MOBILE APPLICATION DEVELOPMENT
PART I

PART 1 contents at a glance:

1. Introduction to Android
2. Features of Android,
3. Android Versions,
4. Android Architecture,
5. Installing Android SDK Tools,
6. Android Development Tools (ADT),
7. Creating Android Virtual Devices (AVD)

Introduction to Android:
Android is an operating system and programming platform developed by Google for mobile phones and other mobile devices, such as tablets. It can run on many different devices from many different manufacturers. Android includes a software development kit (SDK) that helps you write original code and assemble software modules to create apps for Android users. Android also provides a marketplace to distribute apps.

Android Features:
Android is a Linux based operating system it is designed primarily for touch screen mobile devices such as smart phones and tablet computers. The operating system have developed a lot in last 15 years starting from black and white phones to recent smart phones or mini computers.

Features:

- It is open-source.
- Anyone can customize the Android Platform.
- There are a lot of mobile applications that can be chosen by the consumer.
- Head set layout
- Storage
- Connectivity: GSM/EDGE, IDEN, CDMA, Bluetooth, WI-FI, EDGE,3G,NFC, LTE,GPS.
- Messaging: SMS, MMS, C2DM (could to device messaging), GCM (Google could messaging)
- Multilanguage support
- Multi touch
- Video calling
- Screen capture
- External storage
- Streaming media support(H.263, H.264, MPEG-4 SP, AMR, AMR-WB, AAC, HE-AAC, AAC 5.1, MP3, MIDI, OggVorbis, WAV, JPEG, PNG, GIF, and BMP)
- Optimized graphics
- Resizable
- Multi tasking

Android Versions:

Name	Internal codename	Version number(s)	API level	Initial stable release date
Android 1.0	—	1.0	1	September 23, 2008
Android 1.1	Petit Four	1.1	2	February 9, 2009
Android Cupcake	Cupcake	1.5	3	April 27, 2009
Android Donut	Donut	1.6	4	September 15, 2009
Android Eclair	Eclair	2.0	5	October 27, 2009
		2.0.1	6	December 3, 2009
		2.1	7	January 11, 2010[16]
Android Froyo	Froyo	2.2 – 2.2.3	8	May 20, 2010
Android Gingerbread	Gingerbread	2.3 – 2.3.2	9	December 6, 2010
		2.3.3 – 2.3.7	10	February 9, 2011
Android Honeycomb	Honeycomb	3.0	11	February 22, 2011
		3.1	12	May 10, 2011
		3.2 – 3.2.6	13	July 15, 2011
Android Ice Cream Sandwich	Ice Cream Sandwich	4.0 – 4.0.2	14	October 18, 2011
		4.0.3 – 4.0.4	15	December 16, 2011
Android Jelly Bean	Jelly Bean	4.1 – 4.1.2	16	July 9, 2012
		4.2 – 4.2.2	17	November 13, 2012
		4.3 – 4.3.1	18	July 24, 2013
Android KitKat	Key Lime Pie	4.4 – 4.4.4	19	October 31, 2013
		4.4W – 4.4W.2	20	June 25, 2014
Android Lollipop	Lemon Meringue Pie	5.0 – 5.0.2	21	November 4, 2014
		5.1 – 5.1.1	22	March 2, 2015
Android Marshmallow	Macadamia Nut Cookie	6.0 – 6.0.1	23	October 2, 2015
Android Nougat	New York Cheesecake	7.0	24	August 22, 2016
		7.1 – 7.1.2	25	October 4, 2016
Android Oreo	Oatmeal Cookie	8.0	26	August 21, 2017
		8.1	27	December 5, 2017
Android Pie	Pistachio Ice Cream	9	28	August 6, 2018
Android 10	Quince Tart	10	29	September 3, 2019

Android 11	Red Velvet Cake	11	30	September 8, 2020
Android 12	Snow Cone	12	31	October 4, 2021
Android 12L	Snow Cone v2	12.1	32	March 7, 2022
Android 13	Tiramisu	**13**	33	August 15, 2022
Android 14	Upside Down Cake	14	34	Q3 2023

Version	Features
1.0	• Android Market, allowing application downloads and updates through the Market application. • Web browser to show, zoom and pan full HTML and XHTML web pages – multiple pages show as windows ("cards"). • Camera support – however, this version lacked the option to change the camera's resolution, white balance, quality, etc. • Folders allowing the grouping of a number of application icons into a single folder icon on the Home screen. • Access to web email servers, supporting POP3, IMAP4, and SMTP. • Gmail synchronization with the Gmail application. • Google Contacts synchronization with the People application. • Google Calendar synchronization with the Calendar application. • Google Maps with Street View to view maps and satellite imagery, as well as find local businesses and obtain driving directions using GPS. • Google Sync, allowing management of over-the-air synchronization of Gmail, People, and Calendar. • Google Search, allowing users to search the Internet and phone applications, contacts, calendar, etc. • Google Talk instant messaging. • Instant messaging, text messaging, and MMS. • Media Player, enabling management, importing, and playback of media files – however, this version lacked video and stereo Bluetooth support. • Notifications appear in the Status bar, with options to set ringtone, LED or vibration alerts. • Voice Dialer allows dialing and placing of phone calls without typing a name or number. • Wallpaper allows the user to set the background image or photo behind the Home screen icons and widgets. • YouTube video player. • Other applications include: Alarm Clock, Calculator, Dialer (Phone), Home screen (Launcher), Pictures (Gallery), and Settings. • Wi-Fi and Bluetooth support.

2.0	• Expanded Account sync, allowing users to add multiple accounts to a device for synchronization of an email and contacts. • Microsoft Exchange email support, with a combined inbox to browse an email from multiple accounts in one page. • Bluetooth 2.1 support. • Ability to tap a Contacts photo and select to call, SMS, or email the person. • Ability to search all saved SMS and MMS messages, with the added ability to delete the oldest messages in a conversation automatically deleted when a defined limit is reached. • Numerous new camera features, including flash support, digital zoom, scene mode, white balance, color effect and macro focus. • Improved typing speed on a virtual keyboard, with a smarter dictionary that learns from word usage and includes contact names as suggestions. • Refreshed browser UI with bookmark thumbnails, double-tap zoom and support for HTML5. • Calendar agenda view enhanced, showing attending status for each invitee, and the ability to invite new guests to events. • Optimized hardware speed and revamped UI. • Support for more screen sizes and resolutions, with better contrast ratio. • Improved Google Maps 3.1.2. • MotionEvent class enhanced to track multi-touch events. • Pressure-sensitive touch support in API, even though no according hardware existed at that time. • Addition of live wallpapers, allowing the animation of home-screen background images to show movement.
3.0	• Optimized tablet support with a new “holographic” user interface (removed again the following year with version 4.2). • New Easter egg, an image of a Tron-themed bumblebee. • Added System Bar, featuring quick access to notifications, status, and soft navigation buttons, available at the bottom of the screen. • Added the Action Bar, giving access to contextual options, navigation, widgets, or other types of content at the top of the screen. • Simplified multitasking – tapping Recent Applications in the System Bar allows users to see snapshots of the tasks underway and quickly jump from one application to another. • Redesigned the keyboard, making typing fast, efficient and accurate on larger screen sizes • Simplified, more intuitive copy/paste interface. • Multiple browser tabs replacing browser windows, plus form auto-fill and a new “incognito” mode allowing somewhat anonymous browsing. • Quick access to camera exposure, focus, flash, zoom, front-facing camera, time-lapse, and other camera features. • Ability to view albums and other collections in full-screen mode in Gallery, with easy access to thumbnails for other photos. • New two-pane Contacts UI and Fast Scroll to let users easily organize and locate contacts.

	• New two-pane Email UI to make viewing and organizing messages more efficient, allowing users to select one or more messages. • Hardware acceleration. • Support for multi-core processors. • Ability to encrypt all user data. • HTTPS stack improved with Server Name Indication (SNI). • Filesystem in Userspace (FUSE; kernel module). • Disallows applications from having to write access to secondary storage (memory cards on devices with internal primary storage) outside of designated, application-specific directories. Full access to primary internal storage is still allowed through a separate application-level permission. •
4.0	• Major refinements to the "Holo" interface with the new Roboto font family. • Soft buttons from Android 3.x are now available for use on phones. • Separation of widgets in a new tab, listed in a similar manner to applications. • Easier-to-create folders, with a drag-and-drop style. • Improved visual voicemail with the ability to speed up or slow down voicemail messages. • Pinch-to-zoom functionality in the Calendar. • Integrated screenshot capture (accomplished by holding down the Power and Volume-Down buttons). • Improved error correction on the keyboard. • Ability to access applications directly from the lock screen. • Improved copy-and-paste functionality. • Better voice integration and continuous, real-time speech-to-text dictation. • Face Unlock, a feature that allows users to unlock handsets using facial recognition software. • Automatic syncing of browser with users' Chrome bookmarks. • Data Usage section in settings that lets users set warnings when they approach a certain usage limit, and disable data use when the limit is exceeded. • Ability to shut down applications from the recent apps list with a swipe. • Improved camera application with zero shutter lag, time lapse settings, panorama mode, and the ability to zoom while recording. • Built-in photo editor. • New gallery layout, organized by location and person. • Refreshed the "People" application with social network integration, status updates and hi-res images. • Android Beam, a near-field communication feature allowing the rapid short-range exchange of web bookmarks, contact info, directions, YouTube videos and other data. • Support for the WebP image format. • Hardware acceleration of the UI. • Wi-Fi Direct. • 1080p video recording for stock Android devices.

	• Android VPN Framework (AVF), and TUN (but not TAP) kernel module. Prior to 4.0, VPN software required a rooted Android device.
5.0	• Android Runtime (ART) with ahead-of-time (AOT) compilation and improved garbage collection (GC), replacing Dalvik that combines bytecode interpretation with trace-based just-in-time (JIT) compilation. • Support for 64-bit CPUs. • OpenGL ES 3.1 and Android Extension Pack (AEP) on supported GPU configurations. • Recent activities screen with tasks instead of applications, up to a configured maximum of tasks per application. • Vector drawables, which scale without losing definition. • Support for print previews. • Material design, bringing a restyled user interface and “ripple effect” for buttons. • Refreshed lock screen, no longer supporting widgets. • Refreshed notification tray and quick settings pull-down. • Project Volta, for battery life improvements • Searches can be performed within the system settings for quicker access to particular settings. • Lock screen provides shortcuts to application and notification settings. • Guest logins and multiple user accounts are available on more devices, such as phones. • Audio input and output through USB devices. • Third-party applications regain the ability to read and modify data located anywhere on external storage, such as on SD cards. However, those must be adapted to the storage access framework of Android API level 21 or higher. • Pinning of an application's screen for restricted user activity. • Recently used applications are remembered even after restarting the device. • WebViews receive updates independently through Google Play for security reasons, instead of relying on system-wide vendor updates. • Addition of 15 new languages: Basque, Bengali, Burmese, Chinese (Hong Kong), Galician, Icelandic, Kannada, Kyrgyz, Macedonian, Malayalam, Marathi, Nepali, Sinhala, Tamil and Telugu. • Tap and Go allows users to migrate to a new Android device, using NFC and Bluetooth to transfer Google Account details, configuration settings, user data and installed applications. • A quickly flashlight-style application is included, working on supported devices with a camera flash. • User-customizable priorities for application notifications. • Smart lock feature. • SELinux in enforcing mode for all domains. • Updated emoji. • Improved accessibility support (e.g. switch access support). • Block-based over-the-air (OTA) updates for new devices. • Task listing access disabled for third-party applications.

6.0	• Precluded rudimentary file manager (package name: com.android.documentsui), accessible from storage settings. • Memory card mounted to /storage/????-????/ rather than /storage/extSdCard/, with a hexadecimal volume serial number in place of the wildcard the question marks. • Contextual search from keywords within apps. • Introduction of Doze mode, which reduces CPU speed while the screen is off in order to save battery life. • App Standby feature. • Alphabetically accessible vertical application drawer. • Application search bar and favorites. • Native fingerprint reader support. • Direct Share feature for target-specific sharing between apps. • Renamed "Priority" mode to "Do Not Disturb" mode. • App Linking for faster instinctive opening of links with corresponding applications. • Larger Application folders with multiple pages. • Post-install/run-time permission requests. • USB-C support. • Demo Mode feature for screenshot-capture usage. • Automatic full data backup and restore for apps. • 4K display mode for apps. • Adoptable External storage to behave like Internal Storage. • MIDI support for musical instruments. • Experimental multi-window feature. • Support for actions by third-party apps in the text selection menu. • App permissions now granted individually at run-time, not all-or-nothing at install time. Similar to App Ops. • Miracast support dropped. • Many new essential commands supported by Android's Linux shell (/bin/sh). • No screen rotation during touch.
7.0	• Support for file-based encryption. • Unicode 9.0 emoji and skin tone modifier support (and exposes a subset of ICU4J APIs). • Ability to display color calibration. • Ability to zoom in the screen. • Ability to switch to the last opened app by double-tapping the overview button. • Added an Emergency information part. • Added the "Clear All" button to the Overview screen. • Another system partition, which gets updated when not in use, allowing for seamless system updates. • Daydream virtual reality platform (VR interface). • Improved Doze functionality, which aims to prolong battery life. • Improvements to the file browser. • Ability to move files added to Storage Access Framework

	• More Quick Settings options. • Multi-window support, which supports floating apps on a desktop layout. • New Data Saver mode, which can force apps to reduce bandwidth usage. • New JIT Compiler, making for 75 percent faster app installations and a 50 percent reduction in compiled code size. • Just in Time (JIT) compiler with code profiling to ART, which lets it constantly improve the performance of Android apps as they run. • Picture-in-picture support for Android TV. • Redesigned notification shade, featuring instant access to certain settings. • Redesigned Overview screen. • Replaced notification cards with notification sheets. • Settings app navigation drawer. • Vulkan 3D rendering API. • Multiple Device Locales • Discontinuation of Android Camera V1 API • Restricted file system access

8.0	• Project Treble, the biggest change to the foundations of Android to date: a modular architecture that makes it easier and faster for hardware makers to deliver Android updates.
	• Picture-in-picture support.
	• Support for Unicode 10.0 emoji (5.0) and replacement of all blob-shaped emojis by round ones with gradients and outlines.
	• Redesigned Quick Settings and Settings with a white background and respectively black and Accent font colors.
	• Restructured Settings by regrouping sections into similar entries.
	• Adaptive icons
	• Notification improvements.
	  ◦ Notification channels.
	  ◦ Notification dots (badges).
	  ◦ Notification snoozing.
	  ◦ Notification shade multi-colors (for music album art, messengers, etc.).
	• System-wide Autofill framework.
	• Support for AAC, Sony's LDAC and Qualcomm's aptX and aptX HD codecs.
	• App-specific unknown sources.
	• Multi-display support.
	• 2 times faster boot time compared to Nougat according to Google, testing on their Pixel devices.
	• Apps background execution and location limits.
	• Google Play Protect.
	• Downloadable fonts.
	• Integrated printing support.
	• Color management (deep color and wide color gamut).
	• Wi-Fi Assistant.

9	• New user interface for the quick settings menu.

	• The clock has moved to the left of the notification bar. • The "dock" now has a semi-transparent background. • Battery Saver no longer shows an orange overlay on the notification and status bars. • A "screenshot" button has been added to the power options. • A new "Lockdown" mode which disables biometric authentication once activated. • Rounded corners across the UI. • New transitions for switching between apps, or activities within apps. • Richer messaging notifications, where a full conversation can be seen within a notification, full-scale images, and smart replies akin to Google's new app, Reply. • Support for display cutouts. • Redesigned volume slider. • Battery percentage now shown in Always-On Display. • Lock screen security changes include the possible return of an improved NFC Unlock. • Experimental features (which are currently hidden within a menu called Feature Flags) such as a redesigned About Phone page in settings, and automatic Bluetooth enabling while driving. • DNS over TLS. • A new optional gesture-based system interface, allowing users to navigate the OS using swipes more often than the traditional UI. • Redesigned multitask app switcher with the Google search bar and app drawer built-in. • Android Dashboard, which tells the user how much time they are spending on their device and in apps, and allows the user to set time limits on apps. • "Shush", an enhanced version of Do Not Disturb mode activated by placing the phone face down, which mutes standard notifications. • "Adaptive Battery" prediction, which makes use of Doze to hibernate user apps the OS determines the user will not use. • Auto-Brightness feature modifies screen brightness based on user habits. • Wind Down option lets Android users set a specific bedtime that enables Do Not Disturb and turns the entire phone's interface gray to discourage further use at night. • Vulkan 1.1 support. • Call recording options fully disabled
10	• Revamped full-screen gesture navigation with new app open/close animations. • Scoped storage restrictions • New permissions required to access location in background and to access photo, video and audio files. • Background apps can no longer jump into the foreground. • Limited access to non-resettable device identifiers. • Background (idle) access to camera, microphone and sensors disabled for more privacy protection with the side effect of disabling antitheft software.

	• Sharing shortcuts, which allow sharing content with a contact directly. • Floating settings panel, that allows changing system settings directly from apps. • Dynamic depth format for photos, which allow changing background blur after taking a photo. • Support for the AV1 video codec, the HDR10+ video format and the Opus audio codec. • Support for aptX Adaptive, LHDC, LLAC, CELT and AAC LATM codecs • A native MIDI API, allowing interaction with music controllers. • Better support for biometric authentication in apps. • Support for the WPA3 Wi-Fi security protocol. • Support for foldable phones. • Support for Notification Bubbles • New system-wide dark theme/mode • TLS v1.3 support added. • Project Mainline, allows core OS components to be updated via the Google Play Store, without requiring a complete system update
11	• Chat bubbles. • Screen recorder. • Notification history. • New permissions controls. • API distinction between standalone 5G NR and non-standalone 5G. • One-time permission • Permissions auto-reset. • Wireless Android Auto on devices with 5GHz Wi-Fi. • Increased number of updatable core OS components in Google Play from 12 to 21. • Enterprise work profile privacy protections now apply on company-owned devices. • Independent left and right edge sensitivity for gesture navigation.
12	• Easier Wi-Fi sharing. • AVIF image support. • Material You, an updated design language based on Material Design. • Scrolling Screenshot.] • One Handed Mode. • Android Runtime (ART) module added to the updatable core OS components via Google Play, added functionality to existing modules. • Area Magnification can zoom in any content on device. • Extra Dim reduces brightness below minimum level. • Bold Text. • Greyscale. • Mic and Camera indicator and toggle. • Option to choose precise or approximate location. • Privacy Dashboard. • Gestures can work in immersive mode.

	• Performance improvements to system services to improve transitions, power efficiency, and reduce app start-up times. • Third party app stores now have the ability to update apps without constantly asking the user for permission.
13	• Apps are now required to request permission from the user before they are able to send notifications. • The number of active apps is now shown at the bottom of the notifications panel, a tap on it opens a detailed panel which lets the user stop each of them • Support for Bluetooth LE Audio and the LC3 audio codec. • ART update with a new garbage collector (GC) utilizing the Linux userfaultfd system call. It reduces memory pressure, compiled code size, and prevents the risk of killing apps because of low memory during GC Other changes also improve app startup, reduce jank and improve performance Because of the Mainline project, Android 12 ART will also be updated

AndroidApplications

Android applications are usually developed in the Java language using the Android Software Development Kit. Once developed, Android applications can be packaged easily and sold out either through a store such as **Google Play**,**SlideME**,**Opera Mobile Store**,**Mobango**,**F-droid** and the **Amazon Appstore**.

Android powers hundreds of millions of mobile devices in more than 190 countries around the world. It's the largest installed base of any mobile platform and growing fast. Every day more than 1 million new Android devices are activated worldwide.

Categories of Android applications

There are many android applications in the market. The top categories are:

- Entertainment
- Tools
- Communication
- Productivity
- Personalization
- Music and Audio

- Social
- Media and Video
- Travel and Local etc.
- Games applications
- Educational applications
- Business applications

Advantages of Android OS:

- Open Ecosystem
- Customizable UI
- Open Source
- Innovations Reach the Market Quicker
- Affordable Development
- APP Distribution
- Affordable
- Expandable memory
- Run many apps at the same time:-
- Cloud Storage etc

Disadvantages of Android OS:

- Low specification mobiles run slow
- Developing apps for different H/W devices is hard
- Running apps in background may consume more battery etc

SOFTWARE IDES TO DEVELOP ANDROID APPS:

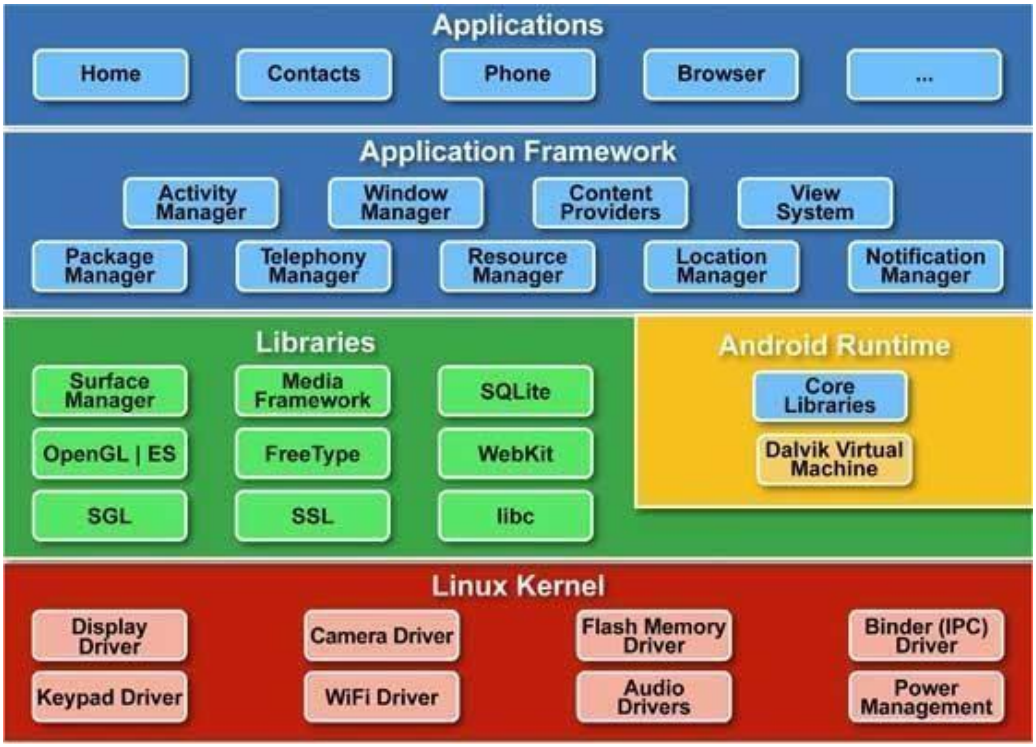
There are so many sophisticated Technologies are available to develop android applications, the familiar technologies, which are predominantly using tools as follows

- Android Studio
- Eclipse IDE
- Adobe Flash etc

ANDROID ARCHITECTURE:

Android Architecture

Android operating system is a stack of software components which is roughly divided into five sections and four main layers as shown below in the architecture diagram.



Linuxkernel

At the bottom of the layers is Linux - Linux 3.6 with approximately 115 patches. This provides a level of abstraction between the device hardware and it contains all the essential hardware drivers like camera, keypad, display etc. Also, the kernel handles all the things that Linux is really good at such as networking and a vast array of device drivers, which take the pain out of interfacing to peripheral hardware.

Libraries

On top of Linux kernel there is a set of libraries including open-source Web browser engine WebKit, well known library libc, SQLite database which is a useful repository for storage and sharing of application data, libraries to play and record audio and video, SSL libraries responsible for Internet security etc.

AndroidLibraries

This category encompasses those Java-based libraries that are specific to Android development. Examples of libraries in this category include the application framework libraries in addition to those that facilitate user interface building, graphics drawing and database access. A summary of some key core Android libraries available to the Android developer is as follows –

- **android.app** − Provides access to the application model and is the cornerstone of all Android applications.
- **android.content** − Facilitates content access, publishing and messaging between applications and application components.
- **android.database** − Used to access data published by content providers and includes SQLite database management classes.
- **android.opengl** − A Java interface to the OpenGL ES 3D graphics rendering API.
- **android.os** − Provides applications with access to standard operating system services including messages, system services and inter-process communication.
- **android.text** − Used to render and manipulate text on a device display.
- **android.view** − The fundamental building blocks of application user interfaces.
- **android.widget** − A rich collection of pre-built user interface components such as buttons, labels, list views, layout managers, radio buttons etc.
- **android.webkit** − A set of classes intended to allow web-browsing capabilities to be built into applications.

Having covered the Java-based core libraries in the Android runtime, it is now time to turn our attention to the C/C++ based libraries contained in this layer of the Android software stack.

AndroidRuntime

This is the third section of the architecture and available on the second layer from the bottom. This section provides a key component called **Dalvik Virtual Machine** which is a kind of Java Virtual Machine specially designed and optimized for Android.

The Dalvik VM makes use of Linux core features like memory management and multi-threading, which is intrinsic in the Java language. The Dalvik VM enables every Android application to run in its own process, with its own instance of the Dalvik virtual machine.The Android runtime also provides a set of core libraries which enable Android application developers to write Android applications using standard Java programming language.

ApplicationFramework

The Application Framework layer provides many higher-level services to applications in the form of Java classes. Application developers are allowed to make use of these services in their applications.

The Android framework includes the following key services −

- **Activity Manager** − Controls all aspects of the application lifecycle and activity stack.

- **Content Providers** − Allows applications to publish and share data with other applications.
- **Resource Manager** − Provides access to non-code embedded resources such as strings, color settings and user interface layouts.
- **Notifications Manager** − Allows applications to display alerts and notifications to the user.
- **View System** − An extensible set of views used to create application user interfaces.

Applications

You will find all the Android application at the top layer. You will write your application to be installed on this layer only. Examples of such applications are Contacts Books, Browser, and Games etc.

Installing Android Studio IDE:

1) Make sure that java is installed and java environment variable paths are created

2) download android studio from : https://developer.android.com/studio

3) After downloading android studio, click on EXE file and run the set up file

4) Go through the set up wizard and complete all steps .

Installing Android SDK Tools

1. The Android SDK contains a debugger, libraries, an emulator, documentation, sample code, and tutorials. Download the Android SDK from http://developer.android.com/sdk/ index.html.
2. Once the SDK is downloaded, unzip its content into the C:\Android\ folder.
3. SDK directory should be set folder where SDK is downloaded

or

1. Launch android studio
2. Go to SDK manager
3. Check whether SDK packages of required versions are downloaded
4. If not downloaded, download.

Android Development Tools (ADT)

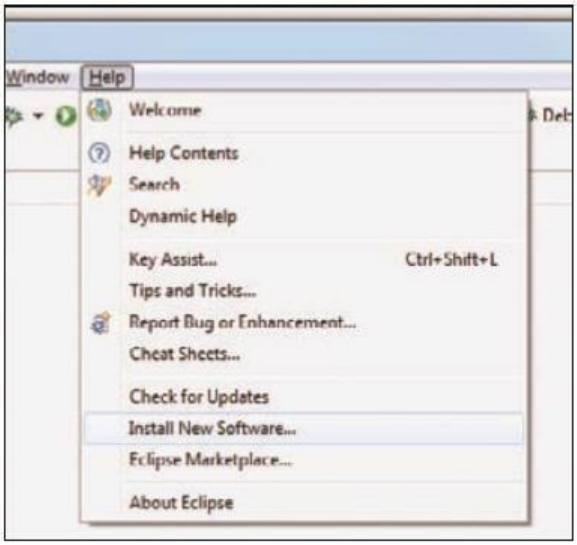
1. The Android Development Tools (ADT) plug-in for Eclipse is an extension to the Eclipse IDE that supports the creation and debugging of Android applications.

Using the ADT, you will be able to do the following in Eclipse:

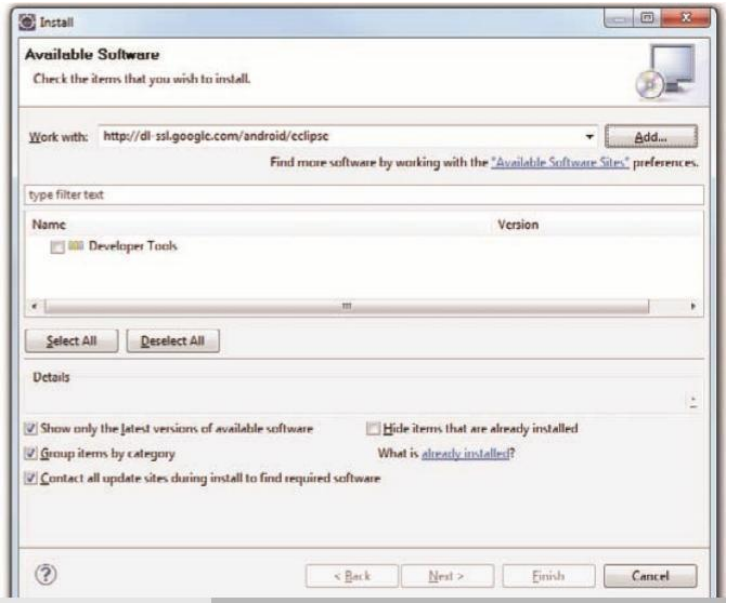
- Create new Android application projects.
- Access the tools for accessing your Android emulators and devices.
- Compile and debug Android applications.
- Export Android applications into Android Packages (APK).
- Create digital certificates for code-signing your APK

To install the ADT

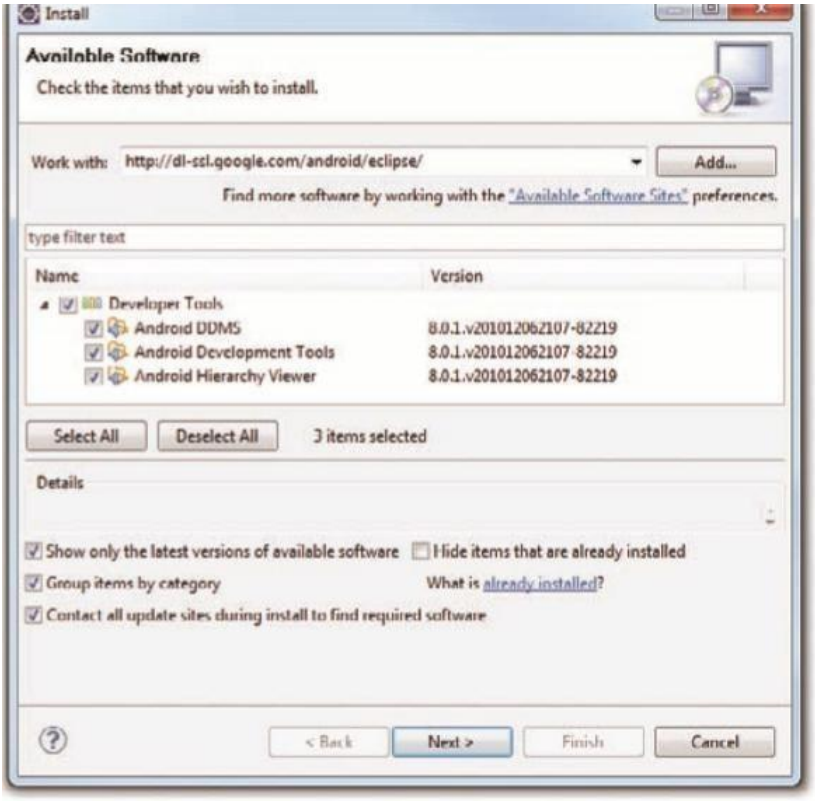
1. Once Eclipse is up and running, select the **Help** ➪**Install New Software**… menu item.



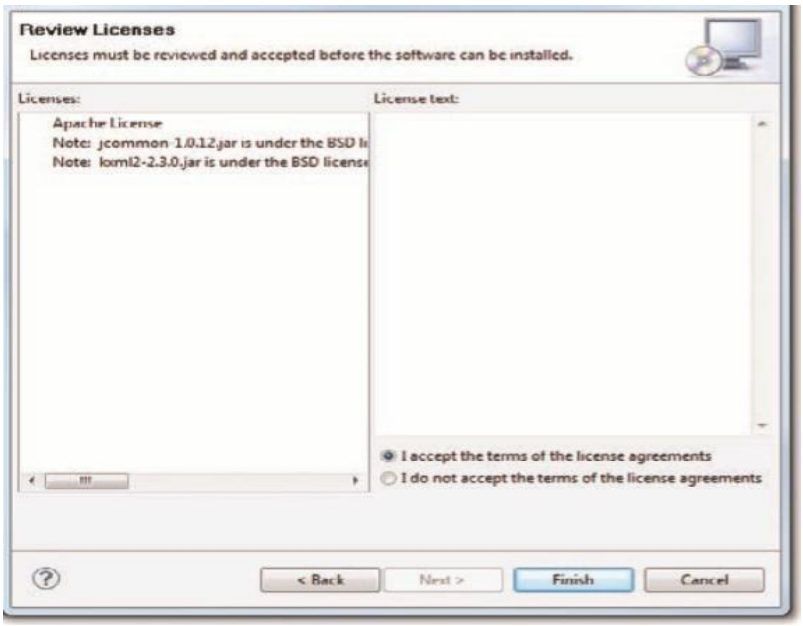
2. In the Install window that appears, type **http://dl-ssl.google.com/android/eclipse** in the text box and click Add.



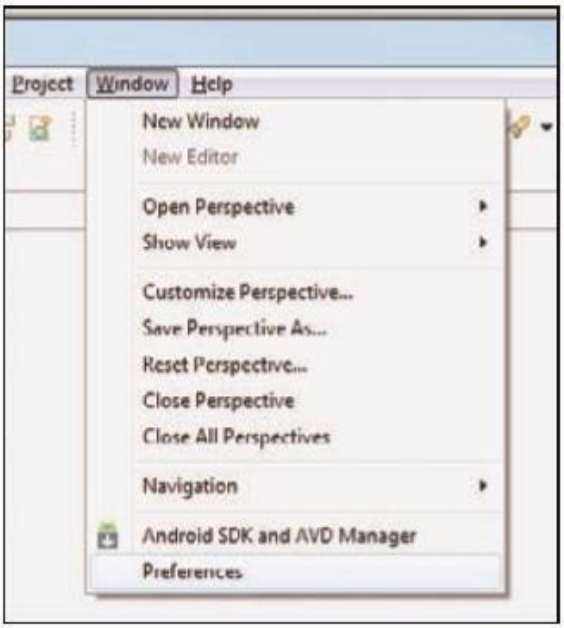
3. After a while, you will see the Developer Tools item appear in the middle of the window. Expand it, and it will reveal its content: Android DDMS, Android Development Tools, and Android Hierarchy Viewer. Check all ofthem and click Next.



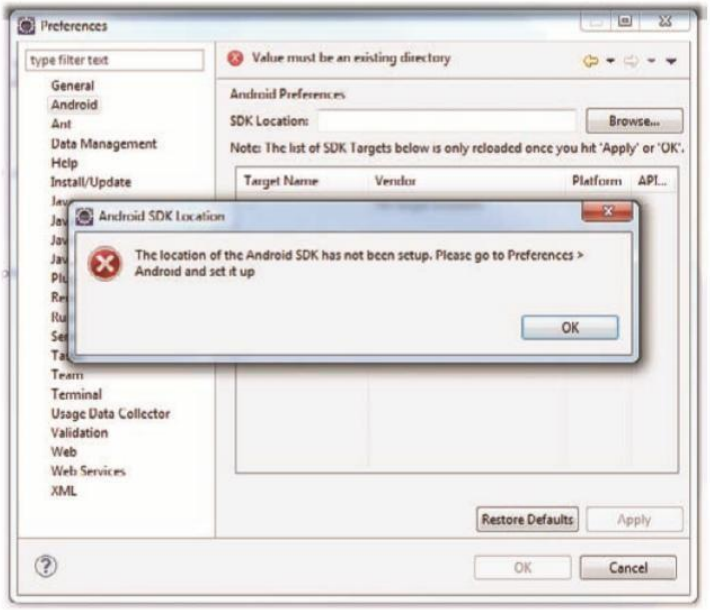
4. You will be asked to review the licenses for the tools. Check the option to accept the license agreements. Click Finish to continue.



5. Once the ADT is installed, you will be prompted to restart Eclipse. After doing so, go to **Window** ⇨ **Preferences**



6. In the Preferences window that appears, select Android. You will see an error message saying that the SDK has not been set up. Click OK to dismiss it.



7. Enter the location of the Android SDK folder. It would be C:\Android\android-sdk-windows. Click OK.

CREATING ANDROID VIRTUAL DEVICES (AVDS)

AVD is used for testing your Android applications

1. Select the **Window menu > AVD Manager**

2. Click on the **new** button, to create the AVD

3. Now a dialog appears, write the AVD name e.g. myavd. Now choose the target android version e.g. android2.2.

4. click the **create AVD**

Steps in Creating a new android application:

Create a New Android Project

1. Launch Android Studio.
2. Choose "Start a new Android Studio Project".
3. In "Select a Project Template" ⇒ select "Phone and Tablet" tab ⇒ "Empty Activity" ⇒ Next.
4. In "Configure your project" ⇒ Set "Name" to "Hello Android" (this will be the "Title" in your phone's app menu) ⇒ The "Package name" and "Save Location" will be updated automatically ⇒ In "Language", select "Java" ⇒ Leave the "Minimum API Level" and the rest to default ⇒ Finish.

MOBILE APPLICATION DEVELOPMENT
PART II

PART II contents at a glance:

1. Features of iOS
2. iOS versions
3. iOS architecture
4. Differences between iOS and Android
5. Role of swift programming language in iOS App development
6. Xcode IDE features for iOSApp development

iOS Introduction:

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 powers many of the company's mobile devices, including the iPhone and iPod Touch; the term also included the versions running on iPads until the name iPadOS was introduced with version 13 in 2019. It is the world's second- most widely installed mobile operating system, after Android. It is the basis for three otheroperating systems made by Apple: iPadOS, tvOS, and watchOS.

1. Features of iOS

The iOS provides the following features.

Multitasking

In June 2010, iOS started supporting multitasking in certain devices like iPhone 4, iPhone 3GS, and iPod Touch 3rd Generation with iOS 4. However, in iOS 4, multitasking was supported through the following seven Background APIs.

1. Background audio: application keeps running in the background until it finishes the active audio or video.
2. Voice over IP: The application is suspended when the phone call is not in progress.
3. Background location: notification services when the location of the device changes.
4. Push Notifications: app receives the push notifications from the server, whether it is in background or foreground mode.
5. Local Notifications: Local notifications can be scheduled in the app at a definite time.
6. Task Completion: App can ask the system for extra time to complete a given task.
7. Fast App Switching

o **Interface**

Apple iOS provides a user-friendly interface that uses multi-touch gestures like swipe, tap, pinch, etc., to facilitate the users interacting with the applications. The users can trigger any event using switches, buttons and sliders. It uses internal accelerometers to respond to shaking the device or rotating in 3D. The interface home screen is the primary navigation and information hub that contains app icons and widgets to launch the particular applications directly from the home screen.

The main page button is located at the top right of the application's screen. The back button is present in the top left of the app's screen. However, to go back, we can use the following ways.

1. Back button at the top left of the display
2. Using swipe-right gesture from the left edge of the app's screen.

3. Press finish action at the top right of the screen.
4. Scroll down on the screen.

- **In-App purchase**

The iOS users can purchase various content like subscriptions, services and new features within the application. Users can make in-app purchases on iOS, iPadOS, macOS, watchOS, and tvOS.

- **Apple Pay**

Apple pay can be integrated into iOS applications to provide an easy and secure way to make payments. The authorization for the apple pay can be done using FaceID and TouchID.

- **Home Screen**

The home screen in the iOS device contains the widget and app icons to launch the applications. It displays the dock at the bottom where we can pin the most frequently used applications. Whenever we press the home button or unlock the device, the home screen appears. The home screen contains the status bar on the top to display the data.

- **Notification Center**

The notifications could not be viewed after being dismissed before the release of iOS 5. Apple introduced the Notification Center, where we can see the history of notifications. However, the user can click on a particular notification to open its associated application or clear it from the notification center.

- **Game Center**

With iOS 4.1, Apple announces a social gaming network where the users can play games with friends. It provides features like a Game center dashboard, leaderboard, achievements, multiplayer and many more.

- **Bluetooth**

Apple provides the Core Bluetooth framework that provides the classes needed to connect with the Bluetooth-equipped low energy wireless technology.

- **Orientations**

The iOS applications can be used in portrait and landscape orientations.
However, Apple provides size classes in XCode to develop the interface for landscape and portrait orientations.

- **Camera integration**

Apple provides AVFoundation Capture Subsystem, a common high-level architecture for audio, images, and video capturing services in iOS.

- **Location services**

With the user's permission, the Location Services allow the applications and website to access the user's device location. The black or white arrow icon is shown in the status bar whenever the location services are active.

- **Maps**

Apple provides a web mapping service to be used as the default map system for iOS. It includes various features like flyover mode. To develop applications that use maps, we can use MapKit provided by Apple.

- **Accessibility**

The apple provides various Accessibility features to be used for people with vision and hearing disabilities. The features like voiceover provide a voice reading information that appears on the screen. It allows the user to communicate with the OS with gestures. Apple keeps updating accessibility to provide new features like pronunciation editor, which can be used with the voice over, with iOS 10 in 2016.

IOS Versions

Version	Most recent version	Recent version release date
iPhone OS 1	1.1.5	July 15, 2008
iPhone OS 2	2.2.1	January 27, 2009
iPhone OS 3	3.1.3	February 2, 2010
iOS 4	4.2.1	November 22, 2010
iOS 5	5.1.1	May 7, 2012
iOS 6	6.1.6	February 21, 2014
iOS 7	7.1.2	June 30, 2014
iOS 8	8.4.1	August 13, 2015
iOS 9	9.3.5	August 25, 2016
	9.3.6	July 22, 2019
iOS 10	10.3.3	July 19, 2017
	10.3.4	July 22, 2019
iOS 11	11.4.1	July 9, 2018
iOS 12	12.5.6[3]	August 31, 2022
iOS 13 / iPadOS 13	13.7	September 1, 2020
iOS 14 / iPadOS 14	14.8.1[4]	October 26, 2021
iOS 15 / iPadOS 15	**15.7**	September 12, 2022
	15.7.1 RC	October 18, 2022

iOS 16 / iPadOS 16	**16.0.3**	October 10, 2022
	16.1 RC	October 18, 2022

iOS 16

iOS 16 was announced at 2022's WWDC in June. It will be rolled out to consumers in Fall 2022 and is expected to include a new lock screen with a new look and enhanced personalization options, such as photo shuffle and widgets on the lock screen.

In conjunction with the upgrade, updates to other apps will be enabled. Those include new Messages features, SharePlay availability in FaceTime and Messages, and upgrades for Apple Wallet including Apple Pay Later and Apple Order Tracking.

iOS 16 will also allow an Apple Maps redesign and new features, such as cycling, lookaround, and multi-stop routing. The iOS upgrade also offers improvements to Spatial Audio that allow for personalization of audio on AirPods.

Members of the Apple Beta Software Program can download and install the iOS 16 beta with a compatible iPhone.

iOS 15

Apple Inc.

Support ended: n./a
Current version: 15.5, released May 16, 2022
Initial version: 15.0, released Sept. 24, 2021

Much like iOS 14, iOS 15 is more of a collection of improvements to the iPhone platform than it is a themed release. Generally speaking, iOS 15 moves forward a number of important things Apple has been working on for a number of releases: Increases security and privacy, blocks more ad tracking, improves Siri and the camera app, and much more.

Some of the biggest steps forward are influenced by the recent remote-work trend. Features in that area include improvements to FaceTime audio, support for FaceTime conferencing on the web and Android, improvements to the Messages app, and more.

Key New Features:

- FaceTime received numerous improvements aimed at improving the experience of using the app and expanding the audience for it, including:

1. **SharePlay** allows people on a FaceTime video call to watch video or listen to audio together, and share screens
2. **Spatial Audio** brings Apple's more-natural, 3D audio experience to improve the naturalness of FaceTime sound
3. **Enhanced Mic Modes** allow you to isolate your voice from background noise to improve audio quality

4. **Portrait Mode** brings this terrific still-photos feature to video to blur your background
5. **Cross-Platform support** allows you to invite anyone to a FaceTime call with a link and for them to join from a web browser or Android devices.

- Focus adds a set of smart notification and communication s settings based on what you're doing at that moment.
- The Photos app gains major improvements such as:

1. **Live Text** lets the app detect text inside your photos and convert it to text that can be copied and pasted, or phone numbers that can be tapped to call
2. **Visual search** lets you search within the Photos app for text embedded your photos.

- In keeping with Apple's ongoing commitment to user privacy, iOS 15 adds:

1. **App Privacy Report** lets you know what permissions each of your apps has, how often it accesses your data, and what third-party domains the app has contacted.
2. **Mail Privacy Protection** blocks tracking pixels, hides your IP address from marketers, and blocks the connection of your data from email with other data sources.
3. **On-device Siri** means that Siri recordings are no longer sent to or stored in the cloud. Siri works completely on your iPhone, and now works offline.

- Support for the iCloud+ service that adds new Homekit and VPN-style features.
- Notifications scheduling and summary.
- Improved driving directions in Maps.
- A redesigned experience and features for managing tabs and groups of tabs in Safari.
- Better ways to find content shared with you and to share medical data from the Health app with your family.

Dropped Support For:

- iPhone 6 series. All iPhone models from the 6S series and up are supported.
- 6th Gen. iPod touch. Only the 7th Gen. iPod touch is supported.

iOS 14

Apple

Support ended: n/a
Current version: 14.6, released May 24, 2021
Initial version: 14.0, released Sept. 17, 2020

There's no single major change or theme to the changes introduced with iOS 14. Instead, iOS 14 is a collection of numerous small and medium-sized changes to the user interface, features, and overall ease of use that add up to making the experience of using an iPhone even better.

Maybe the most notable changes are around customization, thanks to the addition of Homescreen Widgets, the ability to choose default apps in some cases, and improved privacy controls.

How to Change the Color of Apps on iOS 14

Key New Features:

- Homescreen Widgets for customized home screens and shortcuts.

- Smart Stacks that deliver different Homescreen Widgets at different times of the day based on your habits.
- Set third-party apps as default for email and web browser apps.
- App Library, a new way of organizing apps and keeping your home scree neat
- App Clips
- Picture in picture mode
- Improved privacy features to block tracking online.
- Built-in language translation for 11 languages.
- Spatial audio for AirPods delivers surround sound, along with other AirPods improvements.
- Design changes allow phone calls and FaceTime calls to take up less space on the screen and allow you to do other things at the same time.
- Numerous improvements for group texts in iMessage, including threaded replies and mentions.

Dropped Support For:

- None. iOS 14 supports the same set of devices as iOS 13

iOS 13

Apple Inc.

Support ended: n/a
Current version: 13.7, release Sept. 1, 2020.
Initial version: 13.0, released Sept. 19, 2019

Perhaps the biggest change introduced with iOS 13 is that the OS no longer runs on the iPad. That's due to the release of iPadOS (which begins with version 13). That's a new OS dedicated to the making the iPad a more useful productivity device and a potential laptop replacement. It's based on iOS 13 and has many of the same features, but also adds iPad-specific items.

Beyond that, iOS 13 shores up some core features, including launching apps faster, unlocking devices with Face ID faster, and overhauling pre-installed apps like Reminders, Notes, Safari, and Mail. Maybe the most obvious new feature is the Dark Mode, but the changes range much wider than that and further bolster the already-strong OS.

Key New Features:

- System-wide Dark Mode
- Sign In With Apple user account system
- New privacy and security options
- New Portrait Lighting options
- Look Around, a Google Street View-style feature for Apple Maps
- New, improved Siri voice
- Overhauled stock apps like Reminders and Notes

Dropped Support For:

- iPad (due to the release of iPadOS)
- 6th Gen. iPod touch
- iPhone 6 series
- iPhone 5S

iOS 12

Apple Inc.

Support ended: n/a
Current version: 12.4.8. It was released July 15, 2020
Initial version: It was released on September 17, 2018

The new features and improvements added in iOS 12 aren't as extensive or revolutionary as in some previous updates to the OS. Instead, iOS 12 focused more on making refinements to commonly used features and on adding wrinkles that improve how people use their devices.

Some of the key features of iOS 12 included improvements to Siri like Siri Shortcuts, enhanced Augmented Reality with ARKit 2, and giving users and parents ways to monitor and control their device use with Screen Time.

Key New Features:

- Grouped Notifications
- Screen Time
- ARKit 2
- Siri improvements, including Siri Shortcuts and multi-step actions
- Memoji, a personalized kind of Animoji

Dropped Support For:

- N/A

iOS 11

Apple Inc.

Support ended: n/a
Current version: 11.4.1. It was released on July 9, 2018
Initial version: It was released on September 19, 2017

iOS was originally developed to run on the iPhone. Since then, it's been expanded to support the iPod touch and iPad (and versions of it even power the Apple Watch and Apple TV). In iOS 11, the emphasis shifted from the iPhone to the iPad.

Sure, iOS 11 contains lots of improvements for the iPhone, but its major focus is turning the iPad Pro series models into legitimate laptop replacements for some users.

This is done through a series of changes designed to make iOS running on iPad a lot more like a desktop operating system. These changes include all new drag and drop support, split screen apps and multiple workspaces, a file browser app, and support for notation and handwriting with the Apple Pencil.

Key New Features:

- Augmented Reality
- AirPlay 2
- Major enhancements on iPad

Dropped Support For:

- iPhone 5C
- iPhone 5
- iPad 4
- iPad 3

iOS 10

Apple Inc.

Support ended: 2019
Current version: 10.3.4. It was released on July 22, 2019
Initial version: It was released on Sept. 13, 2016

The ecosystem Apple built around iOS has long been referred to as a "walled garden" because it's a very pleasant place to be on the inside, but it's hard to gain access. This was reflected in the many ways Apple locked down the interface of iOS and the options it gave to apps.

Cracks began to show in the walled garden in iOS 10, and Apple put them there.

The major themes of iOS 10 were interoperability and customization. Apps could now communicate directly with each other on a device, allowing one app to use some features from another without opening the second app. Siri became available to third-party apps in new ways. There were even apps built into iMessage now.

Beyond that, users now had new ways to customize their experiences, from (finally!) being able to delete built-in apps to new animations and effects to punctuate their text messages.

Key New Features:

- iMessage apps
- Delete built-in apps

Dropped Support For:

- iPhone 4S
- 5th gen. iPod touch
- iPad 2
- 1st gen. iPad mini

iOS 9

Apple, Inc.

Support ended: 2018
Final version: 9.3.9. It was released on July 22, 2019
Initial version: It was released on Sept. 16, 2015

After a few years of major changes to both the interface and technical foundation of iOS, many observers began to charge that iOS was no longer the stable, dependable, solid performer it had once been. They suggested that Apple should focus on shoring up the foundation of the OS before adding new features.

That's just what the company did with iOS 9. While it did add some new features, this release was generally aimed at solidifying the foundation of the OS for the future.

Major improvements were delivered in speed and responsiveness, stability, and performance on older devices. iOS 9 proved to be an important refocusing that laid the groundwork for the bigger improvements delivered in iOS 10 and 11.

Key New Features:

- Night Shift
- Low Power Mode
- Public beta program

Dropped Support For:

- N/A

iOS 8

Apple, Inc.

Support ended: 2016
Final version: 8.4.1. It was released on Aug. 13, 2015
Initial version: It was released on Sept. 17, 2014

More consistent and stable operation returned to iOS in version 8.0. With the radical changes of the last two versions now in the past, Apple once again focused on delivering major new features.

Among these features was its secure, contactless payment system Apple Pay and, with the iOS 8.4 update, the Apple Music subscription service.

There were continued improvements to the iCloud platform, too, with the addition of the Dropbox-like iClould Drive, iCloud Photo Library, and iCloud Music Library.

Key New Features:

- Apple Music
- Apple Pay
- iCloud Drive
- Handoff
- Family Sharing
- Third-party keyboards
- HomeKit

Dropped Support For:

- iPhone 4

iOS 7

Corbis News / Getty Images

Support ended: 2016
Final version: 7.1.2. It was released on June 30, 2014.
Initial version: It was released on Sept. 18, 2013

Like iOS 6, iOS 7 was met with substantial resistance upon its release. Unlike iOS 6, though, the cause of unhappiness among iOS 7 users wasn't that things didn't work. Rather, it was because things had changed.

After the firing of Scott Forstall, iOS development was overseen by Jony Ive, Apple's head of design, who had previously only worked on hardware. In this version of iOS, Ive ushered in a major overhaul of the user interface, designed to make it more modern.

While the design was indeed more modern, its small, thin fonts were hard to read for some users and frequent animations caused motion sickness for others. The design of the current iOS is derived from the changes made in iOS 7. After Apple made improvements, and users became accustomed to the changes, complaints subsided.

Key New Features:

- Activation Lock
- AirDrop
- CarPlay
- Control Center
- Touch ID

Dropped Support For:

- iPhone 3GS
- iPhone 4, iPhone 4S, 3rd gen. iPad, and iPad 2 couldn't use all features of iOS 7

iOS 6

marco_1186 / Flickr

Support ended: 2015
Final version: 6.1.6. It was released on Feb. 21, 2014
Initial version: It was released on Sept. 19, 2012

Controversy was one of the dominant themes of iOS 6. While this version introduced the world to Siri — which, despite being later surpassed by competitors, was a truly revolutionary technology — problems with it also led to major changes.

The driver of these problems was Apple's increasing competition with Google, whose Android smartphone platform was posing a threat to the iPhone. Google had supplied the Maps and YouTube apps pre-installed with the iPhone since 1.0. In iOS 6, that changed.

Apple introduced its own Maps app, which was badly received due to bugs, bad directions, and problems with certain features. As part of the company's efforts to solve the problems, Apple CEO Tim Cook asked the head of iOS development, Scott Forstall, to make a public apology. When he refused, Cook fired him. Forstall had been involved with the iPhone since before the first model, so this was a profound change.

Key New Features:

- Apple Maps
- Do Not Disturb
- Passbook (now Wallet)

Dropped Support For:

- None, but iPhone 3GS, iPhone 4, and iPad 2 couldn't use all features of iOS 6

iOS 5

Francis Dean / Getty Images

Support ended: 2014
Final version: 5.1.1. It was released on May 7, 2012
Initial version: It was released on Oct. 12, 2011

Apple responded to the growing trend of wirelessness, and cloud computing, in iOS 5, by introducing essential new features and platforms. Among those was iCloud, the ability to activate an iPhone wirelessly (previously it had required a connection to a computer), and syncing with iTunes via Wi-Fi.

More features that are now central to the iOS experience debuted here, including iMessage and Notification Center.

With iOS 5, Apple dropped support for the iPhone 3G, 1st gen. iPad, and 2nd and 3rd gen. iPod touch.

Key New Features:

- iCloud
- iMessage
- Notification Center
- Wireless syncing and activation

Dropped Support For:

- iPhone 3G
- 1st gen. iPad
- 2nd gen. iPod touch
- 3rd gen. iPod touch

iOS 4

Ramin Talaie / Getty Images

Support ended: 2013
Final version: 4.3.5. It was released on July 25, 2011
Initial version: It was released on June 22, 2010

Many aspects of the modern iOS began to take shape in iOS 4. Features that are now widely used debuted in various updates to this version, including FaceTime, multitasking, iBooks, organizing apps into folders, Personal Hotspot, AirPlay, and AirPrint.

Another important change introduced with iOS 4 was the name "iOS" itself. As noted earlier, the iOS name was unveiled for this version, replacing the previously used "iPhone OS" name.

This was also the first version of iOS to drop support for any iOS devices. It was not compatible with the original iPhone or the 1st generation iPod touch. Some older models that were technically compatible were not able to use all features of this version.

Key New Features:

- FaceTime
- Multitasking
- AirPlay
- AirPrint
- iBooks
- Personal Hotspot

Dropped Support For:

- Original iPhone
- 1st Gen. iPod touch

iOS 3

Justin Sullivan / Getty Images News

Support ended: 2012
Final version: 3.2.2. It was released on Aug. 11, 2010
Initial version: It was released on June 17, 2009

The release of this version of iOS accompanied the debut of the iPhone 3GS. It added features including copy and paste, Spotlight search, MMS support in the Messages app, and the ability to record videos using the Camera app.

Also notable about this version of iOS is that it was the first to support the iPad. The 1st generation iPad was released in 2010, and version 3.2 of the software came with it.

Key New Features:

- Copy and paste
- Spotlight search
- Recording videos

iOS 2

Jason Kempin / Getty Images

Support ended: 2011
Final version: 2.2.1. It was released on January 27, 2009
Initial version: It was released on July 11, 2008

One year after the iPhone became a bigger hit than almost anyone projected, Apple released iOS 2.0 (then called iPhone OS 2.0) to coincide with the release of the iPhone 3G.

The most profound change introduced in this version was the App Store and its support for real third-party apps (rather than web apps). Around 500 apps were available in the App Store at launch. Hundreds of other crucial improvements were also added.

Other important changes introduced in the 5 updates iPhone OS 2.0 included podcast support and public transit and walking directions in Maps (both in version 2.2).

Key New Features:

- App Store
- Improved Maps app

iOS 1

Apple Inc.

Support ended: 2010
Final version: 1.1.5. It was released on July 15, 2008
Initial version: It was released on June 29, 2007

The one that started it all, which shipped pre-installed on the original iPhone.

This version of the operating system wasn't called iOS at the time it launched. From versions 1-3, Apple referred to it as the iPhone OS. The name shifted to iOS with version 4.

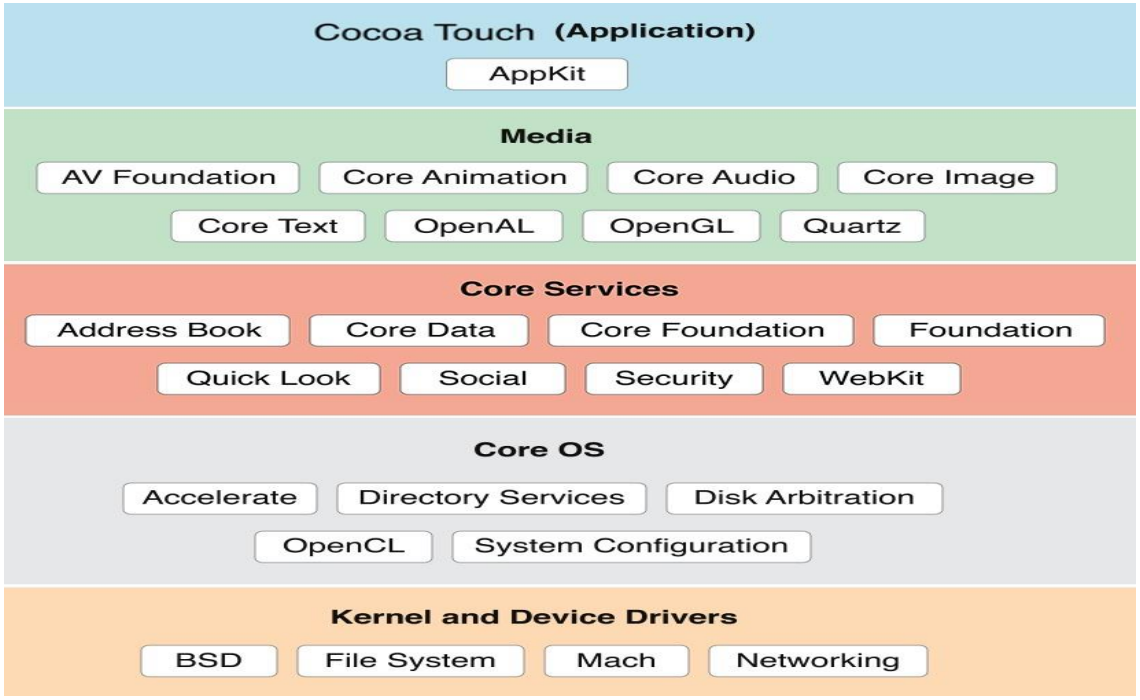
It's hard to convey to modern readers who have lived with the iPhone for years how profound a breakthrough this version of the operating system was. Support for features like the multitouch screen, Visual Voicemail, and iTunes integration were significant advances.

While this initial release was a major breakthrough at the time, it lacked many of the features that would come to be closely associated with the iPhone in the future, including support for real third-party apps. Pre-installed apps included Calendar, Photos, Camera, Notes, Safari, Mail, Phone, and iPod (which was later split into the Music and Videos apps).

Version 1.1, which was released in Sept. 2007 was the first version of the software compatible with the iPod touch.

Key New Features:

- Visual Voicemail
- Multitouch interface
- Safari browser
- Music app



1. Cocoa Touch

The cocoa touch layer provides the following frameworks −

EventKit Framework

This shows the standard system interfaces using view controllers for viewing and changing calendar related events.

GameKit Framework

This provides support for users to share their game related data online using Game center.

MapKit Framework

This provides a scrollable map which can be included into the app user interface.

2.Media Layer:

Graphics, Audio and Video technology is enabled using the Media Layer

.

Graphics Framework:

- **UIKit Graphics –** It describes high level support for designing images and also used for animating the content of your views.
- **Core Graphics framework –** It is the native drawing engine for iOS apps and gives support for custom 2D vector and image based rendering.
- **Core Animation –** It is an initial technology that optimizes the animation experience of your apps.
- **Core Images –** gives advanced support for controlling video and motionless images in a nondestructive way
- **OpenGl ES and GLKit –** manages advanced 2D and 3D rendering by hardware accelerated interfaces

Audio Framework:

- **Media Player Framework –** It is a high level framework which gives simple use to a user's iTunes library and support for playing playlists.
- **AV Foundation –** It is an Objective C interface for handling the recording and playback of audio and video.
- **OpenAL –** is an industry standard technology for providing audio.

Video Framework

- **AV Kit –** framework gives a collection of easy to use interfaces for presenting video.
- **AV Foundation –** gives advanced video playback and recording capability.
- **Core Media –** framework describes the low level interfaces and data types for operating media.

3. Core Services Layer

Some of the Important Frameworks available in the core services layers are detailed:

- **Address book framework** – Gives programmatic access to a contacts database of user.
- **Cloud Kit framework** – Gives a medium for moving data between your app and iCloud.
- **Core data Framework –** Technology for managing the data model of a Model View Controller app.
- **Core Foundation framework –** Interfaces that gives fundamental data management and service features for iOS apps.
- **Core Location framework –** Gives location and heading information to apps.
- **Core Motion Framework –** Access all motion based data available on a device. Using this core motion framework Accelerometer based information can be accessed.
- **Foundation Framework –** Objective C covering too many of the features found in the Core Foundation framework
- **Healthkit framework –** New framework for handling health-related information of user
- **Homekit framework –** New framework for talking with and controlling connected devices in a user's home.
- **Social framework –** Simple interface for accessing the user's social media accounts.
- **StoreKit framework –** Gives support for the buying of content and services from inside your iOS apps, a feature known asIn-App Purchase.

4. Core OS Layer

The Core OS layer holds the low level features that most other technologies are built upon.

- Core Bluetooth Framework.
- Accelerate Framework.
- External Accessory Framework.
- Security Services framework.

Local Authentication framework.

SWIFT Programming language

- Swift is a general purpose programming language for developing iOS applications. It is developed by Apple Inc.
- The development of Swift was started in 2010 by Chris Lattner with other programmers
- The basic idea of Swift was taken from Objective-C, Rust, Haskell, Ruby, Python, C#, CLU, and many other programming languages.

Version	Released Date
Swift 1.0	2014-09-09
Swift 1.1	2014-10-22
Swift 1.2	2015-04-08
Swift 2.0	2015-09-21
Swift 3.0	2016-09-13
Swift 4.0	2017-09-19
Swift 4.1	2018-03-29
Swift 4.2	2018-09-17

- Features of Swift

- *1) Safe and easy programming patterns are followed*
  2) Provides modern programming features
  3) Provide objective C like syntax
  4) Swift is the best way to write iOS and OS X programs
  5) Great access to existing cocoa frameworks
  6) It doesn't need a separate library import to support functionalities like input/output or even the string handling
  7) Swift unifies the procedural and object-oriented portions of the language
  8) Run time used by swift is the same as that of Obj-C system on Mac OS and iOS

Learning Swift

1) Install Xcode and create a playground:

2) Variables and Constants:

Ex:var name = **"Tim McGraw"**

3) Different types of Data: There are various types of data and swift handles them all individually. In swift, literally, a string of characters is known as String which can either be long, short or even empty.

4) Operators: These include the basic: +to add, -to subtract, *to multiply, /to divide, =to assign value. Another common operator that you will see is the modulus which is represented by the % symbol. Swift also has a set of operators that perform the comparison on values.

5) Arrays: Here, a group of values is collected together to a single collection, and later on, access their value by checking their position in the collection. An item's position in an array is known as its index. Swift uses brackets to mark the start and end of an array and each time an array is separated using a comma.

6) Dictionaries: This is another type of collection like an array. But, they let you access the values based on the keys that you specify.

7) Loops: They are simple programming constructs that repeat a block of code for as long as a condition is true. Swift knows what kind of data your array holds. So, it will go through every element in the array, assign it to a constant and then, run a block of your code.

8) Switch cases: This is another type of flow control. One advantage to switch/case is that Swift will ensure that your cases are complete.

9) Functions: Lets you define the re-usable pieces of code that perform specific pieces of functionality.

10) Classes: This is another way of using this language for building complex data types. They are structurally similar but vary in certain functions.

11) Properties: Struc and classes have their own variables and constants and these are called as properties. They allow attaching values to the types to represent them uniquely.

12) Static Properties and methods: Swift lets you create properties and methods that belong to a type. Such properties of Swift are known as static properties and you create one by using the static keyword.

13) Access Control: This feature lets you specify what data inside the strucs and classes should be exposed to the outside world, and you can also choose clarifier's accordingly.

14) Closures: This is another type of data which is extensively used in Swift. These are quite complicated, but, still expressive and powerful. These are widely used in Cocoa touch.

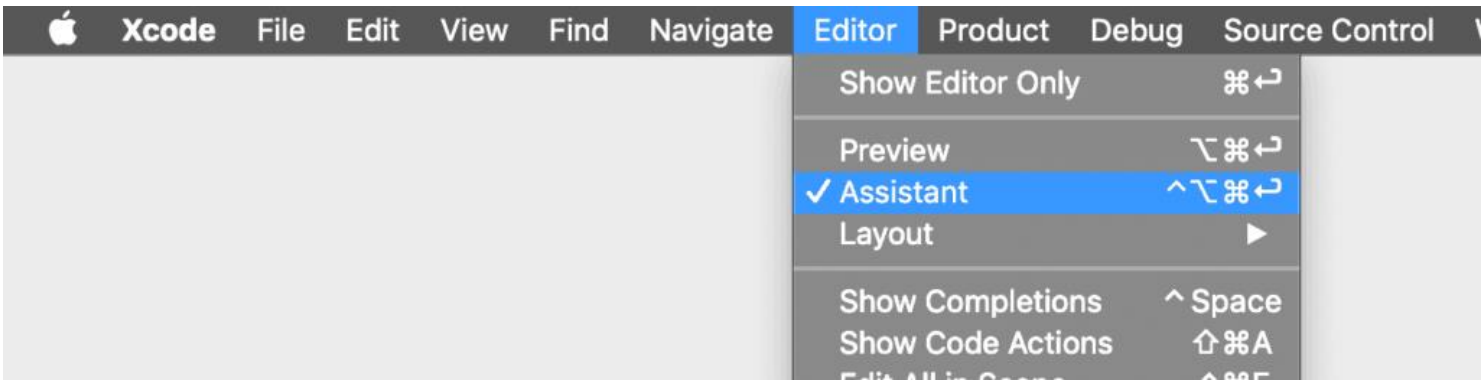
XCODE IDE Features

Source Editor

Write code using a professional editor with advanced code completion, code folding, syntax highlighting, and message bubbles that display warning, errors, and other context-sensitive information inline with your code.

Assistant Editor

The Assistant button splits the editor in two, creating a secondary pane that automatically displays files that are most helpful to you based on the code you are actively editing. It can show the header counterpart, thesuperclass, callers, callees, or other helpful files.


Xcode
File
Edit
View
Find
Navigate
Editor
Product
Debug
Source Control
Show Editor Only
Preview
Assistant
Layout
Show Completions
Space
Show Code Actions

Version Editor

Xcode's Version editor displays a running timeline of commits, helps you determine blame, and graphically goes back in time to compare source files, with full support for Subversion and Git source control (SCM) systems.

Interface Builder Built-In

Design and test your user interface without writing a line of code, prototype in minutes, then graphically connect your interface to the source within the Xcode editor.

Simulator

With the iOS SDK, Xcode can build, install, run, and debug Cocoa Touch apps in a Mac-based Simulator for a streamlined development workflow.

Integrated Build System

Handles the most complex builds, scaling to maximize the power of multi-core Macs, and will automatically sign, provision, and install iPad and iPhone apps onto a device.

Compilers

The powerful open-source LLVM compiler for C, C++, and Objective-C is built into Xcode and available from Terminal. With it, your code compiles quickly, and is optimized by Apple to produce blazing-fast apps specifically tuned for the CPUs in iPhone, iPad, and Mac.

Graphical Debugger

Debug your app directly within the Xcode editor. Hover over any variable to drill into its contents, use Quick Look to see the data it contains, or right-click to add the variable to the watch list

Continuous Integration

Xcode Server controls server-side bots that continuously build, analyze, test, and even archive your Xcode projects. The Xcode IDE configures these bots, analyzes nightly build and test results, and can track down which check-in broke the build.

Asset Catalog

The asset catalog editor in Xcode manages your app's images, grouping together various resolutions of the same asset. When building, Xcode compiles the asset catalog into the most efficient bundle for final distribution.

Open Quickly

Simply press Cmd-Shift-O to instantly open any file within your workspace using the primary editor, or hold the Option key when selecting a file to open it in the Assistant editor. Open Quickly is an essential tool in any keyboard-driven workflow.

OpenGL Frame Capture

Press a single button to capture a complete representation of the current OpenGL frame from an iOS device. Xcode displays the shader information, and can visually construct how the frame was assembled within the Xcode debugger.

Complete Documentation

Easily search and find anything within Help or the Documentation and API Reference viewer.

Live Issues

Just like a word processor highlights spelling errors, Live Issues highlights common coding mistakes, without the need to click 'build' first.

Fix-it

Xcode goes beyond just reporting errors. When you make a coding mistake, Xcode will immediately alert you, and a single keyboard shortcut will instantly fix the issue, so you won't miss a beat while coding

Quick Help

Shortened API documentation is displayed while you're programming, including comments that you write for your code. A brief overview is presented during code completion, with more links and references available within the Utility area.

XCTest Framework

XCTest APIs make it easy to build unit tests that exercise app functionality and are capable of running on Mac, iPad, iPhone, or Simulator.

Static Analysis

Find bugs in your code before the app is even run by letting the built-in static analyzer try out thousands of possible code paths in a few seconds. You'll get a report of potential bugs that could have remained hidden or are nearly impossible to replicate.

	Android	iOS
Developer	Google and Open Handset Alliance	Apple Inc.
Initial release	September 23, 2008	July 29, 2007
Latest stable release and Updates	Android 11	iOS 14.1 and iPadOS 14.1
Customizability	A lot. Can change almost anything.	Limited unless jailbroken
Source model	Open source	Closed, with open source components.
File transfer	Easier than iOS. Using USB port and Android File Transfer desktop app. Photos can be transferred via USB without apps.	More difficult. Media files can be transferred using iTunes desktop app. Photos can be transferred out via USB without apps.
Widgets	Yes, except on lock screen	Yes, except on lock screen
Internet browsing	Google Chrome (other browsers are available). Any browser app can be set as default. Ad blocking is supported with Firefox.	Safari. Any browser app can be set as default but they all use the same rendering engine (Safari/Webkit) behind the scenes. Ad blocking is supported via content blockers like Firefox Focus.

	Android	iOS
Web mapping service	Google Maps	Apple Maps (default). Google Maps also available via a separate app download, but not as default.
Available language(s)	100+ languages	40 languages
Video chat	Google Meet and other 3rd party apps	FaceTime (Apple devices only) and other 3rd party apps
Virtual assistant	Google Assistant	Siri
Available on	Many phones and tablets. Major manufacturers such as Samsung, Oppo, OnePlus, Vivo, Honor and Xiaomi. Android One devices are pure Android. Pixel line of devices is made by Google, using a almost pure version of Android	iPod Touch, iPhone, iPad,Apple TV (2nd and 3rd generation).
Calls and messaging	Google Messages. 3rd party apps like Facebook Messenger, WhatsApp, Google Duo, Discord and Skype all work on Android and iOS both.	iMessage, FaceTime (with other Apple devices only). 3rd party apps like Google Hangouts, Facebook Messenger, WhatsApp, Google Duo, Discord and Skype all work on Android and iOS both.

	Android	iOS
App store , Affordability and interface	Google Play Store – 2,000,000+ apps. Other app stores like Amazon and Aptoide also distribute Android apps. (".APKs"). Apps containing virus rare, but existing.	Apple App Store – 1,000,000+ apps. Apps containing virus very rare or nonexistent.
Alternative app stores and side loading	Several alternative app stores other than the official Google Play Store. (e.g. Aptoide, Galaxy Apps)	Apple blocks 3rd party app stores. The phone needs to be jailbrokenif you want to download apps from other stores.
Battery life and management	Many but not all Android phone manufacturers equip their devices with large batteries with a longer life.	Apple batteries are generally not as big as the largest Android batteries. However, Apple is able to squeeze decent battery life via hardware/software optimizations.
Open source	Kernel (Based on Linux), UI, and some standard apps	The iOS kernel is not open source but is based on the open-source Darwin OS.
File manager	Yes. (Stock Android File Manager included on devices running Android 7.1.1)	Files app, limited and less useful (iOS 12).
Interface	Touch Screen	Touch Screen

	Android	iOS
Photos & Videos backup	Apps available for automatic backup of photos and videos. Google Photos allows unlimited backup of photos at a compressed quality. OneDrive, Amazon Photos and Dropbox are other alternatives.	Up to 5 GB of photos and videos can be automatically back up with iCloud, more paid iCloud storage available via subscription. All other vendors like Google, Amazon, Dropbox, Flickr and Microsoft have auto-backup apps for both iOS and Android.
Security	Monthly security updates. Android software patches are available soonest to Pixel device users. Manufacturers tend to lag behind in pushing out these updates. So at any given time a vast majority of Android devices are running outdated OS software.	Occasional security updates. Security threats rare, because iOS is locked and downloading apps out of the App Store is complicated.
Rooting, bootloaders, and jailbreaking	Access and complete control over your device is available and you can unlock the bootloader.	Complete control over your device is not available.
Cloud services	Native integration with Google Drive storage. 15GB free, $2/mo for 100GB, 1TB for $10. Apps available for Amazon Photos, OneDrive and Dropbox.	Native integration with iCloud. 5GB free, 50GB for $1/mo, 200GB for $3/mo, 1TB for $10/mo. Apps available for Google Drive and Google Photos, Amazon Photos, OneDrive and Dropbox.

	Android	iOS
Biometric Authentication	Fingerprint and/or Face Authentication. Availability depends on manufacturer's hardware.	Fingerprint or Face Authentication. Touch ID available on iPhone (5s and later) and iPad (Air 2 and later) but not on iPhone X or later. Face ID available on iPhone X and later, replacing Touch ID
OS family	Linux	OS X, UNIX
Headphone Jack	Some current Android smartphones and many don't.	None on iPhone 7 and later, lighting to 3.5mm no longer comes with phone after iPhone XS