.[50]

2.3.2   Ending tasks

In iOS 4.0 to iOS 6.x, briefly holding the icons in the application switcher makes them "jiggle" (similarly to the homescreen) and allows the user to *force* quit the applications by tapping the red minus circle that appears at the

corner of the app's icon.[51] Clearing applications from multitasking stayed the same from iOS 4.0 through 6.1.6, the last version of iOS 6.

As of iOS 7, the process has become faster and easier. In iOS 7, instead of holding the icons to close them, they are closed by simply swiping them upwards off the screen. Up to three apps can be cleared at a time compared to one in versions up to iOS 6.1.6.[52]

2.3.3   Task completion

Task completion allows apps to continue a certain task after the app has been suspended.[53][54] As of iOS 4.0, apps can request up to ten minutes to complete a task in the background.[55] This doesn't extend to background up- and downloads though (e.g. if you start a download in one application, it won't finish if you switch away from the application).

2.4   Siri

Main article: Siri (software)

Siri is a personal assistant and knowledge navigator which works as an application on supported devices. The service, directed by the user's spoken commands, can do a variety of different tasks, such as call or text someone, open an app, search the web, lookup sports information, find directions or locations, and answer general knowledge questions (e.g. "How many cups are in a gallon?").[56] Siri was updated in iOS 7 with a new interface, faster answers, Wikipedia, Twitter, and Bing support and the voice was changed to sound more human. Siri is currently only available on the iPhone 4S and later iPhones, the fifth and sixth generation iPod Touch, all of the models of the iPad Mini, and the third-generation and later iPads.

2.5   Game Center

Main article: Game Center

Game Center is an online multiplayer "social gaming network"[57] released by Apple.[58] It allows users to "invite friends to play a game, start a multiplayer game through matchmaking, track their achievements, and compare their high scores on a leaderboard." iOS 5 and above adds support for profile photos.[57]

Game Center was announced during an iOS 4 preview event hosted by Apple on April 8, 2010. A preview was released to registered Apple developers in August.[57] It was released on September 8, 2010 with iOS 4.1 on iPhone 4, iPhone 3GS, and iPod Touch 2nd generation through 4th generation.[59] Game Center made its public

debut on the iPad with iOS 4.2.1.[60] There is no support for the iPhone 3G, original iPhone and the first-generation iPod Touch (the latter two devices did not have Game Center because they did not get iOS 4). However, Game Center is unofficially available on the iPhone 3G via a hack.[61]

3 Development

Authorized third-party native applications are available through Apple's App Store for devices running iPhone OS 2.0 and higher. Native apps must be written in Swift or Objective-C (with some elements optionally in C or C++) and compiled specifically for iOS and the 64-bit ARM architecture or previous 32-bit one (typically using Xcode). Third-party attempts have been made to allow apps written with Java, .NET, and Adobe Flash to run on iOS devices, but due to Apple restrictions these are generally not available in the iOS App Store.

The Safari web browser supports web applications as with other web browsers. Hybrid apps embed a mobile web site inside a native app, possibly using a hybrid framework like Apache Cordova or React Native.

iOS shares some frameworks with Apple's desktop operating system macOS, such as Core Foundation and Foundation Kit; however, its UI toolkit is Cocoa Touch rather than macOS' Cocoa, providing the UIKit rather than the AppKit framework, preventing source compatibility with desktop applications. Also, Unix-like shell access is strictly apps-only, preventing it from being fully Unix despite its Darwin foundation from macOS itself.

3.1 SDK

Main article: iOS SDK
 On October 17, 2007, in an open letter posted to Ap-

iOS SDK 9.1 included in Xcode 7.1
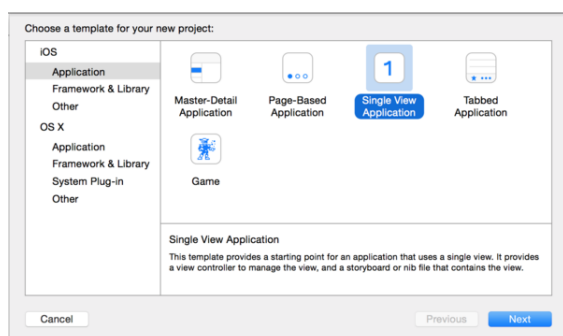
ple's "Hot News" weblog, Steve Jobs announced that a software development kit (SDK) would be made available to third-party developers in February 2008.[62] The SDK was released on March 6, 2008, and allows developers to make applications for the iPhone and iPod Touch,

as well as test them in an "iPhone simulator". However, loading an application onto the devices is only possible after paying an iPhone Developer Program fee.

The fees to join the respective developer programs for iOS and macOS were each set at US$99.00 per year. As of July 20, 2011, Apple released Xcode on its Mac App Store free to download for all Mac OS X Lion users, instead of as a standalone download. Users can create and develop iOS and macOS applications using a free copy of Xcode; however, they cannot test their applications on a physical iOS device, or publish them to the App store, without first paying the yearly $99.00 iPhone Developer or Mac Developer Program fee.[63]

Since the release of Xcode 3.1, Xcode is the development environment for the iOS SDK.

Developers are able to set any price above a set minimum for their applications to be distributed through the App Store, keeping 70% for the developer, and leaving 30% for Apple. Alternatively, they may opt to release the application for free and need not pay any costs to release or distribute the application except for the membership fee.[64]

4 Market share

Main article: Usage share of operating systems

iOS is the second most popular mobile operating system in the world, after Android. Sales of iPads in recent years are also behind Android, while, by web use (a proxy for all use), iPads (using iOS) are still most popular.[65]

By the middle of 2012, there were 410 million devices activated.[66] At WWDC 2014, Tim Cook said 800 million devices had been sold by June 2014.[67]

During Apple's quarterly earnings call in January 27, 2015, Apple announced that they have now sold one billion iOS devices since 2007[68] (a little less than Android sold in 2014 only[69]).

By late 2011, iOS accounted for 60% of the market share for smartphones and tablets.[70] By the end of 2014, iOS accounted for 14.8% of the smartphone market[71] and 27.6% of the tablet and two-in-one market.[72] In February 2015, StatCounter reported iOS was used on 23.18% of smartphones and 66.25% of tablets worldwide.[73]

In the third quarter of 2015, research from Strategy Analytics showed that iOS adoption of the worldwide smartphone market was at a record-low 12.1%, attributed to lackluster performance in China and Africa. Android accounted for 87.5% of the market, with Windows Phone and BlackBerry accounting for the rest.[74][75]

5   Jailbreaking

Main article: iOS jailbreaking

Since its initial release, iOS has been subject to a variety of different hacks centered around adding functionality not allowed by Apple.[76] Prior to the 2008 debut of Apple's native iOS App Store, the primary motive for jailbreaking was to bypass Apple's purchase mechanism for installing the App Store's native applications.[77] Apple claimed that it will not release iOS software updates designed specifically to break these tools (other than applications that perform SIM unlocking); however, with each subsequent iOS update, previously un-patched jailbreak exploits are usually patched.[78]

Since the arrival of Apple's native iOS App Store, and—along with it—third-party applications, the general motives for jailbreaking have changed.[79] People jailbreak for many different reasons, including gaining filesystem access, installing custom device themes, and modifying SpringBoard. An additional motivation is that it may enable the installation of pirated apps. On some devices, jailbreaking also makes it possible to install alternative operating systems, such as Android and the Linux kernel. Primarily, users jailbreak their devices because of the limitations of iOS. Depending on the method used, the effects of jailbreaking may be permanent or temporary.[80]

In 2010, the Electronic Frontier Foundation (EFF) successfully convinced the U.S. Copyright Office to allow an exemption to the general prohibition on circumvention of copyright protection systems under the Digital Millennium Copyright Act (DMCA). The exemption allows jailbreaking of iPhones for the sole purpose of allowing legally obtained applications to be added to the iPhone.[81] The exemption does not affect the contractual relations between Apple and an iPhone owner, for example, jailbreaking voiding the iPhone warranty; however, it is solely based on Apple's discretion on whether they will fix jailbroken devices in the event that they need to be repaired. At the same time, the Copyright Office exempted unlocking an iPhone from DMCA's anticircumvention prohibitions.[82] Unlocking an iPhone allows the iPhone to be used with any wireless carrier using the same GSM or CDMA technology for which the particular phone model was designed to operate.[83]

6   Unlocking

Main article: SIM lock

Initially most wireless carriers in the US did not allow iPhone owners to unlock it for use with other carriers. However AT&T allowed iPhone owners who have satisfied contract requirements to unlock their iPhone.[84]

Instructions to unlock the device are available from Apple,[85] but it is ultimately the sole discretion of the carrier to authorize the device to be unlocked.[86] This allows the use of a carrier-sourced iPhone on other networks. However, because T-Mobile primarily uses a different band than AT&T for its 3G, the iPhone will only work at 3G speeds on the T-Mobile 1900MHz network.[87] There are programs to break these restrictions, but are not supported by Apple and most often not a permanent unlock - a soft-unlock.[88]

7   Digital rights management

The closed and proprietary nature of iOS has garnered criticism, particularly by digital rights advocates such as the Electronic Frontier Foundation, computer engineer and activist Brewster Kahle, Internet-law specialist Jonathan Zittrain, and the Free Software Foundation who protested the iPad's introductory event and have targeted the iPad with their "Defective by Design" campaign.[89][90][91][92] Competitor Microsoft, via a PR spokesman, criticized Apple's control over its platform.[93]

At issue are restrictions imposed by the design of iOS, namely digital rights management (DRM) intended to lock purchased media to Apple's platform, the development model (requiring a yearly subscription to distribute apps developed for the iOS), the centralized approval process for apps, as well as Apple's general control and lockdown of the platform itself. Particularly at issue is the ability for Apple to remotely disable or delete apps at will.

Some in the tech community have expressed concern that the locked-down iOS represents a growing trend in Apple's approach to computing, particularly Apple's shift away from machines that hobbyists can "tinker with" and note the potential for such restrictions to stifle software innovation.[94][95] Former Facebook developer Joe Hewitt protested against Apple's control over its hardware as a "horrible precedent" but praised iOS's sandboxing of apps.[96]

8   Kernel

The iOS kernel is the XNU kernel of Darwin. The original iPhone OS (1.0) up to iPhone OS 3.1.3 used Darwin 9.0.0d1. iOS 4 was based on Darwin 10. iOS 5 was based on Darwin 11. iOS 6 was based on Darwin 13. iOS 7 and iOS 8 are based on Darwin 14. iOS 9 is based on Darwin 15. iOS 10 is based on Darwin 16.[97]

9   Devices

Main article: List of iOS devices
Sources: Apple press release library,[98] Mactracker
Apple Inc. model database[99]

10   See also

- Comparison of mobile operating systems

- iOS version history

- List of iOS devices

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13 External links

- Official website

- Official website Dev Center at Apple Developer Connection

- iOS Reference Library – on the Apple Developer Connection website

- iOS 9 for iPhone and iPad

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