Android P OS Update Instruction for SD660 based Family of Products

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

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.

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:

OS Update Use Case	Non-AB	AB	Notes
Flashing Full OTA Package	Recovery Mode	Android AB Mode	**AB:** Device shall apply Full OTA Package via Android AB mode when applied via EMM. User can manually enter recovery mode to apply Full OTA package too. **Non-AB:** Device shall boot into recovery mode to apply any OTA package
Flashing Diff OTA Package	Recovery Mode	Recovery Mode	**AB:** Device shall boot into recovery mode to apply any OTA Diff package **Non-AB:** Device shall boot into recovery mode to apply any OTA package
Flashing reset Packages	Recovery Mode	Recovery Mode	**AB:** Device shall boot into recovery mode to apply Enterprise Reset, Factory Reset package **Non-AB:** Device shall boot into recovery mode to apply Enterprise Reset, Factory Reset package
Device downtime for OS Update	-	+	**AB:** Full OTA updates can occur while the **system is running**, without interrupting the user. At the end, device reboots into the new installed image.

			Non-AB: Device reboots to recovery mode to install package. User cannot use device while installing OTA package.
Fault tolerance	-	+	**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 Baseline image). **Non-AB:** If device fails to bootup, then device is bricked.
Patch upgrades	Y	Y	
Patch downgrades	Y	Y	SDM660 Android P has **Version Binding** implementation which will cause **data reset** on downgrade.
Hotfix patch support	Y	Y	
Patch Size	-	+	AB saves size from having no Rollback images.
Silent Update	X	Y	AB Full OTA update is 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

Diff OTA package, 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. Diff OTA package, reset packages (Enterprise Reset, Factory Reset), special packages to update /odm or /persist 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.

Diff OTA package consists of following:

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

Diff OTA packages are used to provide incremental updates to device. The size of diff OTA package 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.

Enterprise Reset → Erase userdata partition and persist enterprise partition

Factory Reset → Erase both userdata and enterprise partition

Special recovery packages → packages used to modify 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**.

Android O to Android P Wave-2A upgrade:

Existing customers can upgrade their SDM660 Android O devices to Android P **Wave-2A** release using Android P Full OTA package. In order to migrate from Android O to Android P, following options can be followed.

Wave-2A image: 02-11-01.00-OG-U00-STD

1. Full OTA package of Android P Wave-2A
   a. Install Android P Full OTA package.

Install ota_full_user_gms_yyyymmdd.hhmmss.zip using AB mode clients e.g StageNow, SOTI, AW etc.

User can also install Android P Full OTA package using **adb sideload** option Recovery mode

    i.   Please select "Apply upgrade from ADB" → "Full OTA Package" option from recovery menu

2. Diff OTA package of Android P Wave-2A
   a. Customers can migrate only from Android Oreo Wave-3 image (**01-18-02.00-OG-U00-STD**) to Pie Wave 2A image (**02-11-01.00-OG-U00-STD**) using Diff OTA package.
   b. Install ota_diff_user_gms_yyyymmdd.hhmmss.zip using AB mode clients e.g StageNow, SOTI, AW etc.

   User can also install Android P Diff OTA package using **adb sideload** option Recovery mode

       i.   Please select "Apply upgrade from ADB" → "Diff OTA Package" option from recovery menu

Android P Wave-2A to Android O downgrade:

Customers who have migrated to Android P Wave-2A OS image can downgrade to suitable Android O image. Users can downgrade to Android O image using any of the methods described as below.
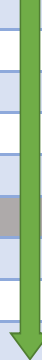
    a. Install Android O Full OTA package (OREO_ota_full_user_gms_yyyymmdd.hhmmss.zip) using AB mode clients e.g StageNow, SOTI, AW etc.
            Package = OREO_ota_full_user_gms_MR1_yyyymmdd.hhmmss.zip

    b. User can also install Android P Full OTA package using adb sideload option Recovery mode. Please select "Apply upgrade from ADB" → "Full OTA Package" option from recovery menu

    c. On downgrade from Android P wave-2A to Android O, user data will be erased.

    d. On downgrade from Android P wave-2A to Android O, enterprise partition will be persisted.

Note:

As per Google CDD requirements, moving from a Higher Google SPL to a lower Google SPL will be considered as OS Downgrade operation even if the Build ID of new OS image (baseline or patch on new baseline) is higher. For a customer who wishes to migrate from a patch image with latest Google SPL on an older baseline to a patch (having lower Google SPL) on newer baseline, should use EnterpriseReset.zip along with other OTA pkg's in a UPL format.

Use-case#1: Migrate from a patch with latest Google SPL on Rev-A / MR1 / Wave-3 / Wave-4 baseline Oreo image to a patch on Pie Wave-2A baseline which might have lower security patch level, then this

is an OS downgrade operation even though the Wave-2A Build ID will be higher compared to a patch on Oreo Rev-A/MR1/Wave-3/Wave-4 baseline.

DOWNGRADE OPERATION com.symbol.intent.action.DOWNGRADE_PACKAGE	Release	Build_ID (ro.device.patch.version)	Google Security Patch level (ro.build.version.security_patch)	UPGRADE OPERATION com.symbol.intent.action.UPDATE_PACKAGE
	Android Oreo			
	Android O Rev-A	01-12-01.00-OG-**U00-STD**	5-Oct-2018	
	WWAN	01-12-01.00-OG-**U16**-STD	5-Oct-2018	
	Android O MR-1	01-13-20.00-OG-**U00-STD**	5-Nov-2019	
	MR-2	01-13-20.00-OG-**U22**-STD	5-May-2018	
	Patch	01-09-25.05-OG-**U02**-STD	5-Jun-2019	
	Android Pie			
	Wave - 2A	02-10-18.00-OG-**U00-STD**	1-Jul-2018	
	Patch	02-10-18.00-OG-**U09**-STD	5-Aug-2018	
	Wave - 2C	02-15-25.00-OG-**U00-STD**	5-Dec-2019	

On OS Downgrade, Data is LOST (userdata erased) on OS Downgrade.
OS Downgrade operation can be within a baseline or across baseline

On OS Upgrade operation, Data is persisted on OS Upgrade.
OS Upgrade operation can be within a baseline or across baseline.

On SDM660 P, 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 Diff OTA package.
3. Downgrade (move to an older/lower version of OS Image) operation will be disabled by default on SDM660 P. Any customers who use older 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 package to downgrade from Pie to Oreo or downgrade to older baselines on Pie.
6. Using a new interface, customers shall be able to perform OS Downgrade to an older patch using Diff OTA package on Pie.
7. The Downgrade interface shall be able to perform only downgrade operation and not OS Upgrade operation.
8. All OS downgrade operation will result in an Enterprise Reset operation. i.e user data is erased on OS downgrade operation.
9. 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

OS Update via EMM	OS Upgrade	OS Downgrade
Intent Action	*com.symbol.intent.action.UPDATE_PACKAGE* *com.symbol.intent.action.VERIFY_UPDATE_PACKAGE*	*com.symbol.intent.action.DOWNGRADE_PACKAGE* *com.symbol.intent.action.VERIFY_DOWNGRADE_PACKAGE*
Allowed OTA Packages	Full OTA Package, Diff OTA Package, UPL	Full OTA Package, Diff OTA Package, 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

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

http://zebra-stage.github.io/mx/

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. Recovery Mode

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

SDM660-O Recovery UI will have following different options to apply different packages from different ways.

a. Reboot system now
b. Apply upgrade from adb
c. Apply upgrade from SD card
d. Apply upgrade from USB drive
e. Apply downgrade from adb
f. Apply downgrade from SD card
g. Apply downgrade from USB drive
h. View recovery logs
i. Power off
j. Ship mode

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.

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

Second option is to apply Diff OTA package. User should select this option to apply OTA-diff upgrade packages.

```
Android Recovery
Zebra/TC72/TC72
9/02-11-01.00-PG-U00-STD/51
eng/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 side load interface.

```
Supported API : 3
Stopping adbd . . .


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

- 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/TC72/TC72
9/02-11-01.00-PG-U00-STD/51
eng/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
Ship mode
```

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

```
Android Recovery
Zebra/TC72/TC72
9/02-11-01.00-PG-U00-STD/51
eng/release-keys
Use volume up/down and power.
Choose a package to install:
/sdcard

../
Downgrade.upl
HE_DELTA_UPDATE_01-18-02.00-OG_TO_02-11-01.U00-PG.zip
HE_FULL_UPDATE_02-11-01.00-PG-U00-STD.zip
Release_Pie_EnterpriseReset_V2.zip
Upgrade.upl
ota_diff_helios_oreo_user_GMS__20190718.201510-U03.zip
ota_diff_helios_user_GMS__20190801.052323-U01.zip
ota_diff_helios_user_GMS__20190801.052323-U02-H02.zip
ota_full_oreo_user_gms_20190718.201510.zip
Android/
LOST.DIR/
RxLogger/
ST9/
```

- 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, Diff OTA packages and install Reset Packages from USB drive.

```
Android Recovery
Zebra/TC72/TC72
9/02-11-01.00-PG-U00-STD/51
eng/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
Ship mode
```

- 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.

```
Android Recovery
Zebra/TC72/TC72
9/02-11-01.00-PG-U00-STD/51
eng/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
Ship mode
```

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.

```
Android Recovery
Zebra/TC72/TC72
9/02-11-01.00-PG-U00-STD/51
eng/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 Full OTA package option user should enter the package name via adb side load interface.

```
Supported API : 3
Stopping adbd . . .


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

Second option is for Diff OTA package. User should select this option to apply OTA-diff downgrade packages.

```
Android Recovery
Zebra/TC72/TC72
9/02-11-01.00-PG-U00-STD/51
eng/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.

```
Supported API : 3
Stopping adbd . . .


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

- 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.

```
Android Recovery
Zebra/TC72/TC72
9/02-11-01.00-PG-U00-STD/51
eng/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
Ship mode
```

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

```
Android Recovery
Zebra/TC72/TC72
9/02-11-01.00-PG-U00-STD/51
eng/release-keys
Use volume up/down and power.
Choose a package to install:
/sdcard

../
Downgrade.upl
HE_DELTA_UPDATE_01-18-02.00-OG_TO_02-11-01.U00-PG.zip
HE_FULL_UPDATE_02-11-01.00-PG-U00-STD.zip
Release_Pie_EnterpriseReset_V2.zip
Upgrade.upl
ota_diff_helios_oreo_user_GMS__20190718.201510-U03.zip
ota_diff_helios_user_GMS__20190801.052323-U01.zip
ota_diff_helios_user_GMS__20190801.052323-U02-H02.zip
ota_full_oreo_user_gms_20190718.201510.zip
Android/
LOST.DIR/
RxLogger/
ST9/
```

- 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, Diff OTA packages and install Reset Packages from USB drive.
  User can only perform OS Downgrade operation and not upgrade operation using this option.

```
Android Recovery
Zebra/TC72/TC72
9/02-11-01.00-PG-U00-STD/51
eng/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
Ship mode
```

- 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.

```
Android Recovery
Zebra/TC72/TC72
9/02-11-01.00-PG-U00-STD/51
eng/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
Ship mode
```

- Ship mode.

```
Android Recovery
Zebra/TC72/TC72
9/02-11-01.00-PG-U00-STD/51
eng/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
Ship mode
```

9. 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

10. Possible device interruptions during Full OTA package:

While a Full OTA Package is installed via AB mode in background, user of the deice 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 SDCard), 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.

11. 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.

12. 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.

SDM660 O includes a feature that sends out a "rescue party" when it notices core system components 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.

13. Recovery logs

User can pull last recovery logs from /data/tmp/public/recovery via adb command.

adb pull /data/tmp/public/recovery

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