



Android 10 OS Update Instruction for Family of Products on SDM660

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Zebra uses AB mechanism for OS Update on SDM660 products running Android O and above. This is a new OS Update mechanism which is unavailable on other Zebra products with Android O.

The intent of this document is to advise Zebra customers and service about

1. AB OS Update mechanism
2. How to apply OTA packages on SDM660
3. How AB devices are different to legacy Non-AB systems
4. Fastboot flashing of AB devices

List of supported devices on A10 are:

TC52, TC57, TC72, TC77, MC3300x, MC93, PS20, EC30, CC600, CC605, CC610, CC6000, VC8300, TC8300, ET51, ET56, L10AW, L10A, MC9300, TC8300, CC600, C6000, TC21, TC26, MC2200, MC2700, TC57X, TC52X, MC3300, EC50, EC55, TC72X, TC77X, WT6300

1. A/B (Seamless) OS Update implementation on SDM660 devices

- Full OTA updates can occur while the **system is running**, without interrupting the user. This means users can continue to use their devices during an OTA. After the installation of OTA package is completed, device reboots into the updated image.
- **AB** device are fault tolerant by providing a backup slot. If device fails to boot-up, then it will fall back to backup slot (slot with previous used good image/Baseline image) and device remains usable.
- In AB Update, updates can be streamed to A/B devices, removing the need to download the package before installing it.

2. How AB system is different to Non-AB system

Patching Use Case	Current (Non-AB)	AB	Notes
Mode for flashing Full OTA Package and Diff OTA Package	Recovery Mode	Android AB & recovery Mode	Non-AB: Device shall boot into recovery mode to apply any OTA package AB: Device shall apply Full OTA Package via Android AB mode and OTA Diff, Reset Packages shall be applied via Recovery mode
WLAN, Audio tuning, ST Automation Packages	Y	Y	
Patch upgrades can go to any patch version in the same baseline	Y	Y	
Patch downgrades can go to any patch version in the same baseline	Y	Y	SDM660 Android O has Version Binding implementation which will cause data reset on downgrade.
Rollback to baseline	Y	Y	Non-AB: We can generate package to rollback. But we don't release the package. AB: If device fails to boot-up into new installed patch OS image, then device shall fall back to baseline image
Standard patches can be applied to hotfixes · Hotfixes are cumulative and have rollback	Y	Y	
Max package for an update scenario	2 files w/UPL	2 files w/UPL	
Patch Size	-	+	AB saves size from no Rollback.
Update Speed			
Silent Update	X	Y	AB silent to user

3. Android AB Mode for OS Update

A full OTA package will be installed via Android AB mode. As part of this:

- a. Full OTA package will be applied on the device silently in the background.
- b. User can continue using the device while Full OTA package will be applied.
- c. Once the Full OTA package is applied, device auto-reboots to boot into new installed image.
- d. Customers can also configure the device to wait for EMMs to notify device to reboot via CSP.

Full OTA package consists of following:

1. HLOS images (system, vendor, boot and dtbo)
2. Non-HLOS images (QCOM images)

Full OTA packages are used when we change to a new Baseline image.

4. Recovery Mode for OS Update

OTA patch images, reset packages and any special packages to update `/persist` or `/odm` partitions will be installed via recovery mode.

As part of this:

- a) Device will be automatically reboot to recovery mode.
- b) OTA patch, reset packages or special packages will be applied using recovery mode.
- c) Device will reboot back to home screen after installation is completed in recovery mode.
- d) Customers can enter recovery mode using following **key combinations** of “**PTT Key + Scan Key + Power button**” or using “**adb reboot recovery**” command.

OTA Patch image consists of following:

1. HLOS images (system, vendor, boot and dtbo)
2. Non-HLOS images (QCOM images)

OTA patch images are used to provide incremental updates to a device. The size of the OTA patch image is smaller compared to Full OTA package and time taken to apply them is also very less.

5. Reset Packages and special recovery packages

Zebra devices support reset packages to erase userdata and enterprise partition. These packages will be applied via recovery mode.

Package	Information
Enterprise Reset	Erase userdata partition and persist enterprise partition
Factory Reset	Erase both userdata and enterprise partition
Special recovery packages	Packages used to modify <code>/persist</code> or <code>/odm</code> partitions or packages to update WLAN region code, audio tuning files etc. can be applied via recovery mode.

6. OS Upgrade and Downgrade

Customer can upgrade the device to another Baseline image or to a patch image on a given baseline. In both cases user data is persisted on all OS Upgrade operation.

Customers can perform OS downgrade to an older baseline or to a patch image belonging to an older baseline. If customer performs **OS downgrade** operation, forced **auto data reset** is performed. **Data persistence is not supported on OS Downgrade.**

DOWNGRADE OPERATION	Release	Build_ID (ro.device.patch.version)	Google Security Patch level (ro.build.version.security_patch)	UPGRADE OPERATION
Android Oreo				
↑	Full Baseline - A	01-12-01.00-OG-U00-STD	1-Oct-2018	↓
	Patch	01-12-01.00-OG-U01-STD	1-Nov-2018	
	Hotfix	01-12-01.00-OG-U01-H01	5-Oct-2018	
	Patch	01-12-01.00-OG-U02-STD	1-Jan-2019	
	Full Baseline - B	01-09-25.05-OG-U00-STD	1-Mar-2019	
	Patch	01-09-25.05-OG-U01-STD	1-May-2018	
	Patch	01-09-25.05-OG-U02-STD	1-Jun-2019	
	<p>On OS Downgrade, Data is LOST (userdata erased) on OS Downgrade. OS Downgrade operation can be within a baseline or across baseline</p>		<p>On OS Upgrade operation, Data is persisted on OS Upgrade. OS Upgrade operation can be within a baseline or across baseline.</p>	

On SDM660 O and above, following is the experience related to OS Update:

1. Customers shall be able to perform OS Upgrade (move to a higher version of OS Image) using Full OTA package.
2. Customers shall be able to perform OS Upgrade (move to a higher version of OS Image) using OTA patch image.
3. Downgrade (move to an older/lower version of OS Image) operation will be disabled by default on SDM660 O. Any customers who use existing CSPs to perform OS Update shall not be able to perform OS downgrade.
4. Existing OS update interface shall be able to perform only OS upgrade operation and not OS Downgrade operation.
5. Using a new interface, customers shall be able to perform OS Downgrade operation with Full OTA/OTA Patch image.
6. The Downgrade interface shall be able to perform only downgrade operation and not OS Upgrade operation.
7. All OS downgrade operation will result in an Enterprise Reset operation. i.e., user data is erased on OS downgrade operation.
8. Following parameters will be considered for OS downgrade operation
 - a. OS Google Security patch level (ro.build.version.security_patch)
 - b. OS patch version (ro.device.patch.version)
 - c. OS Hotfix version
 - d. Custom OS version

7. OS Upgrade and Downgrade via EMMs

Kindly refer to MX tech docs present on Zebra **TechDocs** portal for more details on supported CSP interfaces for OS Upgrade and Downgrade.

<https://techdocs.zebra.com/mx/powermgr/>

OS Update via EMM	OS Upgrade	OS Downgrade
Reset Action	10 - OS Upgrade	11 - OS Downgrade
Allowed OTA Packages	Full OTA Package, OTA Patch image, UPL	Full OTA Package, OTA Patch image, UPL
Data persistence	YES	NO Auto data reset shall be performed
Allowed OS Update use case	UPGRADE ONLY Upgrade from Baseline to a higher OS Patch version Upgrade from Baseline to a higher SPL version Upgrade from Baseline to a higher Baseline Upgrade from Baseline to a higher Hotfix version Upgrade from Patch to a higher Patch version Upgrade from Patch to a higher SPL version Upgrade from Patch to a higher Baseline Upgrade from Patch to a higher Hotfix version Upgrade from Hotfix to a higher Hotfix version Upgrade from Hotfix to a higher SPL version Upgrade from Custom OS to a higher Custom version Upgrade from Custom OS to a higher Custom OS SPL version Upgrade from Custom OS to a higher Custom Baseline	DOWNGRADE ONLY Downgrade from Baseline to a lower/older Baseline Downgrade from Baseline to a OS Patch version on lower/older Baseline Downgrade from Patch to a lower/older Patch version Downgrade from Patch to a lower/older SPL version Downgrade from Patch to a lower/older Baseline Downgrade from Patch to a lower/older Hotfix version Downgrade from Hotfix to a lower/older Hotfix version Downgrade from Hotfix to a lower/older SPL version Downgrade from Custom OS to a lower/older Custom patch version Downgrade from Custom OS to a lower/older Custom OS SPL version Downgrade from Custom OS Baseline to a lower/older Custom OS Baseline version Downgrade from Custom OS Baseline to a Custom OS Patch version on a lower/older Custom OS Baseline version

Recovery UI also has been modified for OS Upgrade and Downgrade. Separate OS Upgrade and Downgrade options have been enabled in recovery UI to perform OS Update operation.

Kindly visit below sections in this document for detailed explanation on recovery mode.

8. AB Streaming Update

An OTA package can reside on server and SDM660 devices can stream the package from server directly to device without saving the OTA package on device. The OS update happens in background and a user notification shall be displayed to indicate that OS update operation is in progress.

OS Update package can be streamed to A/B devices, removing the need to download the OTA package to the device before installing it. With help of AB Streaming mode user can perform OS update operations even if disk space is low. Same OTA package can be used for both AB streaming and AB seamless updates.

Interface to initiate AB streaming update remains same as AB seamless update. Refer to **Section 7** of this document for details on interfaces.

Table below depicts the arguments to be used for AB streaming update:

Operation	Reset Action	Details
UPGRADE	12 - OS Upgrade Streaming	Launches a full-package OS Upgrade via streaming server.
DOWNGRADE	13 - OS Downgrade Streaming	Launches a full-package OS Downgrade via streaming server.

Once AB streaming update has started, a user notification message indicating that OS Update is in progress will be displayed. Same status is available via OEMInfo.

While AB streaming update is in progress, a progress bar shall show the progress of the operation. After AB streaming update has completed, device shall show a notification that in 15 seconds device will auto-reboot.

After 15 seconds, device will auto-reboot into new OS image.

Device needs to authenticate with server before the OTA package residing on server can be streamed. EMM solution or FOTA solution who is initiating OS Update job will have to generate the authentication Id and share with device using Power Manager CSP.

Following Authentication modes are supported for AB streaming mode.

- Token Auth
- Username & Password (Basic Auth).
- No Authentication

Device supports following protocols to perform AB streaming

- http
- https

Installing Full OTA package upgrade/downgrade can be accomplished using AB streaming update. All other Enterprise use cases of Zebra cannot be supported by AB Streaming update.

- Installing LG patches or Delta packages are not supported by AB streaming update.
- Installing multiple OTA packages using UPL is not supported by AB streaming update.

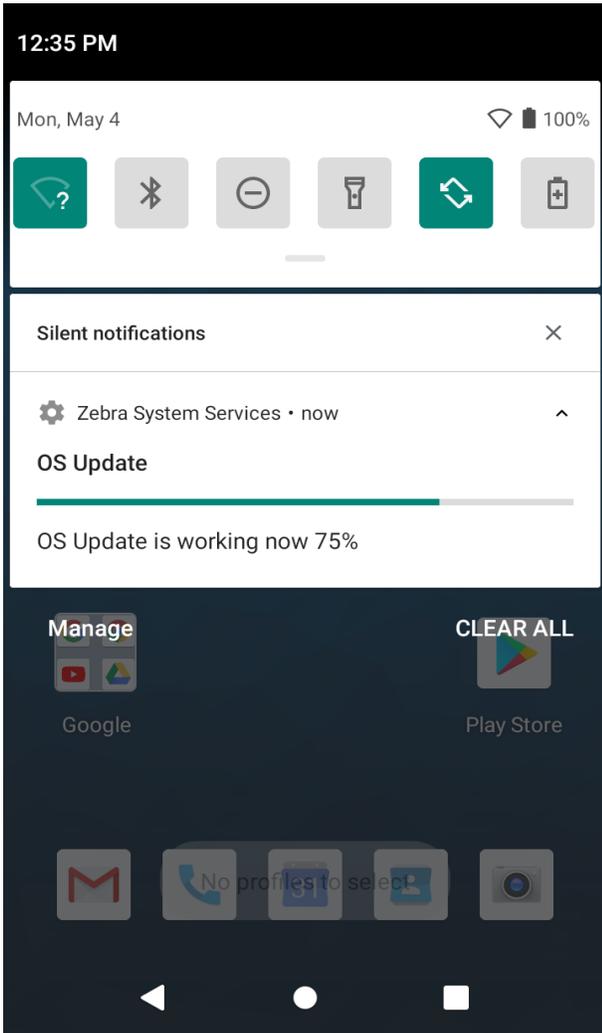
9. User Notification for Full OTA package Upgrade or Downgrade

SPR 36526 was fixed in 01-18-02.00-OG-U00-STD/01-18-02.00-ON-U00-STD OS version. With this fix, we now bring user notification when a Full OTA package is being installed. Earlier OS versions had implemented a silent OS update and thus user was unaware of the background OS Update process.

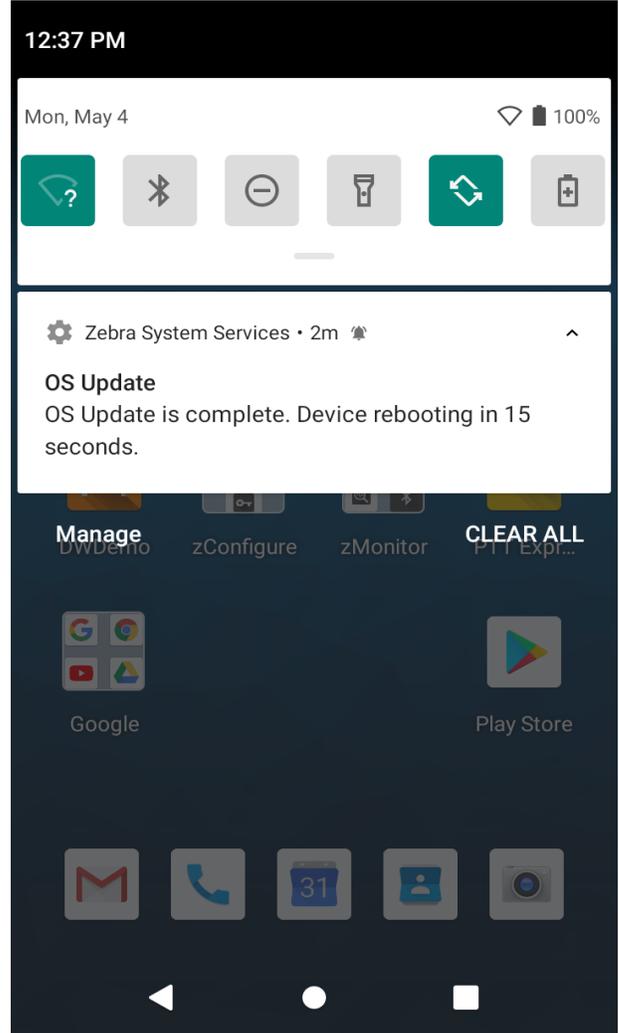
Few of the features of this user notification:

1. This is applicable only for Full OTA package and is not applicable for OTA Patch image.
2. On start of Full OTA package installation, an Icon (android system icon) will be displayed on the Status Bar.
3. On pulling down the notification drawer, a notification will be displayed informing that OS Update is in progress and device will Reboot automatically on completing the same.
4. User will have no control over this notification. i.e., User CANNOT
 - a. Pause/Snooze the OS Update request
 - b. Cancel OS Update request
 - c. Prevent Reboot of device
5. Notification can be cleared by User. Once notification is removed, no new notification shall be displayed again.
6. If EMMs have selected “Suppress Reboot” option while installing a Full OTA package, then device will not auto-reboot. User Notification too indicates the same and waits for EMMs to reboot the device.
7. The notification will also display system interrupts blocking OS Update process. E.g., Low Battery, Media Eject etc.

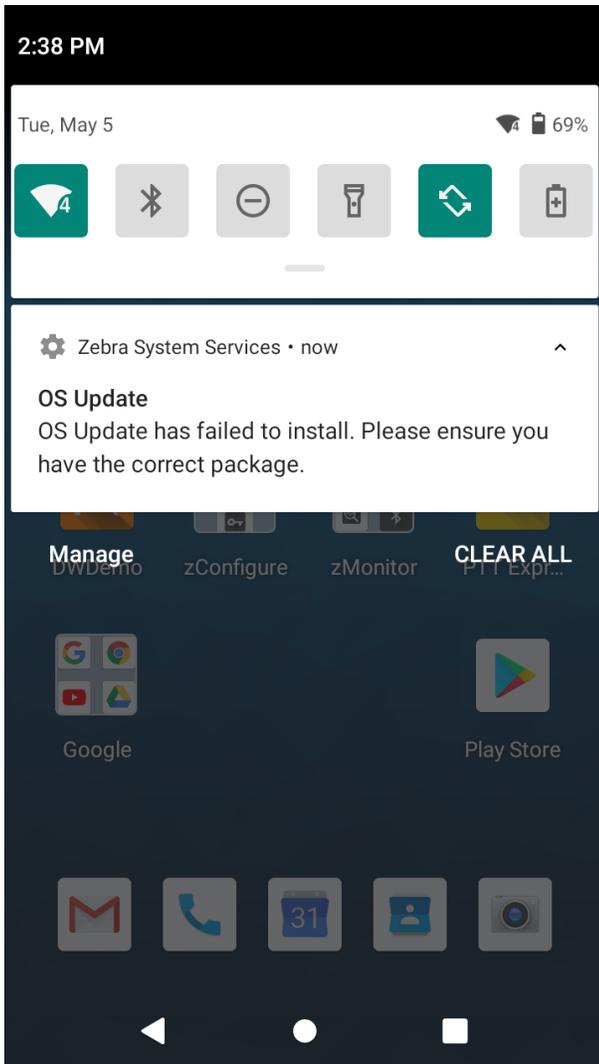
A Full OTA package installation has started



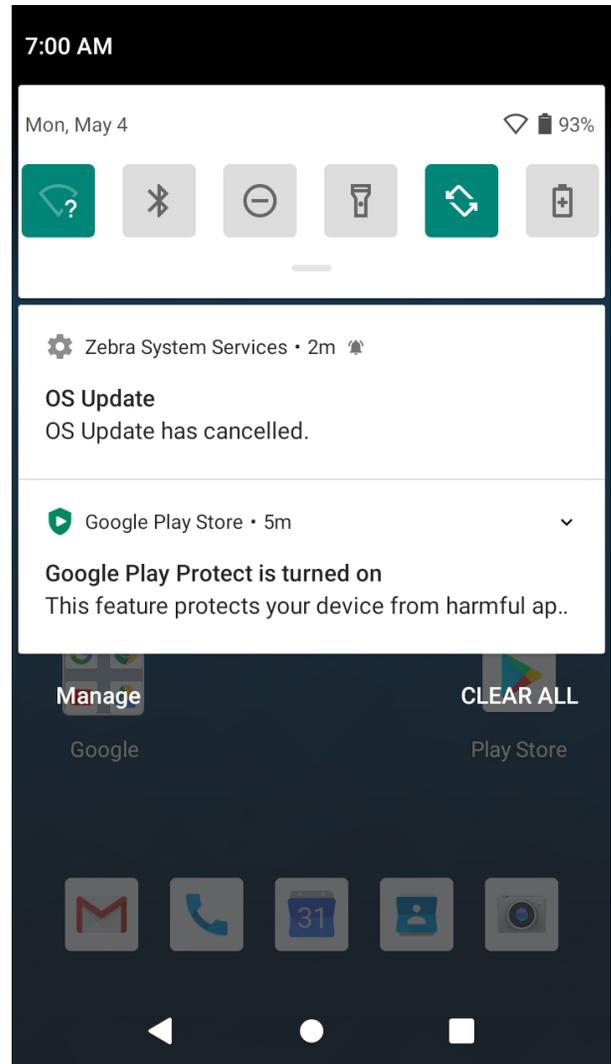
Installation of Full OTA package completed



A Full OTA package installation has failed to apply



Notification for Cancelling an OS Update job



10. Recovery Mode

From recovery UI customers can install full OTA packages, OTA Patch images and reset packages.

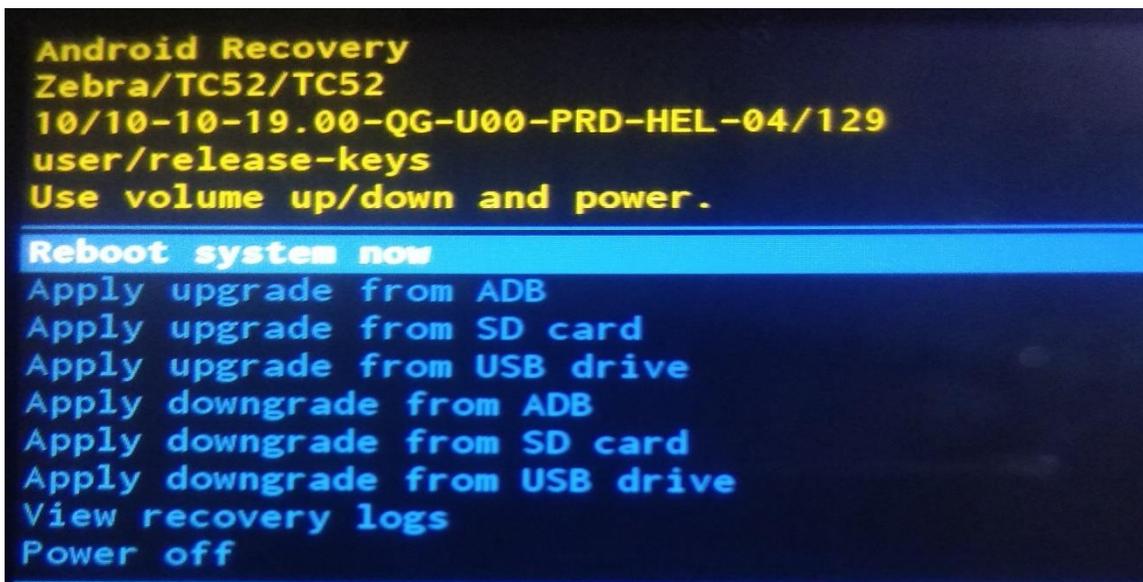
SDM660 Recovery UI provides the following options to perform various operations in recovery mode and apply different packages:

- Reboot system now
- Apply upgrade from adb
- Apply upgrade from SD card
- Apply upgrade from USB drive
- Apply downgrade from adb
- Apply downgrade from SD card
- Apply downgrade from USB drive
- View recovery logs
- Power off

Different UI options and their functionalities are explained below in detail.

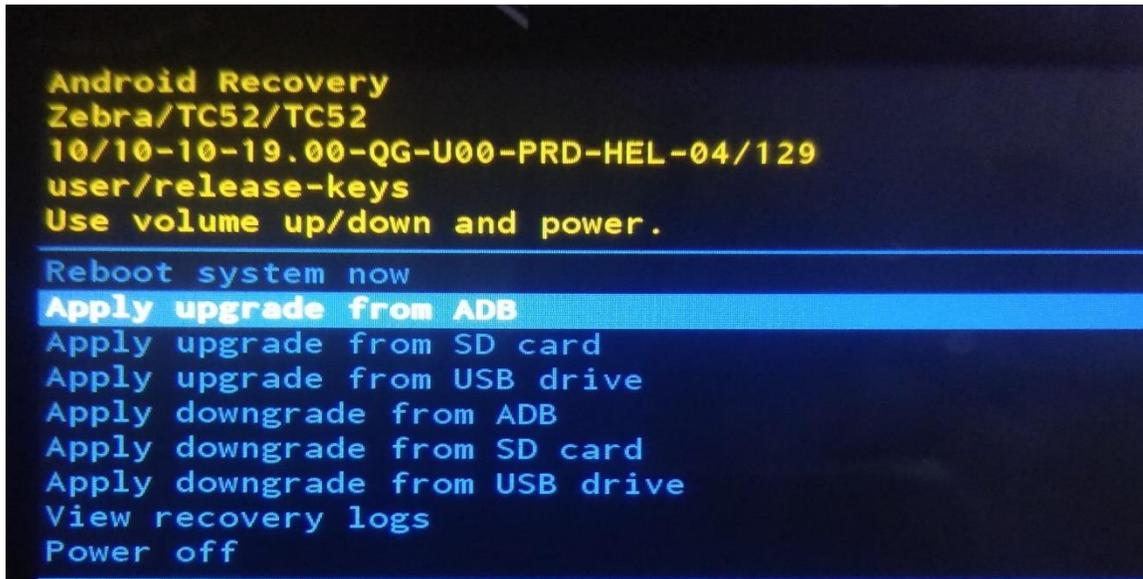
- **Reboot system now**

When this UI option is selected by user, device will boot to OS.

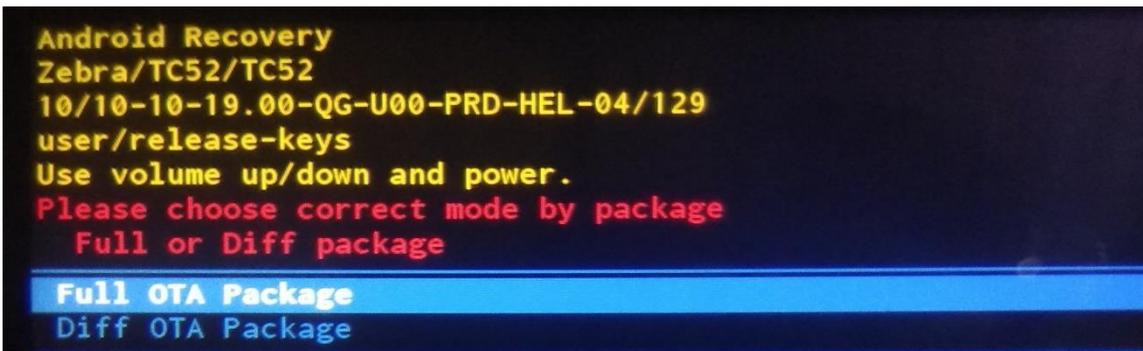


- **Apply upgrade from adb**

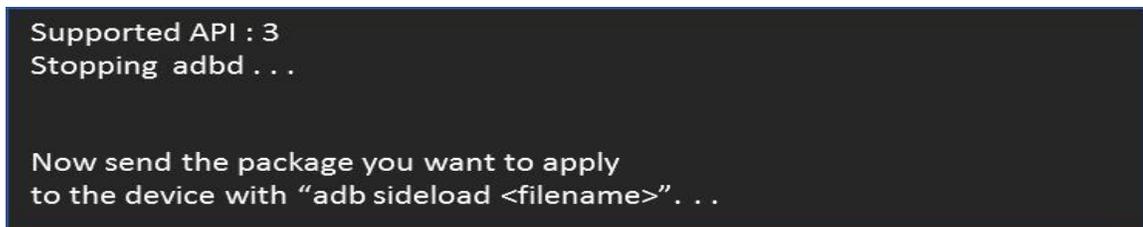
Upgrade packages via adb will be applied when we select this option. User can only perform OS Upgrade operation and not downgrade operation using this option.



User will be provided two different options one option is for Full OTA package. User should select this option to apply Full-OTA upgrade package or reset packages.



After selecting **Full OTA Package** option user should enter the package name via adb sideload interface.



Second option is to apply OTA Patch image (Diff OTA). User should select this option to apply OTA Patch images.

After selecting **Diff OTA Package** option user should enter the package name via adb side load interface.

- Apply upgrade from SD card

Upgrade packages via External SD card will be applied when we select this option. User can only perform OS Upgrade operation and not downgrade operation using this option.

```

Android Recovery
Zebra/TC52/TC52
10/10-10-19.00-QG-U00-PRD-HEL-04/129
user/release-keys
Use volume up/down and power.

Reboot system now
Apply upgrade from ADB
Apply upgrade from SD card
Apply upgrade from USB drive
Apply downgrade from ADB
Apply downgrade from SD card
Apply downgrade from USB drive
View recovery logs
Power off
  
```

Using this option, customers can perform OS Upgrade using Full OTA packages, OTA Patch images and install Reset Packages from SD card.

```

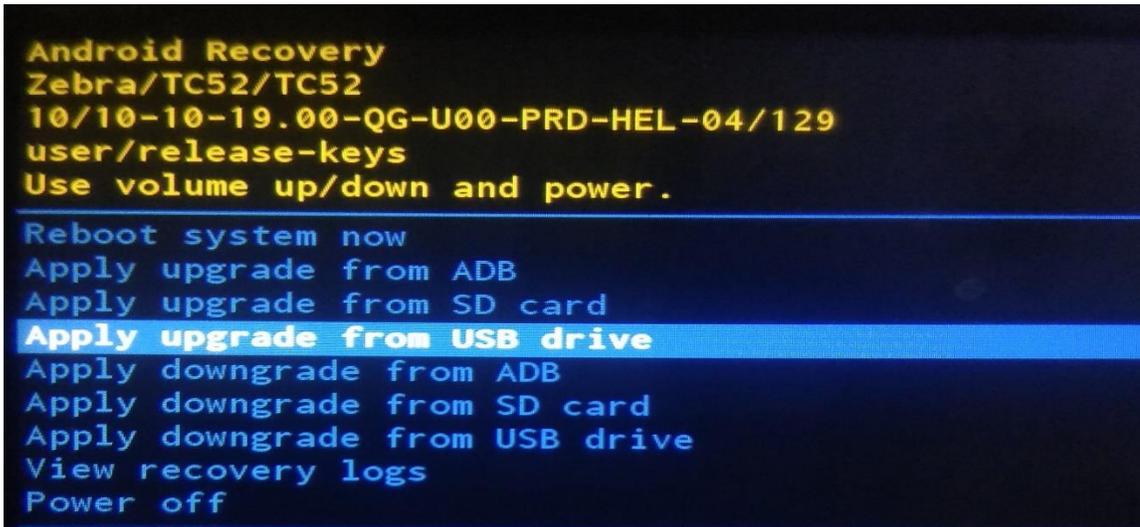
Android Recovery
Zebra/TC52/TC52
10/10-10-19.00-QG-U00-PRD-HEL-04/129
user/release-keys
Use volume up/down and power.
Choose a package to install:
/sdcard

../
Downgrade.upl
Release_Android10_EnterpriseReset_V4.zip
Release_Android10_FactoryReset_V4.zip
Upgrade.upl
ota_full_oreo_user_nongms_20190919.003205.zip
ota_full_user_gms_android10_20200428.162616-U00.zip
ota_full_user_nongms_android10_20200420.015243.zip
updatepackagegist.upl
Alarms/
Android/
DCIM/
Download/
LOST.DIR/
Movies/
Music/
Notifications/
Pictures/
Podcasts/
Ringtones/
RxLogger/
efsstorage/
image/
  
```

- **Apply upgrade from USB drive**

Upgrade packages via USB drive will be applied when we select this option. User can only perform OS Upgrade operation and not downgrade operation using this option.

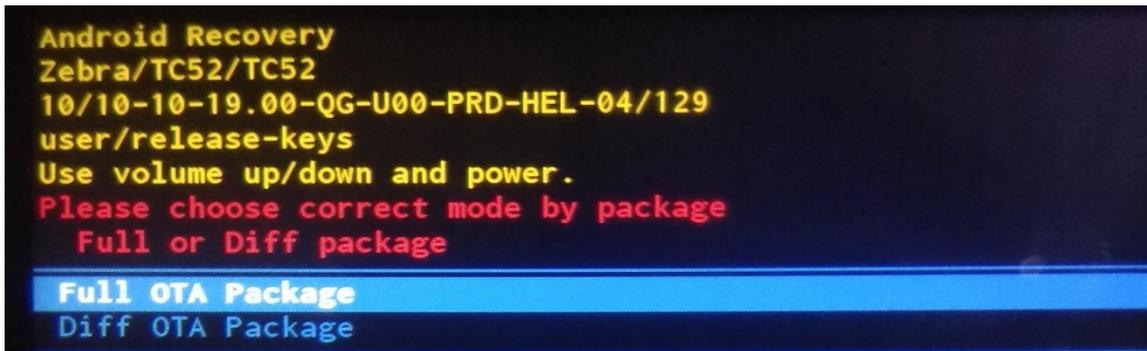
Using this option, customers can perform OS Upgrade using Full OTA packages, OTA Patch images and install Reset Packages from USB drive.



- **Apply downgrade from adb**

Downgrade packages via adb will be applied when we select this option. User can only perform OS Downgrade operation and not upgrade operation using this option.

User will be provided two different options one option is for Full downgrade OTA package. User should select this option to apply Full-OTA downgrade package or reset packages.



Once selecting Full OTA package option user should enter the package name via adb side load interface.

```
Current battery capacity: 95%
Battery Limit           : 30%

Now send the package you want to apply
to the device with "adb sideload <filename>"...
```

Second option is for OTA Patch image (Diff OTA). User should select this option to apply OTA-diff downgrade packages.

```
Android Recovery
Zebra/TC52/TC52
10/10-10-19.00-QG-U00-PRD-HEL-04/129
user/release-keys
Use volume up/down and power.
Please choose correct mode by package
  Full or Diff package

Full OTA Package
Diff OTA Package
```

Once selecting Diff OTA package option user should enter the package name via adb sideload interface.

- **Apply downgrade from SD card**

Downgrade packages via External SD card will be applied when we select this option. User can only perform OS Downgrade operation and not upgrade operation using this option.

Using this option, customers can perform OS downgrade using Full OTA packages, OTA Patch images and install Reset Packages from SD card.

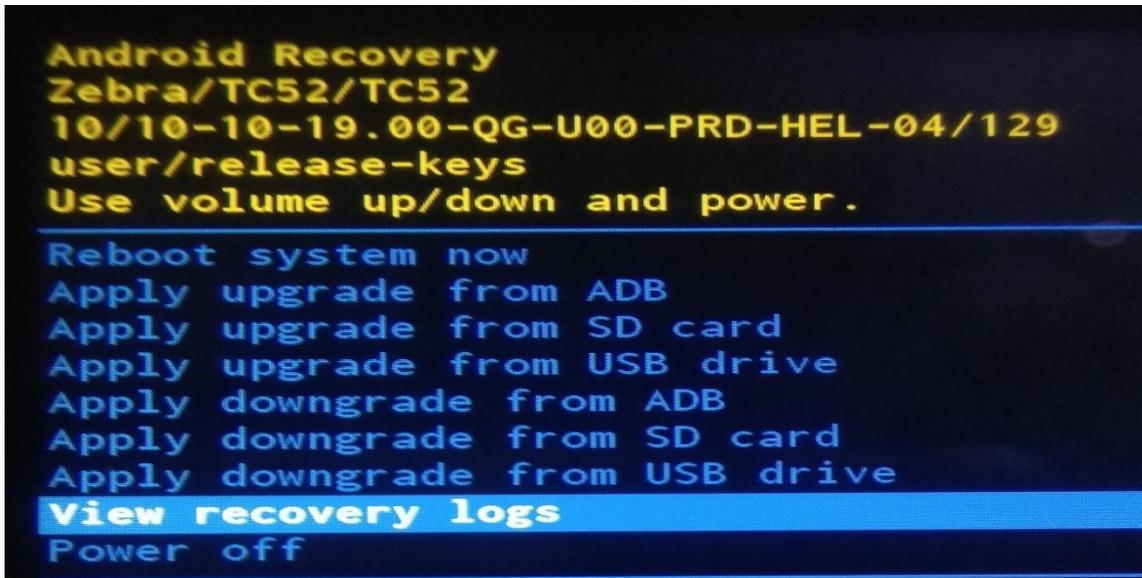
- **Apply downgrade from USB drive**

Downgrade packages via USB drive will be applied when we select this option. Using this option, customers can perform OS Upgrade using Full OTA packages, OTA Patch images and install Reset Packages from USB drive.

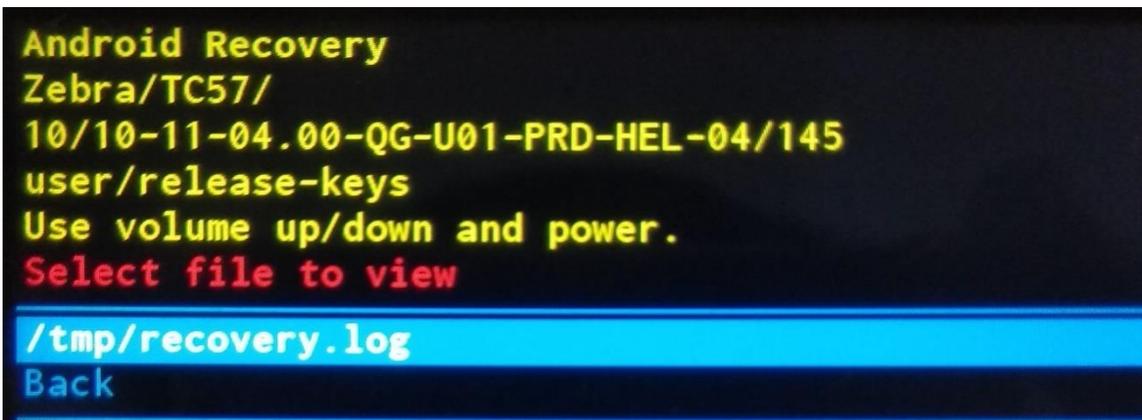
User can only perform OS Downgrade operation and not upgrade operation using this option.

- View recovery logs

By selecting this option user can view recovery logs.



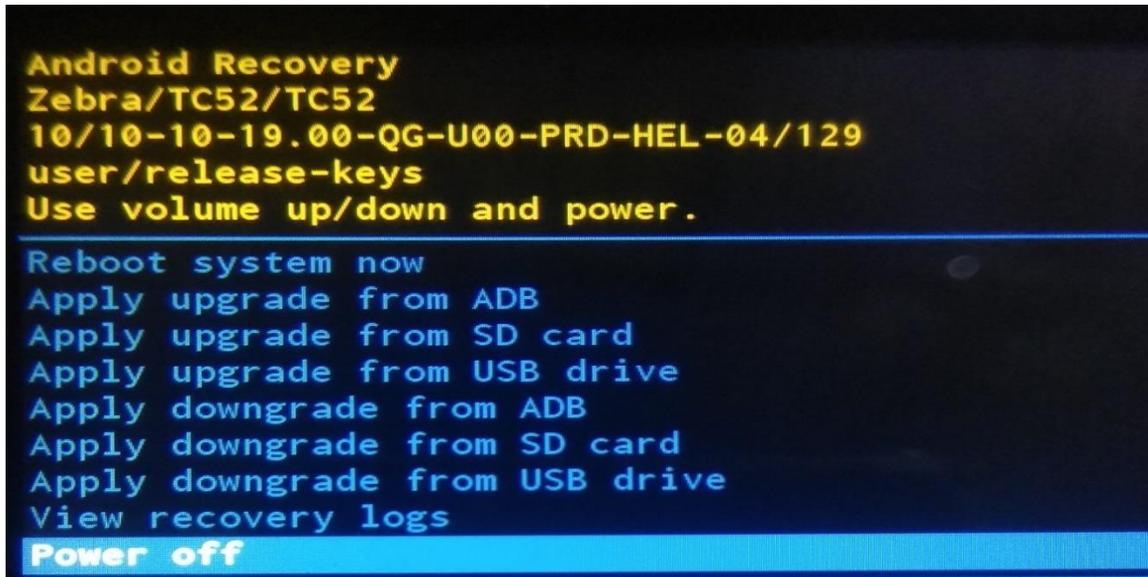
Recovery logs will be available in /tmp/recovery.log



By selecting **Back**, we can return to main menu.

- **Power off**

By selecting this option user can power off device.



11. UPL mechanism

User can apply multiple OS Update packages in a single step using UPL mechanism. UPL allows user to migrate from a baseline / patch image to

- a new patch image on different baseline
- a new patch image on new dessert image
- a patch on older dessert image
- apply reset packages after installing the required OS images

An UPL file can consist of following

- Baseline image (Full OTA package)
- Baseline delta package
- OS patch image (diff/incremental OTA package)
- Reset packages

Rules to build an UPL:

An UPL can consist of following combinations

- Baseline Full OTA package + OS Patch image (e.g. LG patch)
- Baseline Full OTA package + OS Patch image (e.g. LG patch) + Reset package
- Baseline Full OTA package + OS Patch image (e.g. LG patch) + Reset Command
- Baseline Delta package + OS Patch image (e.g. LG patch)
- Baseline Delta package + OS Patch image (e.g. LG patch) + Reset package
- Baseline Delta package + OS Patch image (e.g. LG patch) + Reset Command

An UPL should not be configured as below

- OS Patch image (e.g., LG patch) followed by Baseline Full OTA package
- OS Patch image (e.g., LG patch) followed by Baseline Delta package
- More than 1 OS patch images of same baseline. (e.g.: LG01 + LG02 + LG03)
- No new lines should be present after the last line in UPL file
- No trailing tab spaces should be present after each line in UPL file
- No unwanted characters should be present after each line in UPL file

Device can be reset using following UPL commands are supported on A10. This avoids the need to push a reset package when using UPL.

- EnterpriseReset
- FactoryReset

Few valid examples of UPL files are as below

Sample1.upl	Sample2.upl
package:Full_OTA_Package.zip	package:Baseline_Delta_Package.zip
package:Patch_OS_Package.zip	package:Patch_OS_Package.zip
Sample3.upl	Sample4.upl
package:Full_OTA_Package.zip	package:Baseline_Delta_Package.zip
package:Patch_OS_Package.zip	package:Patch_OS_Package.zip
package:FactoryReset.zip	package:FactoryReset.zip
Sample5.upl	Sample6.upl
package:Full_OTA_Package.zip	package:Baseline_Delta_Package.zip
package:Patch_OS_Package.zip	package:Patch_OS_Package.zip
command:FactoryReset	command:FactoryReset

To install an UPL, copy UPL file and its corresponding OTA packages to the same location on the device. Select UPL filename to install the packages and not any individual OTA package names.

If UPL and OTA packages were copied to internal memory (/sdcard or /data/tmp/public) then these files should not be re-used. UPL files and OTA packages residing in internal memory of device should be deleted after they have been applied. Do not re-use the same packages or UPL files.

An UPL cannot be installed using adb sideload mode

If UPL consists of a Full OTA package and a Diff OTA package:

- Full OTA package shall get installed in Android AB mode (background update)
- Patch/Diff OS image will be installed in recovery mode
- Device will auto reboot to recovery mode after Full OTA package installation has completed.
- Suppress reboot flag shall not be considered in UPL update.

12. Status messages to EMMs

OS Update status is sent as an intent. Data Analytics captures the same and stores it in OEMInfo content provider. EMMs can read OEMInfo content provider to fetch the exact status of OS Update operation. Device does not display any kind of UI notification when an OS Update is in progress/applied/failed.

OS Update State	What does it mean	Next Job request	Comments
IN_PROGRESS	AB OTA Update has started and is in progress.		Device CANNOT accept new OS Update request.
WAITING_FOR_REBOOT	AB OTA Update is installed and Waiting for device to reboot to boot into new OS.		Device CANNOT accept new OS Update request.
IN_SUSPEND	AB OTA Update is in suspend state(e.g Low battery). BSP will resume it once we recover from Low Battery situation.		Device CANNOT accept new OS Update request.
CANCELLED	Media Eject, Device enters critical suspend state will cancel the ongoing job		Device CAN accept new OS Update request
SUCCESS	OS Update request was success and device was able to boot into new OS image		Device CAN accept new OS Update request
FAILED	AB OTA Update Failed (e.g Package error, Signature error etc).		Device CAN accept new OS Update request

13. Possible device interruptions during Full OTA package

While a Full OTA Package is installed via AB mode in background, user of the device will be able to use the device. Thus, device might be put to various states which can interrupt the ongoing OS Update. Device states which can interrupt the OS Update are,

1. Low Battery condition. If Battery falls below 30% capacity, ongoing OS Update will be interrupted and resumed only after connecting to a battery source.
2. Device can be shutdown, enter critical battery state, media ejected (external SD Card), or low Storage in userdata partition (<200MB). In all the above scenarios, ongoing OS Update will be cancelled.
3. If device is rebooted in middle of a OS Update operation, the ongoing job will be suspended. On reboot of device, OS Update job will be resumed and completed.

None of these device conditions will impact while applying OTA diff package as device will reboot to recovery mode for applying it.

14. AB Fallback mechanism

In Android AB system if an OTA fails to apply (for example, because of a bad flash), the user will not be affected. The user will continue to run the old OS (existing OS image), and the customer can re-attempt the update.

If an OTA update is applied but fails to boot, the device will reboot back (fallback) into the old/existing OS image and device remains usable. This allows our customer to re-attempt the update.

15. Rescue Party Mode

Sometimes devices can end up in reboot loops, which cause customers to file support tickets or warranty inquiries. This process is frustrating for customers and expensive.

Android on SDM660 includes a feature that sends out a "rescue party" when it notices core system components are stuck in crash loops. Rescue Party then escalates through a series of actions to recover the device. As a last resort, Rescue Party reboots the device into recovery mode and prompts the user to perform a factory reset.

Rescue party logs can be collected using RxLogger. One must enable RxLogger plugin for recovery mode to collect rescue party logs.

16. Recovery logs

User can fetch recovery logs using RxLogger. One must enable RxLogger plugin for recovery mode to collect recovery logs.

User will not be able to pull recovery logs from `/data/tmp/public/recovery` path which was available in Android Oreo & Pie.

Last 10 Recovery logs are saved under this folder for debug purposes.