	14	15	16		18		21	22	23	24	25	26 & <u>27</u>	
Codename •	Ice Cream Sandwich	Ice Cream Sandwich	Jelly Bean	Jelly Bean	Jelly Bean	KitKat	Lollipop	Lollipop	Marshmallow	Nougat	Nougat	Oreo	• Codename
Following versions Release date	4.0 4.0.1, 4.0.2 18 Oct 2011	4.0.4	4.1.1. 4.1.2	4.2.1, 4.2.2	4.3.1	4.4.1, 4.4.2, 4.4.3, 4.4.4 31 Oct 2013	5.0 5.0.1, 5.0.2 12 Nov 2014	5.1 5.1.1 09 Mar 2015	6.0 6.0.1 05 Oct 2015	22 Aug 016	7.1 7.1.1 04 Oct 2016		Version nameFollowing versionsRelease date
Kernel version • VERSION_CODE const •	3.0.1 ICE_CREAM_SANDWICH	16 Dec 2011	3.0.31	3.4.0	24 Jul 2013 3.4.39 JELLY_BEAN_MR2	3.10 KITKAT	3.16.1		3.18.10 M	4.4.1		4.10	Kernel version VERSION_CODE const
Graphical theme and font Runtime / APK / Signing	Holo theme and Roboto font	Holo theme and Roboto font	Holo theme and Roboto font	Holo theme and Roboto font	Holo theme and Roboto font	Holo theme and Roboto font Dalvik (with experimental ART)	Material Design and refined Roboto font	Material Design and refined Roboto font	Material Design and refined Roboto font Stricter APK validation, an APK must be re-signed	Material Design and refined Roboto font *JIT compiler with code profiling for ART			Graphical theme and font Runtime / APK / Signing
/ NDK			-_(\v)_/				64 bit support (ARM v8, x86-64 and MIPS-64)	—	if any of the contents are removed	 System prevents apps from dynamically linking against non-NDK libraries Seamless system updates (with dual system partition) Jack toolchain preview with lambdas and other Java 8 goodies APK Signature Scheme v2 	-_(''')_/-	 If an app installs an UncaughtExceptionHandler that does not call through to the default one, the system does not kill the app when an uncaught exception occurs Native libraries no longer load if they contain any load segment that is both writable and executable Neural Network API (NNAPI) introduced 	/ NDK
	All-or-nothing premission model (since 1.0) Health Devices Profile (HDP)	All-or-nothing premission model (since 1.0) Apps can detegrmine the features (UUIDs) supported by a remote device	All-or-nothing premission model (since 1.0) Android Beam supports large payload transfers over Bluetooth	BT stack rewritten, switch from Bluez to BlueDroid	All-or-nothing premission model (since 1.0) Audio/Video Remote Control Profile (AVRCP) 1.3	▶ Bluetooth HID over GATT	Custom permissions uniqueness addressed	All-or-nothing premission model (since 1.0)	Runtime permissions 02:00:00:00:00:00 as constant BT/Wifi MAC Bluetooth stylus support	Runtime permissions	Runtime permissions	audio codec	Permissions Bluetooth
Bluetooth Low Energy •				▶ Gamepad and joystick HID devices support	BLE support	► AVRCP 1.3 with volume setting	Concurrent scanning (central mode) and advertising (peripheral mode)	 -_(עי)_/-	Improved Bluetooth Low Energy Scanning, setCallbackType() w/ScanFilter		- 	Bluetooth devices battery level reporting	- Bluetooth Low Energy
NFC / Infrared •	Android Beam (NDEF Push with NFC)	+ - _('y)_/+	-\			➤ NFC Host Card Emulation (HCE) ➤ NFC reader mode ➤ Infrared transmitters API	 Register an NFC application ID (AID) dynamically, NDEF record containing UTF-8 text data 	 	Android Pay introduced (NFC HCE)		- 	 	- NFC / Infrared
/ Recent / Lock screen	Lock screen actions	Lugar careen widgets should no longer include	➤ Google Now launcher ➤ Voice Search ➤ Home screen rotates on tablets	Multiple user support (enabled on tablets) Daydream - interactive screensaver mode for Android devices (feature name shared with API25 Daydream VR)	Restricted profiles (on tablets)		 Multiple users on smartphones, "Guest" temporary login Nofitications on Lock screen 	-_(\y)_/-		Multi-window and resizeable apps support, affecting lifecycle	Round (Circular) Icon Resources Pixel Launcher (Pixel only) Google Assistant (debut on Pixel@7.1, available for 6.0+)	 Adaptive icons - 2-layer laucher icons with foreground, background and mask shape Pinning Shortcuts and Widgets Home screen notification badges Device themes, WallpaperColors API Custom Lockscreen shortcuts 	Multitasking / Launcher / Recent / Lock screen
	Split action bar	Home screen widgets should no longer include their own padding	Create notifications with larger content regions,	Lockscreen widgets introduced	NotificationListenerService - receive informat ion		notifications Heads up notifications (over other app), notifica-	Quick WiFi and Bluetooth change from Notifica-		→ Visual rework, bundled notifications, direct ⊢	App shortcuts support Notification Panel tweaks - pen-style "edit"	Notification channels ; notification snoozing;	Widgets / App shortcutsNotifications / Action Bar
/ Navigation Bar	· Collapsible action view (i.e. search)		big image previews, multiple action buttons, and configurable priority > setSystemUiVisibility() - control the appearance of system UI elements		about new notifications as they are posted by the systemNotification Access API (enables forwarding notifications to wereables)	▶ Immersive full-screen mode	tion priority settings	tion Panel		reply and others • Quick Settings Tile API	button and an extra quick settings icon	 timeouts (time-based auto cancellation); custom background colors; MessagingStyle (conversation-alike condensed style) Navigation bar - two extra icons with customizable KeyCode Notification alert sound max once per second per app 	,
	 Wi-Fi P2P (direct) VpnService allows applications to setup their own VPN Data usage monitor 	+	 Support for multicast DNS-based service discovery (mobile devices, printers, cameras, media players, and others) Wi-Fi P2P service discovery isActiveNetworkMetered() - help manage the data usage that may cost your users money 	-_('y)_/+	Scan-only mode that allows the device Wi-Fi to scan access points to help obtain the location without connecting to an access point	Wi-Fi Tunneled Direct Link Setup (TDLS)	Multiple network connections	org.apache.http package and AndroidHttpClient — class deprecated	 O2:00:00:00:00:00 as BT/Wifi MAC Apps not permitted to modify or delete WifiConfiguration objects created by the user or by other apps Forced Wifi network with disableAllOthers=true (behavior change for SDK>=21) Hotspot 2.0 Release 1 AndroidHttpClient removed 	Data Saver - blocks background data usage and signals apps to use less data in the foreground	-_(\(\mu\)_/-	Wi-Fi Aware based on the Neighbor Awareness Networking (NAN) - ad hoc communication for nearby devices	• Networks / Wifi
		Social stream API Calendar provider updates	— 		 Quick SMS response for incoming calls Contact provider: query for "contactables", query for contacts deltas 	SMS Provider with user-selectable default SMS app, SMS_DELIVER_ACTION versus SMS_RECEIVED_ACTION		Multiple SIM support (official) High Definition voice calls	-_(\u)_/-	Number Blocking Call Screening	APIs for Carriers and Calling Apps: multi-endpoint calling, CDMA voice privacy property, voicemail and video telephony	 Permission ANSWER_PHONE_CALLS for answering incoming phone calls programmatically AppSpecificSmsToken for one-time incoming SMS intent handling, good for SMS-based authorization/authentication without READ_SMS permission 	/ Calendar
Storage / filesystem •	-_('y')_/-	+	-_(\y)_/-	-_('y)_/		► READ_EXTERNAL_STORAGE permission changes ► Storage access framework operating on file level	Storage Access Framework, directory subtree level management	—	Adoptable Storage Devices - encrypts and formats the SD card to behave like part of internal storage	 File system permission changes - 0700 app dir permissions StrictMode API policy that prohibits exposing file:// URIs outside your app Direct Boot - LOCKED_BOOT_COMPLETED Scoped Directory Access Virtual Files Seamless system updates (with dual system partition) 	-_('y)_/-	 Cached data with quotas Custom seekable remote DocumentsProviders (i.e. for exposing files available on network storage) SharedPreferences with custom storage method via PreferenceDataStore New StrictMode detectors - UnbufferedIo, ContentUriWithoutPermission, UntaggedSockets 	• Storage / filesystem
Services •		+	Possibility of running service in isolatedProcess	ー 	 	 	bindService() method now requires an explicit Intent	—	 		-_(\mu)_/-	Background Execution Limits - after several minutes in background, system stops the app's background services	• Services
	KeyChain - import and access certificates in the system key store ASLR (Address Space Layout Randomization)	+	-_(\y)_/-	Secure USB debugging (allow debugging from authenticated computers only) Security scan of sideloaded apps (opt-in)	➤ SELinux (permissive mode) ➤ Android key store for app-private keys ➤ Hardware credential storage	➤ SELinux (enforcing mode) ➤ ECDSA added to the keystore provider ➤ VPNs are now applied per user	Default TLS/SSL changes: TLSv1.2 and TLSv1.1 protocols are now enabled, AES-GCM (AEAD) cipher suites are now enabled, MD5, 3DES, export, and static key ECDH cipher suites are now disabled, Forward Secrecy cipher suites (ECDHE and DHE) are preferred	Device Protection if device lost or stolen - after wipe it will require you to connect to the internet and then enter the account password of the last Google account on the Android device	 Move from OpenSSL to the BoringSSL Android Keystore provider no longer supports DSA. ECDSA is still supported USB connections set to charge-only mode by default Confirm Credential - app can authenticate users based on how recently they last unlocked their device Assist API - opt-out via FLAG_SECURE 	 File based encryption Key Attestation Network Security Config - custom trust anchors, Debug-only overrides, Cleartext traffic opt-out, Certificate pinning Default Trusted Certificate Authority - apps that target Android 7.0 only trust system-provided certificates and no longer trust user-added Certificate Authorities (CA) default TLS/SSL changes: RC4 disabled, CHACHA20-POLY1305 enabled 		The install source permission is now limited to only user-authorized apps RecoverableSecurityException for easier handling runtime permissions Authenticators can use their own policy to decide whether to hide accounts from, or reveal accounts to, an app. The Android system tracks applications which can access a particular account Platform no longer supports SSLv3 Values of ANDROID_ID are now scoped per-app instead of per-user	
Fingerprint WebView / browser	JavaScript V8 engine	+	— 			the state of the s	* Webview upgradeable through Google Play Chromium M37 WebRTC, WebAudio, and WebGL Web Components		FingerprintManager introduction Custom Chrome Tabs - seamless transitions between native and web content Support for global bookmarks removed	➤ WebView now powered by Chrome installed on device ➤ WebView multiprocess, changes regarding Javascript, geolocation	Fingerprint reader swipe down gesture	new error codes, incl. LOCKOUT_PERMANENT Version API, Google SafeBrowsing API, Termina- tion Handle API, Renderer Importance API Programmatic Safe Browsing actions	Fingerprint WebView / browser
System interactions / Data share / Text edit / Keyboard / Fonts		+	 Memory state information - onLowMemory() and getMyMemoryState() Live Wallpaper preview App stack navigation - parentActivityName creates synthetic back stack and other changes Copy and paste with intents Activity launch animations 	 Content providers are no longer exported by default Some device settings defined by Settings. System are now read-only System settings have been updated to support multiple users with the addition of Settings. Global. 	Restricted profile environment might not have all the standard Android apps available - also has to deal with UserManager.getUserRestrictions() Manifest: declarable required features	Tools for analyzing memory use	➤ Screen capture and screen share, android.media.projection API ➤ Android Beam (NFC) in share menu	—	 Custom text selection actions in a floating toolbar App Linking - associate an app with a web domain, skip prompting users to select an app for a particular web link Auto Backup for Apps Direct Share - at the top of the share list, a list of contacts with app icons next to their names will pop up 	Multi-window Support	 App Shortcuts - from the launcher directly to key actions within your app Demo User Hint - see if the device is running as the demo user (sandbox) Keyboard image insertion (IME mode) w/Com mit Content API Better Wallpaper metadata 	fontFamily XML attribute Content provider dataset paging Autosized text view App Categories (android:appCategory) in Manifest Smart sharing - each type of content will have suggested apps to share with (using Intent's	 System interactions / Data share / Text edit / Keyboard / Fonts
Sensors •	AMBIENT_TEMPERATURE, RELATIVE_HUMIDITY Synthetic sensors greatly improved	+			► GAME_ROTATION_VECTOR, ► GYROSCOPE_UNCALIBRATED, ► MAGNETIC_FIELD_UNCALIBRATED	 GEOMAGNETIC_ROTATION_VECTOR ROTATION_VECTOR STEP_DETECTOR STEP_COUNTER Batched sensor events 	Tilt detector, heart rate sensor, interaction composite sensors (gestures)	—- +		 	-_('')_/-	EXTRA_CONTENT_ANNOTATIONS)	- • Sensors
/ GPU API / VR	Hardware acceleration for all windows enabled by default OpenGL ES 2.0 (since Android 2.0 on NDK and 2.2 on Java)	+	ー - - - - - - - - - - - - - - - - - - -	Secondary Displays over either a wired connection or Wi-Fi RTL Layout Support	OpenGL ES 3.0 Optical bounds layout ("red" ninepatches) New values for screenOrientation Improved support for bi-directional text XXXHDPI introduced (then understood as 4k TV support rather than 1440x2560 5 inch phones)	GLES2.0 SurfaceFlinger	OpenGL ES 3.1 w/Android Extension Pack	—	 	 User-selectable DPI density Vulkan API OpenGL™ ES 3.2 API w/Android Extension Pack Google "Daydream" VR SDK for Android (name shared with Jelly Bean interactive screensaver mode) 	 Improved VR Thread Scheduling Night Light display mode (like f.lux) Touch-input latency improvements 	 Wide-gamut color display support - incl. bitmaps with color profile (AdobeRGB, Pro Photo RGB, DCI-P3, etc.) Multi-display support, move the activity from one display to another, Seamless rotations for fullscreen activities AnimatorSet API now supports seeking and playing in reverse 	General UI / OpenGL / GPU API / VR
Video / Media / UI •	RemoteControlClient	+	 MediaCodec class provides access to low-level media codecs Gapless playback between two separate MediaPlayer objects 	 Triple buffering Mipmaps in the Bitmap class Miracast support Renderscript Compute - run tasks on the GPU 	 MediaExtractor and MediaCodec enhancements Media DRM Video encoding from a Surface MediaMuxer class enables multiplexing between one audio stream and one video stream Playback progress and scrubbing for RemoteControlClient Mipmaps for a BitmapDrawable 	 Adaptive video playback Surface image reader New RemoteController APIs for custom media remote controllers Closed captions Scene transitions Immersive full-screen mode Screen recording Wi-Fi CERTIFIED Miracast Renderscript GPU acceleration available from NDK 	Media playback control (MediaSession API), media browsing, package-specific directories on shared storage for media files	—	4K Display Mode Themeable ColorStateLists	Synchronous movement to the SurfaceView Custom Pointer API (mouse/touchpad representation) Picture-in-picture (PIP) on Android TV		 Picture-in-picture (PIP) on all devices Media metrics; media player controls buffering, offering better frame seek and plyback of DRM content Media recorder supports MPEG2_TS Multiple A/V streams within MediaMuxer Easy adding new ringtones and sounds - with Add ringtone" as last list item 	● Video / Media / UI
	Face detection API Handware focus, metering areas and zoom	 Location information for an image or video Manage video stabilization 	onAutoFocusMoving() tells you whether auto focus has started moving or has stopped moving APIs to produce standard camera sounds	> 360 degree Photo Sphere images > Camera app with fullscreen preview	Photo Sphere improvements		camera2 API	—	 Camera access is now prioritized, previously it was "first come, first serve" Flashlight API (setTorchMode) 	<u></u>	New Camera app (Exposure adjustment, viewfinder grid modes, Smart Burst, and AE/AF Locking)		+─● Camera
Audio •		+		— 	— 	 On-demand audio timestamps Peak and RMS measurement Loudness enhancer 	low-latency audio input, Multi-channel audio - stream mixing, USB audio peripherals	—	► Camera2 Reprocessing API			New aptX high-quality Bluetooth audio codec —	——● Audio
	ADTS raw AAC audio encoding WEBP images	+	Noise Suppressor (NS)	— 	VP8	▶ Audio Tunneling to DSP	OPUS (audio), HEVC (video)	—		<u> </u>	- 	MPEG2_TS	● Codecs
	・Matroska video 	+	一十	Project Butter - UI animations run at 60fps	TRIM support for NAND chip storage	➤ AlarmManager batches together alarms, which are now inexact by default ➤ Project Svelte - optimize OS to fit in 512 MB RAM	Project Volta: JobScheduler Battery historian support Battery Saver mode added	—	Doze mode App Standby	Doze on the Go Project Svelte - optimize the way apps run in the background Sustained Performance API - prev. for Nexus 6P		Background Location Limits - background apps to receive location updates only a few times each hour (affects apps targeting older SDKs) Background Execution Limits - after several minutes in background, system stops the app's background services Apps can no longer register broadcast receivers for implicit broadcasts in their manifest (with	├─● Optimizations / Job schedulers
	Explore-by-touch mode Accessibility for views and accessibility services	+	 		SDK	—	├─ +	—-		 Multiple locales in Settings, better support bilingual use-cases Emoji - variation selectors, skin tone IU4J API partial support 	New emoji that represent a wider range of professions for women as well as men	whitelisted exceptions) TTS language detection, accessibility button, fingerprint gestures, word-level highlighting, hint text (even for controls which doesn't display hint text), continued gesture dispatch	• i18n / Emoji / Accessibility
Android for Work and Education		+	ー 		Codename KitKat Version name 4.4W[atch] Following versions	 	Managed provisioning, apps with Work badge, unified notifications, device owner apps	—	 Changes affecting work contacts in personal contexts, Wifi configrations, Device Policy Controllers and others Silent install and uninstall of apps by Device Owner, runtime permission management and other changes Work status notification (briefcase icon when managed app has activity in foreground) 	 Accessibility Enhancements Work Mode on/off switch button in Notification panel Security challenge, always on VPN, customized provisioning Changes to certificate installation, password resetting, secondary user management, and access to device identifiers 	├─ 	The ability to use a managed profile on a corporate-owned device. An overhauled work profile featuring a user-friendly setup flow Enterprise management for file-based encryption. Delegation of app management APIs	Android for Work and Education
Kiosk mode •		+	一十	ー十	4.4W.1, 4.4W.2 Release date 26 Jun 2014 Kernel version 3.10	 	Screen pinning, kind of kiosk mode: blank status bar, home and recent hidden, no new task starting; feature connected with device owner	—	managed app has activity in foreground) COSU - Corporate-Owned, Single-Use device disable or re-enable keyguard, status bar, safe boot	 	·- 	·	● Kiosk mode
			Google Play filter for TV apps: uses-feature			Printing Framework - print using a printer connected over Wi-Fi, Bluetooth, or other services		—+		Print Service Enhancements Android TV: Picture-in-picture (PIP) multiwindow		FEATURE RAM LOW and FEATURE RAM NORMAL	Printing Android ecosystem and
derivatives: TV, Wear, Auto, Things			"android.hardware.type.television"		smartwatches	_\ -	support • Android Auto supported	__/_/	_\\/_/	and Recording API		as new filters for Package Manager / Play store	derivatives: TV, Wear, Auto, Things

