[GMS-M-14.10-002] Keymaster 4 with certificate extension data schema version 3 enables developers to verify additional properties through Key Attestation including verifiedBootHash. New DEVICES launching with Android 9 and higher are STRONGLY RECOMMENDED to support Keymaster 4 with certificate extension data schema version 3.

Preliminary GMS release with Go 2GB details
updated: October, 10 2019

15 Android Go

Android CDD defines *a class of devices with limited size of RAM* (Low Memory Device) and requires them to return `True` for the public API `ActivityManager.isLowRamDevice()`.

After January 2, 2020, GMS compliant devices will be considered as either a GMS Go device or a GMS Standard device based on the device RAM and the IsLowRAMDevice flag as shown in the table below:

Device RAM	Partner Choice	IsLowRAMDevice = true	IsLowRAMDevice = false
512	Required Go	GMS Go device (follow GMS section 15)	Not allowed
1 GB	Required Go	GMS Go device (follow GMS section 15)	Not allowed
1.5 GB	Optional Go	GMS Go device (follow GMS section 15)	GMS Standard device (follow Standard GMS rules)
2 GB	Optional Go	GMS Go device (follow GMS section 15)	GMS Standard device (follow Standard GMS rules)

Partners are required to sign the *MADA addendum for Android Go* to ship the GMS on Low Memory Devices and launch with Android 8.0 or higher releases. Such devices (GMS Go Device) MUST meet the requirements in this section, which override some conflicting requirements in other sections in this document.

> Note: This does not apply to GMS Devices already launched with pre-8.0 Android releases and upgrade to Android 8.0 or higher releases.

In this section, all references of memory sizes, for example 512 MB, refers to the binary notation of Megabyte (1024x1024).

15.1 Geo-availability for Android Go

[GMS-M-15.1-001] GMS Go Devices MUST be compliant with the *Geo-availability for Android Go*, which is available from the GMS Help Center. If a GMS app is not listed in the Geo-availability for Android Go, its standard Geo-availability MUST be applied.

15.2 GMS Go Core Services and Apps

GMS Go Core services and apps include required apps and commonly used services. The required apps are listed below and must be presented with launcher icons as shown in section 15.3.

Core services

[GMS-M-15.2-001] GMS Go Devices MUST preload the complementary Core services listed below along with the Core services listed in section 2.2.

APK Filename / Package name	Description	Note
SearchSpeechServices `com.google.android.apps.speechservices`	Supports Google speech recognition service on GMS Go Devices.	
LatinImeGoogleGo `com.google.android.inputmethod.latin`	Lightweight version of Gboard app for GMS Go Devices.	This version shares the same package name with the full version but declares `android.hardware.ram.low` feature flag in its manifest.
NavGo `com.google.android.apps.navlite`	A headless app that implements turn-by-turn navigation feature for the Maps Go app.	Starting from November 15, 2018 onwards, Go devices that preload Maps Go app MUST also preload NavGo. Go devices that use the full version of Maps are not required to preload NavGo, but there is no functional impact if preloaded anyway.

Core apps

[GMS-M-15.2-002] The following apps replace the Core apps, defined in section 2.2, for GMS Go Devices.

512 MB	<2 GB	=2 GB
Google Assistant Go	Google Assistant Go	Google Assistant Go

512 MB	<2 GB	=2 GB
Google Chrome	Google Chrome	Google Chrome
Gallery Go	Gallery Go	Gallery Go
Gmail Go	Gmail Go	Gmail (full version)
Google Go	Google Go	Google Go
Maps Go	Maps Go	Maps (full version)
Play Store	Play Store	Play Store
YouTube Go †	YouTube Go †	YouTube (full version)
		Google Duo
		YouTube Music
		Google Drive

† Include YouTube Go or YouTube (full version) to your users depending on the Geo-availability rules

> Note: On Go devices launched on or after November 4, 2019, Gallery Go is a required core app.

> Note: A digital wellbeing solution with parental controls at the top level of the settings app [per section 3.4.1] is STRONGLY RECOMMENDED

> Note: On 512 MB RAM Go devices that launched before September 3, 2019, Maps Go is a GMS Go optional app.

Optional apps

[GMS-O-15.2-003] Partners MAY distribute the optional GMS apps listed in the Geo-availability for Android Go as well as the standard Geo-availability. Such apps not not listed in the Core apps requirements will count towards the application preload quota.

> Note: The optional Android Go GMS apps listed under Geo-availability can only be preloaded on a GMS Go Device.

15.3 Home Screen Appearance

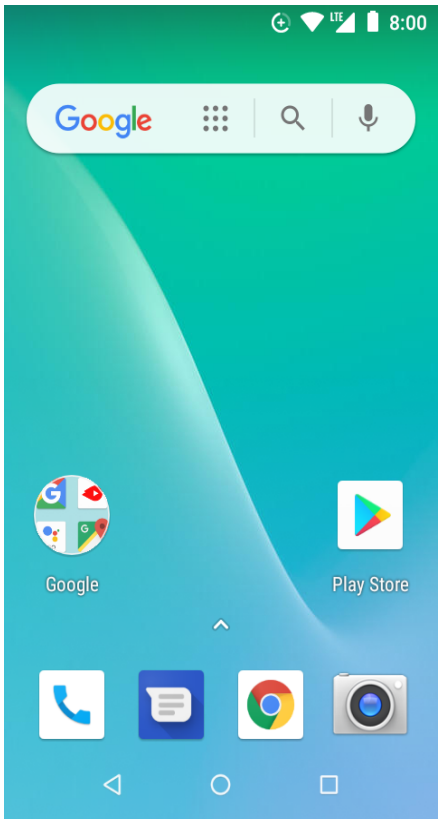
Default home screen layout

[GMS-M-15.3-001] The default home screen for GMS Go Devices MUST feature:

- the Google-provided Search Widget at the top,
- the Google Collections folder, named "Google", containing the GMS Go Core app icons, and
- the Play Store app icon.

[GMS-O-15.3-002] The default home screen for GMS Go Devices MAY feature:

- up to two additional applications or folders of the Partner's choice right above the hotseat.



An example layout for the default home screen

Additional home screens

<2 GB	=2 GB
If the launcher application contains an Apps Menu then no additional home screens are allowed. Otherwise, additional home screen(s) are allowed to the right of the default home screen	Additional home screens are allowed for 2GB devices, Partners should limit the total number of home screen no more than 2 for the best out of box experience.

If the launcher application contains an Apps Menu then no additional home screens are allowed by the partner. Otherwise, additional home screen(s) are allowed by the partner to the right of the default home screen.

Placement of the Google search widget

In order to provide a consistent user experience, the approved implementation of the Google Search Widget is provided via the Google Go app.

Placement of the Google Collections folder

[GMS-M-15.3-003] This folder on the default home screen MUST:

- be labelled "Google."
- have the GMS Go Core app icons in the following order from left to right, top to bottom (subject to the Geo-availability and device memory configuration):
- MUST NOT include any non-Google apps

Position	512 MB	<2 GB	=2GB
1	Google Go	Google Go	Google Go
2	YouTube Go †	YouTube Go †	YouTube (full version)
3	Gmail Go	Gmail Go	Gmail (full version)
4	Assistant Go	Assistant Go	Assistant Go
5	Maps Go	Maps Go	Maps (full version)
6	Gallery Go	Gallery Go	Gallery Go

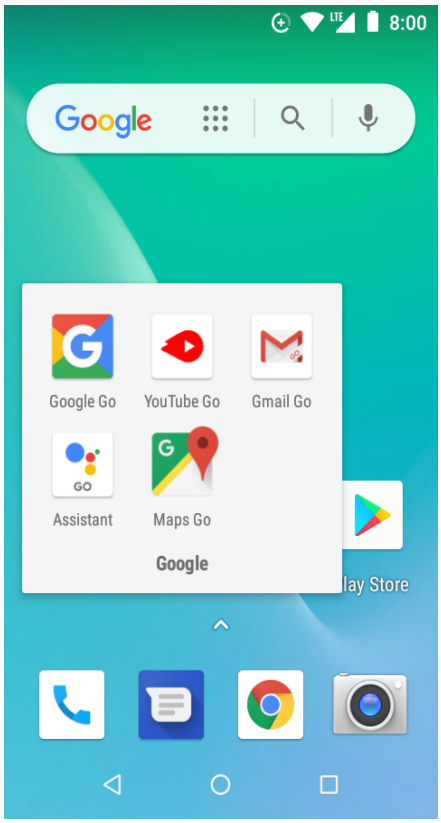
† Include YouTube Go or YouTube (full version) to your users depending on the Geo-availability rules

The following Go core 2GB apps are optional in the Google Collection folder:

- Duo
- YouTube Music
- Google Drive

These apps can adhere to one of the following placements:

- on the default home screen.
- on the hotseat.
- within the Google Collections folder at the end of the collection of GMS Go Core app icons.



Appearance of Google Collections Folder

Placement of apps in hotseat or default home screen

[GMS-O-15.3-004] Any GMS app MAY be placed in the hotseat or the default home screen. GMS Go Core app icons SHOULD be removed from the Google Collections folder if they are placed in the hotseat or default home screen. The hotseat MUST contain four application icons. On a device with an HD (720p) or above display, the hotseat MAY contain five application icons.

Placement of optional GMS apps

[GMS-O-15.3-005] Optional GMS app icons SHOULD adhere to one of the following placements:

- on the default home screen,
- on the hotseat, or
- within the Google Collections folder at the end of the collection of GMS Go Core app icons.

Placement on Apps Menu

For devices with an Apps Menu:

- **[GMS-M-15.3-006]** All GMS apps MUST be placed in the Apps Menu.
- **[GMS-M-15.3-007]** If a Partner chooses to implement folders within the Apps Menu, the GMS Go Core app icons SHOULD be placed within the Google folder.

- **[GMS-M-15.3-008]** The Play Store SHOULD be in the top level of the Apps menu and MUST NOT reside within any folder on the Apps Menu.
- **[GMS-M-15.3-009]** Other GMS app icons MAY be placed within the Google folder or at the top level of the Apps Menu.

15.4 User Data Partition

[GMS-M-15.4-001] For optimal performance, the f2fs filesystem MUST be enabled on the user data partition for flash-based storage devices.

[GMS-M-15.4-002] The user data partition size MUST NOT be less than specified in the table below. These partition sizes allow users to install applications and store content on their devices.

Flash storage size (GB*)	User data partition size (GB*)
4	1.2
8	5.0
16	12.0
>=32	24.0

* Numbers are specified in GB using decimal definition, based on powers of 10. This definition uses the prefix as defined in the International System of Units (SI).

> Note: If a GMS Go Device uses a file based swap outside of the user data partition, the size of the user data partition can be reduced by 0.2 GB for 512 MB RAM devices and by 0.4 GB for 1 GB RAM devices.

15.5 RAM Usage

[GMS-M-15.5-001] A device's free memory on boot MUST be more than the specified limits, and the persistent processes total PSS MUST NOT be more than the specified limits. These limits provide better performance and a good user experience.

Setup a device to calculate memory

To calculate a device's free memory or to calculate a device's persistent memory, setup the device by ensuring that:

- the apps on the device must only be the ones pre-installed by the device manufacturer.
- all settings should be in the default state.
- you reboot the device after the initial setup. The device must not be in the first boot after being flashed. After rebooting the device, wait for 5 minutes.

- you keep the screen on and the device unlocked when measuring values.

A device's free memory on boot

Depending on a device's configured screen size, the PSS value of MemAvailable in cat/proc/meminfo and the dirty PSS of cached processes at warm boot should be greater than:

RAM Size	Mem. Available
512 MB	125 MB
768 MB	285 MB
1 GB	430 MB
1.5 GB	650 MB
2 GB	850 MB

Calculating a device's free memory

Calculate the device's free memory:

1. To get MemAvailable values, run:
   `$ adb shell cat /proc/meminfo`
2. Identify all the cached processes:
   `$ dumpsys meminfo`
3. Sum **private dirty** and **private clean** memory of each process identified in step 2.
4. Add the results in step 1 and step 3.

Persistent processes total memory usage

The persistent processes total PSS must not exceed the values in the table. This is calculated using `dumpsys meminfo`, looking at the Total PSS by OOM adjustment under the Persistent header.

Screen size	HVGA	(F)WVGA/(F)WVGA+	qHD	HD
512 MB	80 MB	85 MB	N/A	N/A
768 MB	85 MB	90 MB	95 MB	N/A
1 GB to <2 GB	85 MB	90 MB	95 MB	100 MB
= 2GB	100 MB	110MB	120 MB	130 MB

Calculating a device's persistent memory

Calculate a device's persistent memory:

1. Enter the command:
   ```
   $ adb shell dumpsys meminfo
   ```
2. Persistent memory is the **Total PSS by OOM adjustment** under the **persistent** header

15.6 512 MB RAM devices

Screen size and camera resolution limits

[GMS-M-15.6-001] The display resolution and camera resolution MUST NOT exceed the limits below in order to provide a good user experience and good performance.

RAM size	Maximum display resolution	Maximum camera resolution
512 MB	(F)WVGA+	5MP

15.7 Application Preload

Minimum target SDK version

[GMS-SR-15.7-001] All preloaded apps and all apps installed by OEMs are STRONGLY RECOMMENDED to target SDK 26 (Oreo) or higher, per section 6.8. All apps installed by OEMs include apps requested or required by a telecom operator and apps installed using OTA mechanisms.

Definition of headed application

An application that registers for the following intent filter is a headed application:

```
<intent-filter>
  <action android:name="android.intent.action.MAIN" />
  <category android:name="android.intent.category.LAUNCHER" />
</intent-filter>
```

Number of preloaded headed applications

[GMS-M-15.7-002] The maximum number of headed applications preloaded, or otherwise installed by device manufacturer without explicit user opt-in, on the device MUST NOT exceed the limits below. GMS Go Core apps and one app from each exempt headed app category listed below will not count towards this limit.

Flash storage size (GB)	Max number of headed applications
4	8 (7 if launched before November 4, 2019)

Flash storage size (GB)	Max number of headed applications
8	8 (7 if launched before November 4, 2019)
>=16	System: 8 User data: 8 (7 if launched before November 4, 2019)
>=32	System: 10 User data: 10

Note: The Max number of headed application increases from 7 to 8 for new DEVICES launching on or after November 4, 2019.

Exempt headed app categories

Note: If a category below does not have a default app, then one app per category will be exempt, and the rest will count towards the limit of preloaded headed applications.

Note: For new DEVICES launching on or after November 4, 2019, if you preload your own gallery app, then it will be exempt and not count towards the limit of preloaded headed applications.

App category	Identifying the exempt app
Calculator	Action: `ACTION_MAIN` Category: `CATEGORY_APP_CALCULATOR`
Calendar	Action: `ACTION_MAIN` Category: `CATEGORY_APP_CALENDAR`
Camera	Provider for intent with Action: `ACTION_IMAGE_CAPTURE`
Clock	Action: `ACTION_SHOW_ALARMS` Category: `CATEGORY_APP_DEFAULT`
Contacts	Action: `ACTION_MAIN` Category: `CATEGORY_APP_CONTACTS`
Dialer	Provider for intent with action: `ACTION_DIAL`
Files	Action: `android.os.storage.action.MANAGE_STORAGE` Category: `android.intent.category.DEFAULT`
FM radio	Verification via whitelist. Please work with your Google Account Manager to add your FM radio app to the whitelist.

App category	Identifying the exempt app
Gallery	Action: `ACTION_MAIN` Category: `CATEGORY_APP_GALLERY`
SMS	Action: `ACTION_MAIN` Category: `CATEGORY_APP_MESSAGING`
Music player	Action: `ACTION_MAIN` Category: `CATEGORY_APP_MUSIC`
Launcher	Action: `ACTION_MAIN` Category: `android.intent.category.HOME`
Settings	Action: `android.settings.SETTINGS` Category: `android.intent.category.DEFAULT`
SIM toolkit	Verification via whitelist. Please work with your Google Account Manager to add your SIM toolkit app to the whitelist.
Sound recorder	Verification via whitelist. Please work with your Google Account Manager to add your Sound recorder app to the whitelist.
Weather	Verification via whitelist. Please work with your Google Account Manager to add your Weather app to the whitelist.

15.8 Application Memory

[GMS-M-15.8-001] All preloaded apps and all apps installed by OEMs without user action on the devices MUST meet the performance requirements outlined below. This includes Google apps, all apps installed by OEMs without user action, apps requested or required by a telecom operator and apps installed using OTA mechanisms.

Peak PSS memory usage requirements

On a clean device, depending on the configured screen size, preloaded apps and apps installed by OEMs in each app category below MUST not exceed the peak PSS memory usage requirements outlined below.

To test each app's peak PSS memory usage requirement, first setup a device by ensuring that:

- the apps on the device must only be the ones pre-installed by the device manufacturer.
- all setting should be in the default state in which the device will be shipped.
- the device is connected to a stable wifi and includes a working SIM card.
- you keep screen on and the device unlocked when measuring values.
- all other apps are closed before starting a test. Background apps can affect the test cases.

The following table describes how to test each app category, and it lists what the peak PSS usage (in MB) should be.

App category	Test scenario steps	HVGA	(F)WVGA / (F)WVGA+	qHD	HD
Dialer Default	1. Open the phone app. 2. Make a phone call by dialling a number. 3. Hang up. 4. Close the dialer app, and exit to the home screen.	65	65	65	65
Browsers All preloads	1. Open the browser app. 2. Navigate to about:blank. Navigating to a website other than about:blank may affect test results. 3. Keep the browser open for 5 seconds after the page fully loads. 4. Close the browser app, and exit to the home screen. **Note**: PSS targets include the rendered process also.	130	130	130	130
SMS App Default	1. Open the messaging app. 2. Send a text message. 3. Close the messaging app, and exit to the home screen.	50	55	60	65
Gallery Default	1. Open the gallery app. 2. Open a sample image. 3. View the image for 5 seconds. 4. Close the gallery app, and exit to the home screen. **Note**: Whitelisted cloud galleries are exempt from this test.	55	60	65	70
Camera Default	1. Open the camera app. 2. Use the default camera to take a picture. 3. Close the camera app, and exit to the home screen.	75	80	80	85
Music app Default	1. Open the music app. 2. Play a music file for 30 seconds. 3. Close the music app, and exit to the home screen.	35	40	45	50

App category	Test scenario steps	HVGA	(F)WVGA / (F)WVGA+	qHD	HD
Streaming music app Default	1. Open the streaming music app. 2. Wait for 5 seconds. 3. Close the streaming music app, and exit to the home screen.	80	90	100	110
Launcher Default	1. Reboot the device. 2. Unlock the screen. 3. Stay on the home screen for 60 seconds. 4. Measure the memory usage. **Note**: For the launcher, the measurement is taken after the wait time, rather than during the peak, unlike other apps.	30	35	40	50
Streaming video player Default	1. Open the streaming video player app. 2. Wait for 5 seconds. 3. Close the streaming video app, and exit to the home screen.	80	90	100	110
Maps	1. Open the maps app. 2. Wait for 10 seconds. 3. Close the maps app, and exit to the home screen.	135	135	135	135

All preloaded apps and apps installed by OEMs not covered in the requirements above MUST not exceed the following peak PSS memory usage requirements (in MB) for the corresponding device configured screen size:

App category	Test scenario steps	HVGA	(F)WVGA	qHD	HD
All other apps	1. Open the app. 2. Wait for 60 seconds. 3. Grant all permissions and set up the app. 4. Close the app and clear all caches. 5. Start measurements. 6. Open the app. 7. Wait for 5 seconds. 8. Close the app, and exit to the home screen.	55	60	65	75

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