History of android

Android Inc. was founded in [Palo Alto, California](https://en.wikipedia.org/wiki/Palo_Alto,_California), in October 2003 by [Andy Rubin](https://en.wikipedia.org/wiki/Andy_Rubin), [Rich Miner](https://en.wikipedia.org/wiki/Rich_Miner), Nick Sears, and Chris White.[[13]](https://en.wikipedia.org/wiki/Android_(operating_system)#cite_note-13)[[14]](https://en.wikipedia.org/wiki/Android_(operating_system)#cite_note-Google_Buys_Android-14) Rubin described the Android project as "tremendous potential in developing smarter mobile devices that are more aware of its owner's location and preferences".[[14]](https://en.wikipedia.org/wiki/Android_(operating_system)#cite_note-Google_Buys_Android-14) The early intentions of the company were to develop an advanced operating system for [digital cameras](https://en.wikipedia.org/wiki/Digital_camera), and this was the basis of its pitch to investors in April 2004.[[15]](https://en.wikipedia.org/wiki/Android_(operating_system)#cite_note-pcworld-camera-os-15) The company then decided that the market for cameras was not large enough for its goals, and by five months later it had diverted its efforts and was pitching Android as a handset operating system that would rival [Symbian](https://en.wikipedia.org/wiki/Symbian" \o "Symbian) and Microsoft [Windows Mobile](https://en.wikipedia.org/wiki/Windows_Mobile).[[15]](https://en.wikipedia.org/wiki/Android_(operating_system)#cite_note-pcworld-camera-os-15)[[16]](https://en.wikipedia.org/wiki/Android_(operating_system)#cite_note-16)

Rubin had difficulty attracting investors early on, and Android was facing eviction from its office space. [Steve Perlman](https://en.wikipedia.org/wiki/Steve_Perlman), a close friend of Rubin, brought him $10,000 in cash in an envelope, and shortly thereafter wired an undisclosed amount as seed funding. Perlman refused a stake in the company, and has stated "I did it because I believed in the thing, and I wanted to help Andy."[[17]](https://en.wikipedia.org/wiki/Android_(operating_system)#cite_note-17)[[18]](https://en.wikipedia.org/wiki/Android_(operating_system)#cite_note-18)

In July 2005,[[14]](https://en.wikipedia.org/wiki/Android_(operating_system)" \l "cite_note-Google_Buys_Android-14) [Google](https://en.wikipedia.org/wiki/Google) acquired Android Inc. for at least $50 million.[[19]](https://en.wikipedia.org/wiki/Android_(operating_system)#cite_note-Murky_road_despite_dominance-19) Its key employees, including Rubin, Miner and White, joined Google as part of the acquisition.[[14]](https://en.wikipedia.org/wiki/Android_(operating_system)#cite_note-Google_Buys_Android-14) Not much was known about the secretive Android at the time, with the company having provided few details other than that it was making software for mobile phones.[[14]](https://en.wikipedia.org/wiki/Android_(operating_system)#cite_note-Google_Buys_Android-14) At Google, the team led by Rubin developed a mobile device platform powered by the [Linux kernel](https://en.wikipedia.org/wiki/Linux_kernel). Google marketed the platform to [handset makers](https://en.wikipedia.org/wiki/Original_equipment_manufacturer) and [carriers](https://en.wikipedia.org/wiki/Mobile_network_operator) on the promise of providing a flexible, upgradeable system.[[20]](https://en.wikipedia.org/wiki/Android_(operating_system)#cite_note-20) Google had "lined up a series of hardware components and software partners and signaled to carriers that it was open to various degrees of cooperation".[*[attribution needed](https://en.wikipedia.org/wiki/Wikipedia:Attribution_needed" \o "Wikipedia:Attribution needed)*][[21]](https://en.wikipedia.org/wiki/Android_(operating_system)#cite_note-21)

Speculation about Google's intention to enter the mobile communications market continued to build through December 2006.[[22]](https://en.wikipedia.org/wiki/Android_(operating_system)#cite_note-22) An early [prototype](https://en.wikipedia.org/wiki/Prototype) had a close resemblance to a [BlackBerry](https://en.wikipedia.org/wiki/BlackBerry) phone, with no touchscreen and a physical [QWERTY](https://en.wikipedia.org/wiki/QWERTY) [keyboard](https://en.wikipedia.org/wiki/Computer_keyboard), but the arrival of 2007's [Apple](https://en.wikipedia.org/wiki/Apple_Inc.) [iPhone](https://en.wikipedia.org/wiki/IPhone" \o "IPhone) meant that Android "had to go back to the drawing board".[[23]](https://en.wikipedia.org/wiki/Android_(operating_system)#cite_note-23)[[24]](https://en.wikipedia.org/wiki/Android_(operating_system)#cite_note-24) Google later changed its Android specification documents to state that "Touchscreens will be supported", although "the Product was designed with the presence of discrete physical buttons as an assumption, therefore a touchscreen cannot completely replace physical buttons".[[25]](https://en.wikipedia.org/wiki/Android_(operating_system)#cite_note-25) By 2008, both [Nokia](https://en.wikipedia.org/wiki/Nokia) and BlackBerry announced touch-based smartphones to rival the [iPhone 3G](https://en.wikipedia.org/wiki/IPhone_3G" \o "IPhone 3G), and Android's focus eventually switched to just touchscreens. The first commercially available smartphone running Android was the [HTC Dream](https://en.wikipedia.org/wiki/HTC_Dream), also known as T-Mobile G1, announced on September 23, 2008.[[26]](https://en.wikipedia.org/wiki/Android_(operating_system)#cite_note-26)[[27]](https://en.wikipedia.org/wiki/Android_(operating_system)#cite_note-27)

[](https://en.wikipedia.org/wiki/File:HTC_Android_T-Mobile_G1.jpg)

[HTC Dream](https://en.wikipedia.org/wiki/HTC_Dream) or T-Mobile G1, the first commercially released device running Android (2008)

On November 5, 2007, the [Open Handset Alliance](https://en.wikipedia.org/wiki/Open_Handset_Alliance), a [consortium](https://en.wikipedia.org/wiki/Consortium) of technology companies including Google, device manufacturers such as [HTC](https://en.wikipedia.org/wiki/HTC), [Motorola](https://en.wikipedia.org/wiki/Motorola_Mobility) and [Samsung](https://en.wikipedia.org/wiki/Samsung), wireless carriers such as [Sprint](https://en.wikipedia.org/wiki/Sprint_Corporation) and [T-Mobile](https://en.wikipedia.org/wiki/T-Mobile_US), and chipset makers such as [Qualcomm](https://en.wikipedia.org/wiki/Qualcomm) and [Texas Instruments](https://en.wikipedia.org/wiki/Texas_Instruments), unveiled itself, with a goal to develop "the first truly open and comprehensive platform for mobile devices".[[28]](https://en.wikipedia.org/wiki/Android_(operating_system)#cite_note-Announcement_of_OHA-28)[[29]](https://en.wikipedia.org/wiki/Android_(operating_system)#cite_note-29)[[30]](https://en.wikipedia.org/wiki/Android_(operating_system)#cite_note-30) Within a year, the Open Handset Alliance faced two other [open source](https://en.wikipedia.org/wiki/Open-source_software) competitors, the [Symbian Foundation](https://en.wikipedia.org/wiki/Symbian_Foundation" \o "Symbian Foundation) and the [LiMo Foundation](https://en.wikipedia.org/wiki/LiMo_Foundation" \o "LiMo Foundation), the latter also developing a [Linux](https://en.wikipedia.org/wiki/Linux)-based mobile operating system like Google. In September 2007, [*InformationWeek*](https://en.wikipedia.org/wiki/InformationWeek) covered an Evalueserve study reporting that Google had filed several [patent](https://en.wikipedia.org/wiki/Patent) applications in the area of mobile telephony.[[31]](https://en.wikipedia.org/wiki/Android_(operating_system)#cite_note-31)[[32]](https://en.wikipedia.org/wiki/Android_(operating_system)#cite_note-32)

Since 2008, Android has seen [numerous updates](https://en.wikipedia.org/wiki/Android_version_history) which have incrementally improved the operating system, adding new features and fixing [bugs](https://en.wikipedia.org/wiki/Software_bug) in previous releases. Each major release is named in alphabetical order after a dessert or sugary treat, with the first few Android versions being called "[Cupcake](https://en.wikipedia.org/wiki/Cupcake)", "[Donut](https://en.wikipedia.org/wiki/Donut)", "[Eclair](https://en.wikipedia.org/wiki/Eclair" \o "Eclair)", and "[Froyo](https://en.wikipedia.org/wiki/Frozen_yogurt" \o "Frozen yogurt)", in that order. During its announcement of [Android KitKat](https://en.wikipedia.org/wiki/Android_KitKat) in 2013, Google explained that "Since these devices make our lives so sweet, each Android version is named after a dessert", although a Google spokesperson told [CNN](https://en.wikipedia.org/wiki/CNN) in an interview that "It's kind of like an internal team thing, and we prefer to be a little bit — how should I say — a bit inscrutable in the matter, I'll say".[[33]](https://en.wikipedia.org/wiki/Android_(operating_system)#cite_note-33)

In 2010, Google launched its [Nexus](https://en.wikipedia.org/wiki/Google_Nexus) series of devices, a lineup in which Google partnered with different device manufacturers to produce new devices and introduce new Android versions. The series was described as having "played a pivotal role in Android's history by introducing new software iterations and hardware standards across the board", and became known for its "[bloat-free](https://en.wikipedia.org/wiki/Software_bloat)" software with "timely ... updates".[[34]](https://en.wikipedia.org/wiki/Android_(operating_system)#cite_note-34) At its [developer conference](https://en.wikipedia.org/wiki/Google_I/O) in May 2013, Google announced a special version of the [Samsung Galaxy S4](https://en.wikipedia.org/wiki/Samsung_Galaxy_S4), where, instead of using Samsung's own Android customization, the phone ran "stock Android" and was promised to receive new system updates fast.[[35]](https://en.wikipedia.org/wiki/Android_(operating_system)#cite_note-35) The device would become the start of the [Google Play edition](https://en.wikipedia.org/wiki/List_of_Google_Play_edition_devices) program, and was followed by other devices, including the [HTC One](https://en.wikipedia.org/wiki/HTC_One_(M7)) Google Play edition,[[36]](https://en.wikipedia.org/wiki/Android_(operating_system)#cite_note-36) and [Moto G](https://en.wikipedia.org/wiki/Moto_G_(1st_generation)) Google Play edition.[[37]](https://en.wikipedia.org/wiki/Android_(operating_system)#cite_note-37) In 2015, [*Ars Technica*](https://en.wikipedia.org/wiki/Ars_Technica) wrote that "Earlier this week, the last of the Google Play edition Android phones in Google's online storefront were listed as "no longer available for sale" and that "Now they're all gone, and it looks a whole lot like the program has wrapped up".[[38]](https://en.wikipedia.org/wiki/Android_(operating_system)#cite_note-38)[[39]](https://en.wikipedia.org/wiki/Android_(operating_system)#cite_note-39)

[Eric Schmidt](https://en.wikipedia.org/wiki/Eric_Schmidt), [Andy Rubin](https://en.wikipedia.org/wiki/Andy_Rubin) and [Hugo Barra](https://en.wikipedia.org/wiki/Hugo_Barra) at a 2012 press conference announcing Google's Nexus 7 tablet

From 2008 to 2013, [Hugo Barra](https://en.wikipedia.org/wiki/Hugo_Barra) served as product spokesperson, representing Android at press conferences and [Google I/O](https://en.wikipedia.org/wiki/Google_I/O), Google's annual developer-focused conference. He left Google in August 2013 to join Chinese phone maker [Xiaomi](https://en.wikipedia.org/wiki/Xiaomi).[[40]](https://en.wikipedia.org/wiki/Android_(operating_system)#cite_note-40)[[41]](https://en.wikipedia.org/wiki/Android_(operating_system)#cite_note-41) Less than six months earlier, Google's then-[CEO](https://en.wikipedia.org/wiki/CEO) [Larry Page](https://en.wikipedia.org/wiki/Larry_Page) announced in a blog post that Andy Rubin had moved from the Android division to take on new projects at Google, and that [Sundar Pichai](https://en.wikipedia.org/wiki/Sundar_Pichai" \o "Sundar Pichai) would become the new Android lead.[[42]](https://en.wikipedia.org/wiki/Android_(operating_system)#cite_note-42)[[43]](https://en.wikipedia.org/wiki/Android_(operating_system)#cite_note-43) Pichai himself would eventually switch positions, becoming the new CEO of Google in August 2015 following the company's restructure into the [Alphabet](https://en.wikipedia.org/wiki/Alphabet_Inc.) conglomerate,[[44]](https://en.wikipedia.org/wiki/Android_(operating_system)#cite_note-44)[[45]](https://en.wikipedia.org/wiki/Android_(operating_system)#cite_note-45) making [Hiroshi Lockheimer](https://en.wikipedia.org/wiki/Hiroshi_Lockheimer) the new head of Android.[[46]](https://en.wikipedia.org/wiki/Android_(operating_system)#cite_note-46)[[47]](https://en.wikipedia.org/wiki/Android_(operating_system)#cite_note-47)

In June 2014, Google announced [Android One](https://en.wikipedia.org/wiki/Android_One), a set of "hardware reference models" that would "allow [device makers] to easily create high-quality phones at low costs", designed for consumers in developing countries.[[48]](https://en.wikipedia.org/wiki/Android_(operating_system)#cite_note-48)[[49]](https://en.wikipedia.org/wiki/Android_(operating_system)#cite_note-49)[[50]](https://en.wikipedia.org/wiki/Android_(operating_system)#cite_note-50) In September, Google announced the first set of Android One phones for release in India.[[51]](https://en.wikipedia.org/wiki/Android_(operating_system)#cite_note-51)[[52]](https://en.wikipedia.org/wiki/Android_(operating_system)#cite_note-52) However, [*Recode*](https://en.wikipedia.org/wiki/Recode) reported in June 2015 that the project was "a disappointment", citing "reluctant consumers and manufacturing partners" and "misfires from the search company that has never quite cracked hardware".[[53]](https://en.wikipedia.org/wiki/Android_(operating_system)#cite_note-53) Plans to relaunch Android One surfaced in August 2015,[[54]](https://en.wikipedia.org/wiki/Android_(operating_system)" \l "cite_note-54) with Africa announced as the next location for the program a week later.[[55]](https://en.wikipedia.org/wiki/Android_(operating_system)#cite_note-55)[[56]](https://en.wikipedia.org/wiki/Android_(operating_system)#cite_note-56) A report from *The Information* in January 2017 stated that Google is expanding its low-cost Android One program into the United States, although *The Verge* notes that the company will presumably not produce the actual devices itself.[[57]](https://en.wikipedia.org/wiki/Android_(operating_system)#cite_note-57)[[58]](https://en.wikipedia.org/wiki/Android_(operating_system)#cite_note-58)

Google introduced the [Pixel and Pixel XL smartphones](https://en.wikipedia.org/wiki/Pixel_(smartphone)) in October 2016, marketed as being the first phones made by Google,[[59]](https://en.wikipedia.org/wiki/Android_(operating_system)#cite_note-59)[[60]](https://en.wikipedia.org/wiki/Android_(operating_system)#cite_note-60) and exclusively featured certain software features, such as the [Google Assistant](https://en.wikipedia.org/wiki/Google_Assistant), before wider rollout.[[61]](https://en.wikipedia.org/wiki/Android_(operating_system)#cite_note-61)[[62]](https://en.wikipedia.org/wiki/Android_(operating_system)#cite_note-62) The Pixel phones replaced the Nexus series,[[63]](https://en.wikipedia.org/wiki/Android_(operating_system)#cite_note-63) with a new generation of Pixel phones launched in October 2017.[[64]](https://en.wikipedia.org/wiki/Android_(operating_system)#cite_note-64)

In May 2019, the operating system became entangled in the [trade war between China and the United States](https://en.wikipedia.org/wiki/China%E2%80%93United_States_trade_war) involving [Huawei](https://en.wikipedia.org/wiki/Huawei) which like many other tech firms have become dependent on access to the Android platform.[[65]](https://en.wikipedia.org/wiki/Android_(operating_system)#cite_note-65)[[66]](https://en.wikipedia.org/wiki/Android_(operating_system)#cite_note-66) In the summer of 2019, Huawei announced it would create an alternative operating system to Android[[67]](https://en.wikipedia.org/wiki/Android_(operating_system)#cite_note-67)[[68]](https://en.wikipedia.org/wiki/Android_(operating_system)#cite_note-68) known as [Harmony OS](https://en.wikipedia.org/wiki/Harmony_OS),[[69]](https://en.wikipedia.org/wiki/Android_(operating_system)#cite_note-69) and have filed for intellectual property rights across major global markets.[[70]](https://en.wikipedia.org/wiki/Android_(operating_system)#cite_note-70)[[71]](https://en.wikipedia.org/wiki/Android_(operating_system)#cite_note-71) Huawei does not currently have any plans to replace Android in the near future, as Harmony OS is designed for [internet of things](https://en.wikipedia.org/wiki/Internet_of_things) devices, rather than for smartphones.[[72]](https://en.wikipedia.org/wiki/Android_(operating_system)#cite_note-verge-harmony-72)

On August 22, 2019, it was announced that Android "Q" would officially be branded as Android 10, ending the historic practice of naming major versions after desserts. Google stated that these names were not "inclusive" to international users (due either to the aforementioned foods not being internationally known, or being difficult to pronounce in some languages).[[73]](https://en.wikipedia.org/wiki/Android_(operating_system)#cite_note-73)[[74]](https://en.wikipedia.org/wiki/Android_(operating_system)#cite_note-74) On the same day, *Android Police* reported that Google had commissioned a statue of a giant number "10" to be installed in the lobby of the developers' new office.[[75]](https://en.wikipedia.org/wiki/Android_(operating_system)#cite_note-75) Android 10 is scheduled to be released on September 3, 2019 to [Google Pixel](https://en.wikipedia.org/wiki/Google_Pixel) phones first.[[76]](https://en.wikipedia.org/wiki/Android_(operating_system)#cite_note-76)

Android booting sequence

Today we will be looking into the Android boot process. When the user press power button then the booting sequence starts.

*Diagram to show Android Booting Sequence*

First thing that is loaded while booting Android is BOOTLOADER . CPU has a hard coded address from where the first instruction is fetched. This address generally points to the chip which has BOOTLOADER programmed on it. The main function of bootloader is to :

1. Initialize RAM
2. Put basic HW in quiescent state
3. Load kernel and RAM disk
4. Jump to kernel

Now kernel has been loaded into the RAM the control passes to the Kernel. The initial kernel startup is very hardware dependent, but its purpose is to set things up so that the CPU can start executing C code as early as possible. Once that’s done, the kernel jumps to the architecture-independent start\_kernel() function, initializes its  
various subsystems, and proceeds to call the “init” functions of all built-in drivers. The majority of messages printed out by the kernel at startup come from these steps. The kernel then mounts its root filesystem and starts the init process.

That’s when Android’s init kicks in and executes the instructions stored in its /init.rc file to set up environment variables such as the system path, create mount points, mount filesystems, set OOM adjustments, and start native daemons.

These native daemons are started and they initialize their corresponding module. We will focus on special daemon called Zygote which plays a very crucial role in launching applications.  Its functionality is centralized here in order to unify the components shared by all apps and to shorten their start-up time. The init doesn’t actually start the Zygote directly; instead it uses the app\_process command to get Zygote started by the Android Runtime. The runtime then starts the first Dalvik VM of the system and tells it to invoke the Zygote’s main().

Zygote is active only when a new app needs to be launched. To achieve a speedier app launch, the Zygote starts by preloading all Java classes and resources that an app may potentially need at runtime. This effectively loads those into the system’s RAM. The Zygote then listens for connections on its socket (/dev/socket/zygote) for requests to start new apps. When it gets a request to start an app, it forks itself and launches the new app. The beauty of having all apps fork from the Zygote is that it’s a “virgin” VM that has all the system classes and resources an app may need preloaded and ready to be used. In other words, new apps don’t have to wait until those are loaded to start executing.

All of this works because the Linux kernel implements a copy-on-write (COW) policy for forks. As you may know, forking in Unix involves creating a new process that is an exact copy of the parent process. With COW, Linux doesn’t actually copy anything. Instead, it maps the pages of the new process over to those of the parent process and  
makes copies only when the new process writes to a page. But in fact the classes and resources loaded are never written to, because they’re the default ones and are pretty much immutable within the lifetime of the system. So all processes directly forking from the Zygote are essentially using its own mapped copies. Therefore, regardless of the  
number of apps running on the system, only one copy of the system classes and the resources is ever loaded in RAM.

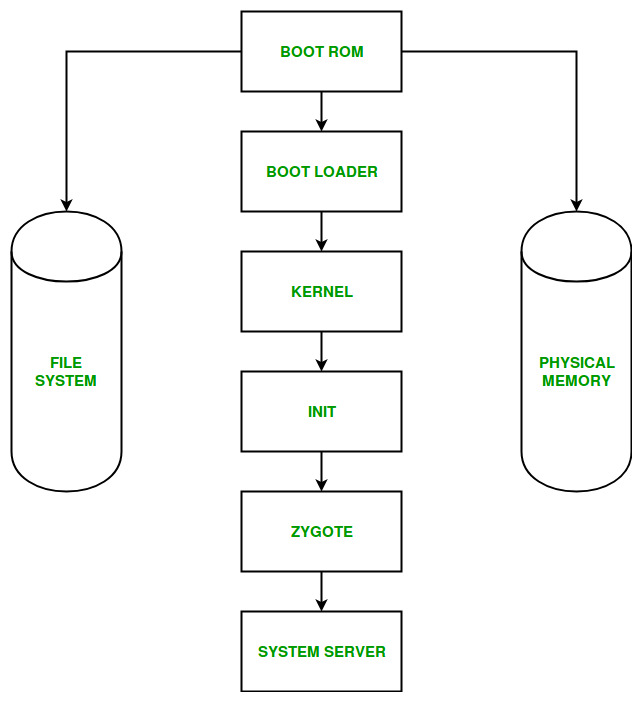
Although the Zygote is designed to listen to connections for requests to fork new apps, there is one “app” that the Zygote actually starts explicitly: the System Server. This is the first app started by the Zygote, and it continues to live on as an entirely separate process from its parent. The System Server then starts initializing each system service it houses and registering it with the previously started Service Manager. One of the services it starts, the Activity Manager, will end its initialization by sending an intent of type Intent.CATEGORY\_HOME. This starts the Launcher app, which then displays the home screen familiar to all Android users.

Android Boot Process

**Booting Process**

In computing, [booting](https://en.wikipedia.org/wiki/Booting) is starting up a computer or computer appliance until it can be used. It can be initiated by hardware such as a button press, or by software command. After the power is switched on the computer is relatively dumb, and can read only part of its storage called Read-only memory. There a small program is stored called firmware. It does power-on self-tests, and most importantly, allows accessing other types of memory, like hard disk and main memory. The firmware loads bigger programs into the computer’s main memory and runs it. In general purpose computers, but as well in smart phones, tablets, optionally a boot manager is run.

**Android Boot Process**



Android Boot Process includes the following six steps:

1. **Boot ROM:** This Step is known as power ON and system startup. This means that whenever we press the power button, the Boot ROM code starts executing from a pre-defined location which is hardwired in ROM. Boot ROM loads the BootLoader into RAM and starts executing.
2. **BootLoader:** Bootloaders is a low-level code contains the instructions that tell a device how to start up and find the system kernel. A Bootloader is a place where manufacturers put their locks and restrictions.

The bootloader is a code that is executed before any Operating System starts to run. The BootLoader executes in 2 Stages:  
**a)** In the first stage, it detects external RAM and loads a program which helps in the second stage.  
**b)** In the second stage, the bootloader setups the network, memory etc which requires to run Kernel.

1. **Kernel:** Once kernel boots, it starts setup cache, protected memory, scheduling, loads drivers, starts kernel daemons, mounts root file system, initializing Input/Output, starts interrupts, initializes process table. A Kernel is the lowest level of easily replaceable software that interfaces with the hardware in our device. When kernel finish system setup first thing it looks for “init” in system files and launch root process or first process of a system.
2. **Init:** Init is the very first process or we can say that it is the grandfather of all the processes.

The Init process has 2 responsibilities:

* + Mounts directories like /sys, /dev or/proc
  + Runs /init.rc script. The init.rc is responsible for the initial set up of the system.

The init process is what will set up all native services and this is similar to a regular Linux system boot.

1. **Zygote and Dalvik VM:** The Zygote is a VM process that starts as the system boots. When app\_process launces Zygote, it first creates the Dalvik VM and then calls Zygote’s main() method. Zygote receives a request to launch an App through/dev/socket/zygote. Once it happens, it triggers a fork() call.

When a process is a fork, it creates a clone to itself. It replicates itself in another memory space. This is done pretty efficiently. When this happens to Zygote, it creates an exact and clean new Dalvik VM as a thread, preloaded with all necessary classes and resources that any App will need. This makes the process of creating a VM and load resources pretty efficiently.

It enables code sharing across the Dalvik VM which helps in the achievement of minimal startup time.

1. **System Servers:** After zygote preloads all necessary Java Classes and resources, it starts System Server. The System server is the core of the Android system. The first thing that happens is that the server will load a native library called android\_servers that provides interfaces to native functionalities.

Then the native *init*method that will setup native services called. After setting up the native services it creates the server thread. This thread will start the remaining services in the system according to the necessary start order.

Each service is running in a separate Dalvik thread in the SystemServer.

Once system Services up and running in memory, Android has completed boot process, At this time “ACTION\_BOOT\_COMPLETED” standard broadcast action will fire.