



# LIBRE SYNC

## **Failsafe Firmware Upgrade Technical Note Module : LS9**

**Rev: 1.9**

**Libre Wireless Technologies Private Limited**

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# 1. Document Information



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## 1.1. Abstract

This document explains in brief the LS9-Module Firmware upgrade process and the Failsafe Mechanism implemented to safeguard the modules from being corrupted or unusable, in case of power failure or reset during the firmware upgrade.

All the supported firmware upgrade *methods*, *sources*, *triggers* are mentioned in Chapter 2.

## 1.2. Document Convention

Icon	Meaning	Description
	Note	Provides information good to know
	Caution	Indicates situation that might result in loss of data or hardware damage

## 1.3. Revision History

Revision	Date	Description of change	Author
1.9	May 14, 2017	Updated Section 3.2	Supriya
1.8	May 10, 2017	Updated Section 3.3	Supriya
1.7	May 5, 2017	Updated Section 3.2 and 3.3 with information for USB Method	Supriya Kiran
1.6	March 9, 2017	Updated Section 3.2	Kannan
1.5	March 7, 2017	Updated Section 3.3	Kannan Sri hari
1.4	March 6, 2017	Added Section 3.3	Kannan Sri Hari

## 2. Firmware Upgrade for L9-Module

LS-Platform supports firmware upgrade of LS-Application, and HOST-MCU image in LS9-Modules.

Libre provides **Software Customization Kit (SCK)** to create a Single-Image, required for the upgrading process.

Software Customization Kit (SCK) is used to generate a combined firmware image. SCK Tool combines **Factory NV-items**, **LS-Application Image**, and **HOST-MCU** firmware into a single image file for firmware upgrade.

Single Image speeds-up the process of firmware upgrade and helps in updating the entire system in one-shot.



- For more information on how to use the “**Software Customization Kit**”, refer to LibreWireless-TechNote\_LS9\_Software\_Customization\_Kit.

### 2.1. Firmware Upgrade Architecture

The LS platform at present supports firmware upgrade in the following methods

- Firmware upgrade over internet
- Firmware upgrade over network
- Firmware upgrade over USB



The only allowed method for GCAST units for firmware update is via the Internet. Network/USB methods will be enabled only during the product development stage.

The image selection process is the same for the LS-Application and HOST-MCU. The software will identify the image and upgrade the image automatically.

The SDRAM / DDR is used as staging area for the firmware upgrade process.

The total time taken to complete the firmware upgrade process is around a minute. For Internet update, the firmware download time will vary based on the speed of the internet.

Figure 2-1 shows the firmware upgrade architecture including the source input options, staging area, and interface with memories.

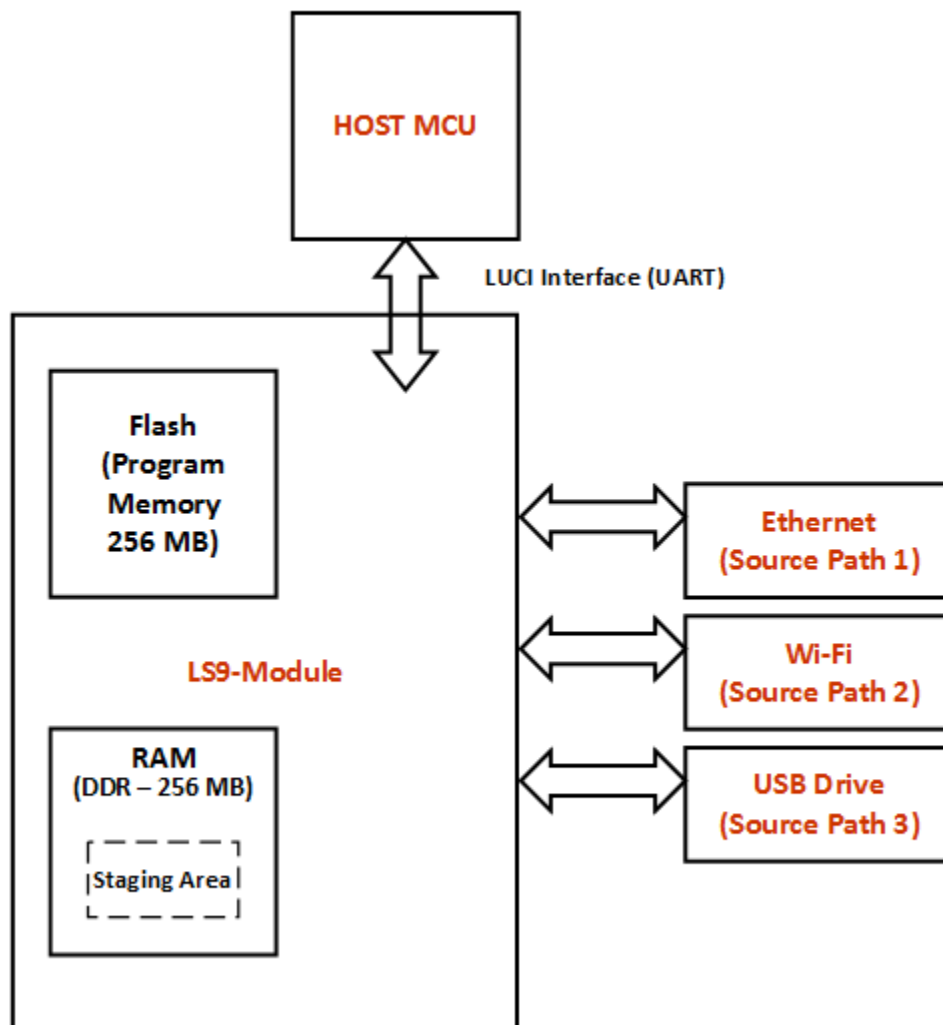


Figure 2.1-1: Firmware Upgrade Architecture for LS9

## 2.2. Sources for Firmware Image.

The file to upload for the firmware upgrade is the Libre Single-Image. LS9 checks for the magic number, CRC and version information before starting the upgrade process.

The LS module checks for the software components such as Application-Image, and HOST-Image, present in the Single-Image file. The module will upgrade the component available in the Single-Image, on to the LS module, and the HOST-MCU.

The Application-Image to be uploaded is selected from one of the sources listed below.

- **Internet:** Downloads the file from the given URL path as specified in the NV-Item “fwdownload\_xml”.
- **Network:** Triggered from webpage, selects and downloads the file from the local system.
- **USB:** Downloads the file from the root directory path of the USB.



USB method of upgrade is supported for Non-GCAST modules only.

## 2.3. Firmware Upgrade Triggers

Firmware Upgrade is triggered from the LS9-Module or the HOST-MCU. Triggering Firmware upgrade is done using the LUCI protocol.

### 2.3.1. Trigger Types

- 1 **LS Auto Update** (Compulsory): LS Auto update is scheduled to happen at regular intervals frequently. LS-modules checks for the firmware image in the server and triggers the update process if the firmware in the server is of a higher version than the one in the module.
- 2 (Optional) Triggered over **WEB-Page** via Network method.
- 3 (Optional) Triggered by **HOST-MCU** Message-Box # 65 (Methods - Internet, and USB).

For information on the procedure to upgrade the firmware image refer to Firmware Update chapter in the LS9 User Guide, *LibreWirelessUserGuide-LS\_Platform\_LS9*.



For LS9 module, the device webpage supports only **network method** of upgrade Internet and USB method of upgrade from webpage is not supported.

## 3. Failsafe Firmware Upgrade for LS9

Firmware Upgrade process stores the new image in the DDR and overwrites the flash memory in the LS-Module with the new image on successful upgrade.

Failsafe mechanism ensures either new firmware image is successfully programmed to the flash memory or recovers the existing firmware image in case of power failure during the firmware upgrade.

### 3.1. Preparing for Internet Upgrade of LS9



Failsafe Mechanism is applicable for network and internet update only.

Before updating the LS9 firmware onto the modules, see section 3.1 of LibreWirelessUserGuide-LS\_Platform\_LS9, to ensure the firmware upgrade guidelines are followed. If the guidelines are not followed, it shall result in LS9 modules non-functional.

Internet Method of Firmware Upgrade is applicable for release **v9018 / v9019** and beyond.

Internet Method of Firmware upgrade has two parts

**Libre Application software:** Mandatory in Libre Firmware Upgrade Mechanism. Updates everything except GCAST OTA Image, on upgrade.

**GCAST OTA Application Image:** Customers should get in touch with Google to get the required GCast OTA Application Image.

Each customer has to **maintain their own server**; in which they will place their own customized image.

URL for the server location is customizable using the NV-Item ***fwdownload.xml***.

After successful update of the firmware, LS module will send reboot command to Host-MCU. It's up to HOST-MCU to reboot whenever required.



**HOST-MCU Firmware:** HOST-MCU firmware can be updated only along with the LS-Application firmware. Independent update of HOST-MCU firmware is not allowed.

### 3.1.1. Server setup Requirements

- Public IP from ISP providers.
- Down Time should be ZERO.

Customers are recommended to have server setup with above requirements or any cloud service.



Use only 'http server'. LS9 does not support '**https** server'.

### 3.1.2. NV-Items to be considered

- fwdownload\_xml (See [section 4.1.2](#))
- Model
- Manufacturer
- Brand
- ProductName
- ProductType
- ProductReleaseTrack
- ProductBuildType

For details on the configuration of the NV-Items, refer to ***LibreWirelessTechNote -Non-Volatile\_Items\_in\_LibreSync*** available in Libre Portal.



NV items should be set with the same value as submitted to Google for GCast certification.

### 3.1.3. Firmware Download XML

NV-Item ***fwdownload\_xml*** is used to provide the URL for the XML file that contains the information about Firmware version, HOST-MCU version and the link to download the firmware. Use the syntax below to provide the URL for firmware update.

#### To Provide the URL for Firmware Update over Internet

```
#setenv fwdownload_xml <<Link to firmware_download.xml file>>
```

### Firmware Download XML Structure

Firmware Download XML file includes the following tags.

- **fw\_version:** fw\_version is tag used to set the firmware version. firmware version should start with 'p' followed by the actual version number.  
For example, p9065
- **mcu\_version:** mcu\_version tag is used to set the HOST-MCU version.
- **firmware:** Firmware tag is used to give the URL of the system firmware image.  
For example, [http://192.168.1.143/83\\_IMAGE\\_network\\_9065](http://192.168.1.143/83_IMAGE_network_9065)
- **otapackage:** Ota package is used to give the link of the CAST OTA package. The CAST OTA package is downloaded, when LS-Firmware Upgrade is initiated. OTA file can be upgraded only when a higher Firmware version is available in the server.  
For example, <http://192.168.1.143/application.zip>

#### Note:

- For the Non-GCAST product, including the **otapackage** tag in the xml file is not required.
- Customers can obtain the CAST OTA from Google on signing of the appropriate agreement with Google.
- The OTA package file placed in the URL should always be a **.zip** file.
- **crc32check:** CRC32 Check for firmware image which is mentioned in <firmware> field.

- CRC check is applicable for the Single-Image (LS-Application Image + HOST-MCU Image).
- CRC check is not applicable for GCast OTA Application Image.
- **ForceUpgrade:** Setting the tag ForceUpgrade as true, is to ensure the start of firmware upgrade on the device even if the device is in Play-State.

```
<content>
  <fw_version>p9050</fw_version>
  <mcu_version>091</mcu_version>
  <firmware>http://192.168.1.143/83_IMAGE_network_9065</firmware>
  <otapackage>http://192.168.1.143/application.zip</otapackage>
  <crc32check>7f57ba88</crc32check>
  <ForceUpgrade>true</ForceUpgrade>
</content>
```



Ensure to provide the direct URL link for the URLs of Firmware Download XML, Firmware, and Cast OTA package. Redirection methods are not supported.

Application will parse the XML and verify the Firmware version of LS9 and HOST-MCU version. If the given versions in the XML are greater than existing version in DUT, firmware upload process triggers. Otherwise it aborts the upload mechanism.

### 3.1.4. LUCI Message-Box to be Considered

- **Message-Box 222-Cast OTA Update**
  - This message-box is used to update the status of the Cast Firmware update of the LS-Device via OTA (Over The Air). LibreSync sends the following data to HOST-MCU / APP.
    - **4:** Force Upgrade, HOST-MCU should get ready for immediate reboot.

- **2: Ready for Restart**
- **1: Downloading OTA image in background.**
- **Message-Box 223 – Firmware Upgrade Internet**
  - This message-box is used to send notification to the Network Controller APP, on the availability of firmware. LibreSync sends the following data to APP.
    - **UPDATE\_STARTED:** This data is sent when internet update has started automatically from a separate source (Not from LUCI/HOST command).
    - **UPDATE\_IMAGE\_AVAILABLE:** This data is sent when the LS9 firmware image (83\_IMAGE\_network) for Internet method of upgrade is downloaded from the server.
    - **NO\_UPDATE:** This data is sent when the update is not available.
    - **CRC\_CHECK\_ERROR:** This data is sent when the downloaded image CRC and the CRC written in the <crc32check> of the XML file used for internet upgrade do not match.
    - **DOWNLOAD\_FAIL:** This data is sent when the 83\_IMAGE\_network download is failed.

For details on usage of the LUCI Message-Box, refer to ***LibreWirelessTechNote - LS\_Light\_Weight\_Universal\_Control\_Interface***, available in Libre Portal.

## 3.2. Firmware Upgrade Process

The LibreSync module updates the Single Image by hand-shaking with HOST-MCU, about the upgrade-progress over LUCI.

LUCI commands are exchanged only when the NV-Item **hostpresent** is set to '1'.

***#setenv hostpresent 1***

The procedure in which upgrade process is executed is explained below.

### 3.2.1. Network Method

**Step 1.** User Triggers Firmware Upgrade from the device web-page



Firmware Upgrade via USB and Internet is not supported when triggered from the web-page.

**Step 2.** LS initiates Firmware upgrade by sending “start” on Message-Box#66.

**Step 3.** LS starts the Application-Firmware Upgrade, and sends the progress to HOST-MCU, through **Message-Box # 66**. Message-Box sends the data in percentage that is, 0%...2%...4%...6%...8%...10%.....100%.

**Step 4.** If HOST-MCU Firmware is present, then LS indicates the HOST-MCU, presence of HOST-Image over Message-Box# 68. And LS sends HOST-Firmware through X-MODEM protocol.

**Step 5.** Firmware Upgrade Completion status

- **Failure:** LS indicates any failure in the Firmware Upgrade, through Message-Box # 66, to the HOST-MCU. Message-Box contains data as **FF**.
- **Success:** LS sends “**Complete**” on successful completion of firmware upgrade process.

**Step 6.** LS Requests reboot-command from HOST-MCU through Message-Box# 114. LS module reboots in application.

**Step 7.** HOST-MCU sends reboot-command to LS over Message-Box# 115

**End --**

### 3.2.2. Internet Method

#### Single-Image Update

**Step 1.** LS9 checks for the new Firmware version by parsing the fw\_download xml file.

**Step 2.** LS9 Checks if the firmware upgrade is Silent Upgrade or Force Upgrade

- **Silent Upgrade:** Firmware Upgrade begins only when the device is in Power-ON state and is not in play-state. If the device is in play-state, then the Firmware Upgrade is postponed until the device is not in play-state.
- **Force Upgrade:** Force Upgrade is enforced on the devices. Firmware Upgrade on the device begins immediately.  
In this method Firmware Upgrade begins when the device is in Power-ON state and if the device is even in play-state.

**Step 3.** LS sends the firmware download notification to HOST-MCU / APP, over Message-Box 223.

**1 UPDATE\_STARTED:** when LS initiates firmware upgrade.

**2 UPDATE\_DOWNLOAD:** when LS begins downloading the firmware.

**Step 4.** LS sends the **download progress** to HOST-MCU, through **Message-Box # 223**. Message-Box sends the data in percentage that is,  
*0%...2%...4%...6%...8%...10%.....100%.*

**Step 5.** LS Sends UPDATE\_IMAGE\_AVAILABLE over Message-Box # 223.

**Step 6.** LS starts the Application-Firmware Upgrade, and sends the progress to HOST-MCU, through **Message-Box # 66**. Message-Box sends the data in percentage that is, *0%...2%...4%...6%...8%...10%.....100%.*

**Step 7.** If HOST-MCU Firmware is present, then LS indicates the HOST-MCU, presence of HOST-Image over Message-Box# 68. And LS sends HOST-Firmware through X-MODEM protocol

**Step 8.** Firmware Upgrade Completion status

- **Failure:** LS indicates any failure in the Firmware Upgrade, through Message-Box # 66, to the HOST-MCU. Message-Box contains data as **FF**.
- **Success:** LS sends “**Complete**” on successful completion of firmware upgrade process.

**Step 9.** LS Requests reboot-command from HOST-MCU through Message-Box# 114. LS module reboots in application.

**Step 10.** HOST-MCU sends reboot-command to LS over Message-Box# 115

**End --**

## **Upgrading Only HOST-MCU Firmware**

**Step 1.** LS9 checks for the new HOST-MCU and LS9 Firmware version by parsing the fw\_download xml file.

- 1** If the LS9 Firmware Version and HOST-MCU firmware version is greater than the existing firmware version, LS updates the HOST-MCU firmware and LS9 Application image.
- 2** If there is no change in the LS9 firmware Version, but a new HOST-MCU firmware is available, then LS updates **only the HOST-MCU firmware**.

**Step 2.** LS9 Checks if the firmware upgrade is Silent Upgrade or Force Upgrade

- **Silent Upgrade:** Firmware Upgrade begins only when the device is in Power-ON state and is not in play-state. If the device is in play-state, then the Firmware Upgrade is postponed until the device is not in play-state.
- **Force Upgrade:** Force Upgrade is enforced on the devices. Firmware Upgrade on the device begins immediately.  
In this method Firmware Upgrade begins when the device is in Power-ON state and if the device is even in play-state.

**Step 3.** LS sends the firmware download notification to HOST-MCU / APP, over Message-Box 223.

**1 UPDATE\_STARTED:** when LS initiates firmware upgrade.

**2 UPDATE\_DOWNLOAD:** when LS begins downloading the firmware.

**Step 4.** LS sends the **download progress** to HOST-MCU, through **Message-Box # 223**. Message-Box sends the data in percentage that is,  
*0%...2%...4%...6%...8%...10%.....100%.*

**Step 5.** LS Sends UPDATE\_IMAGE\_AVAILABLE over Message-Box # 223.

**Step 6.** LS starts the Application-Firmware Upgrade, and sends the progress to HOST-MCU, through **Message-Box # 66**. Message-Box sends the data in percentage that is, *0%...2%...4%...6%...8%...10%.....100%.*

**Step 7.** If HOST-MCU Firmware is present, then LS indicates the HOST-MCU, presence of HOST-Image over Message-Box# 68. And LS sends HOST-Firmware through X-MODEM protocol

**1** If there is a power failure during the update, then on next reboot LS will update the HOST-MCU Firmware again.

i. This is handled even if the LS9 Application image is already updated to the module.

**Step 8.** Firmware Upgrade Completion status

- **Failure:** LS indicates any failure in the Firmware Upgrade, through Message-Box # 66, to the HOST-MCU. Message-Box contains data as **FF**.
- **Success:** LS sends “**Complete**” on successful completion of firmware upgrade process.

**Step 9.** LS Requests reboot-command from HOST-MCU through Message-Box# 114. LS module reboots in application.

**Step 10.** HOST-MCU sends reboot-command to LS over Message-Box# 115

**End --**



## Error Cases Handle by LS during HOST-MCU Firmware Upgrade.

Below listed cases are handled by LS internally. LS ensures a failsafe firmware upgrade in all the cases listed below.

- HOST-MCU stops all communication in between x-modem transfer. That is UART just hangs and LS9 keeps waiting for an acknowledgment to send the next packet.
- The timer (running in the background during x-modem transfer) on expiry will trigger a reboot request.
  - *After reboot, the HOST-MCU update will be triggered again as a part of failsafe.*
  - *In case of x-modem success, normal reboot will be triggered before the timer expires*
- HOST-MCU misses the reboot request sent after HOST-MCU update.
  - *HOST-MCU takes sometimes takes time to switch from xmodem to LUCI.*
  - *LS sends one more reboot request just in case HOST-MCU misses the previous reboot request.*
- HOST-MCU fails to reject non-x-modem UART packets if any, during x-modem transfer.
  - *HOST MCU will only receive valid x-modem packets during x-modem transfer.*
- Other UART ports are closed
- HOST-MCU receives reboot request, but still is in some error state in which its not able to acknowledge with MB 115.
  - LS9 will wait for 60 seconds and trigger a graceful shutdown itself.

### 3.2.3. USB Method – Non-GCast Products Only

**Step 1.** HOST-MCU requests LS for USB Firmware Upgrade over Message-Box 65

**Step 2.** LS sends 'start' to HOST-MCU over Message-Box 66

**Step 3.** LS sends update progress in percentage to HOST-MCU over Message-Box 66

**Step 4.** If HOST-MCU firmware is present

- 1** LS indicates HOST-MCU presences of HOST-Image with the size of the image over Message-Box 68
- 2** LS Sends HOST-MCU firmware over X-Modem packet

**Step 5.** LS sends firmware upgrade success status as '**complete**' over Message-Box 66.

**Step 6.** LS sends reboot-request to HOST-MCU over Message-Box 114

**Step 7.** HOST-MCU sends reboot-command to LS over Message-Box 115

**End --**

## 3.3. Firmware Update Sequence Diagrams

### 3.3.1. Network Method

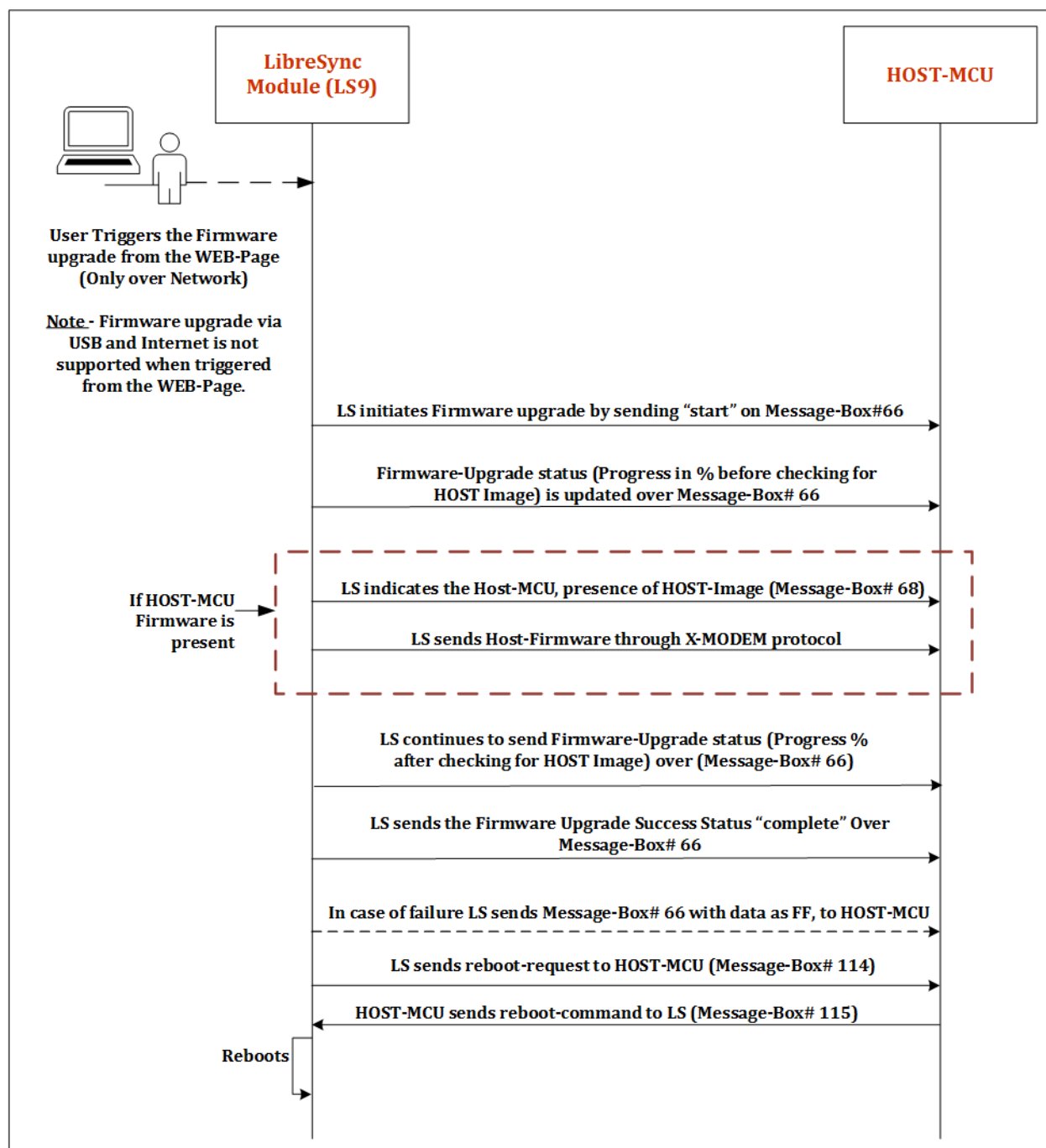


Figure 3-1: Network method of Firmware Update

### 3.3.2. Internet Method

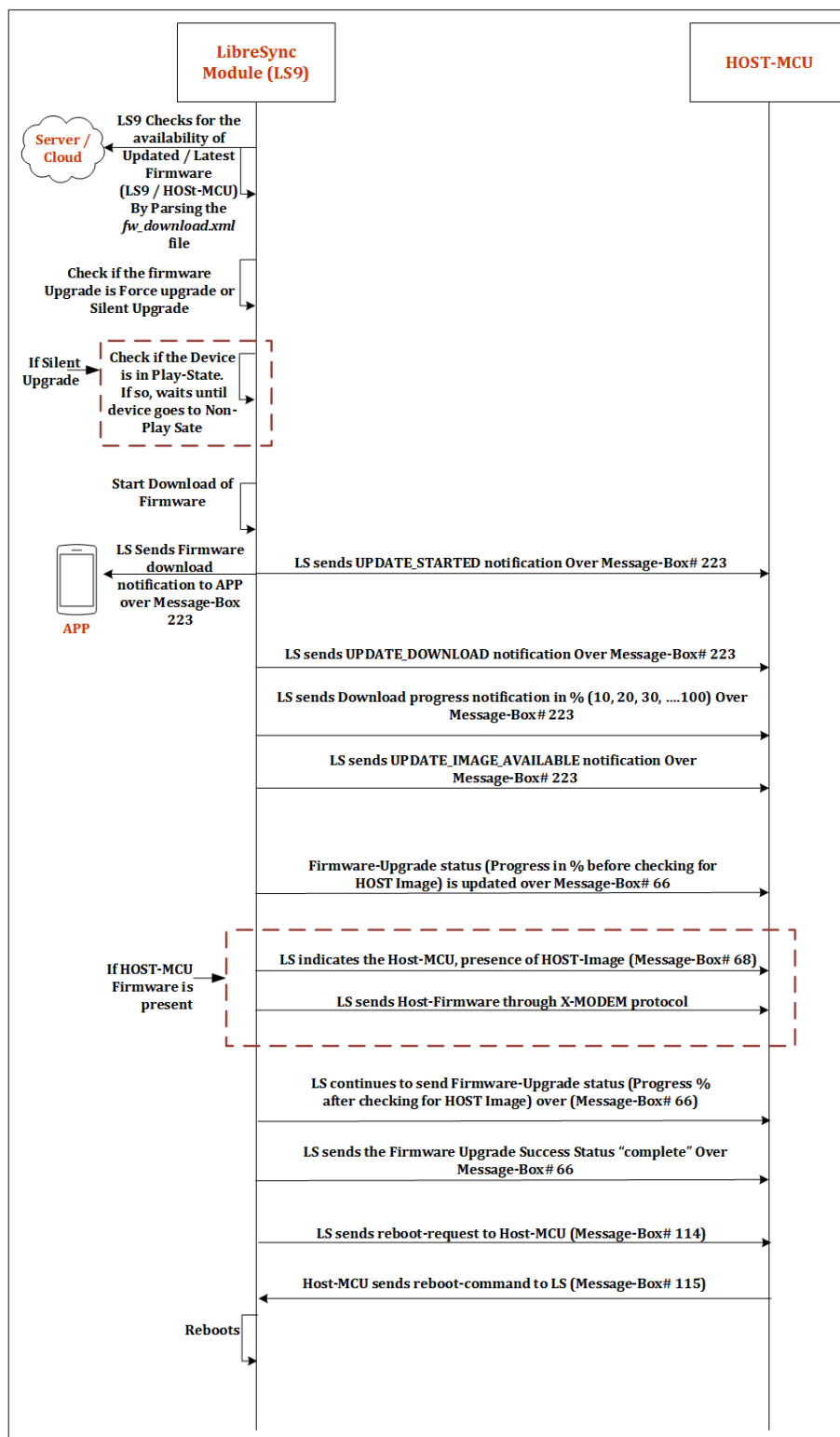


Figure 3-2: Internet Method of Firmware Update

### 3.3.3. Internet Method: No\_Update Error Case

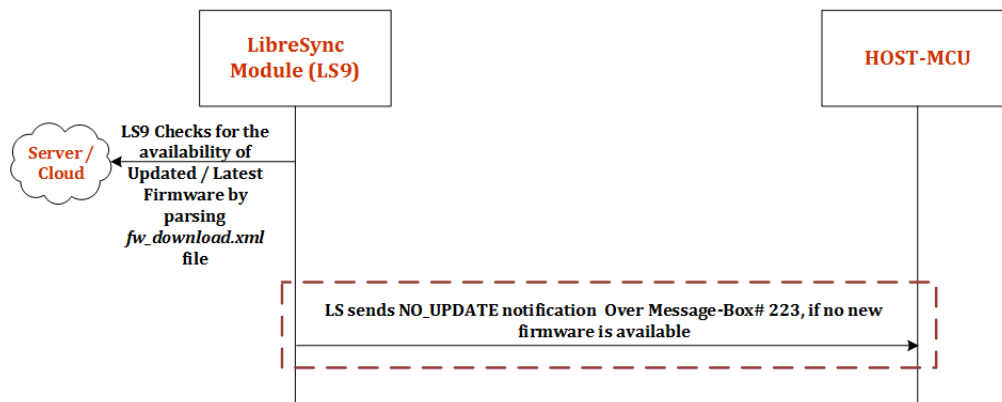


Figure 3-3: Internet Method- No\_Update Error Case

### 3.3.4. Internet Method: Download-Failure Case

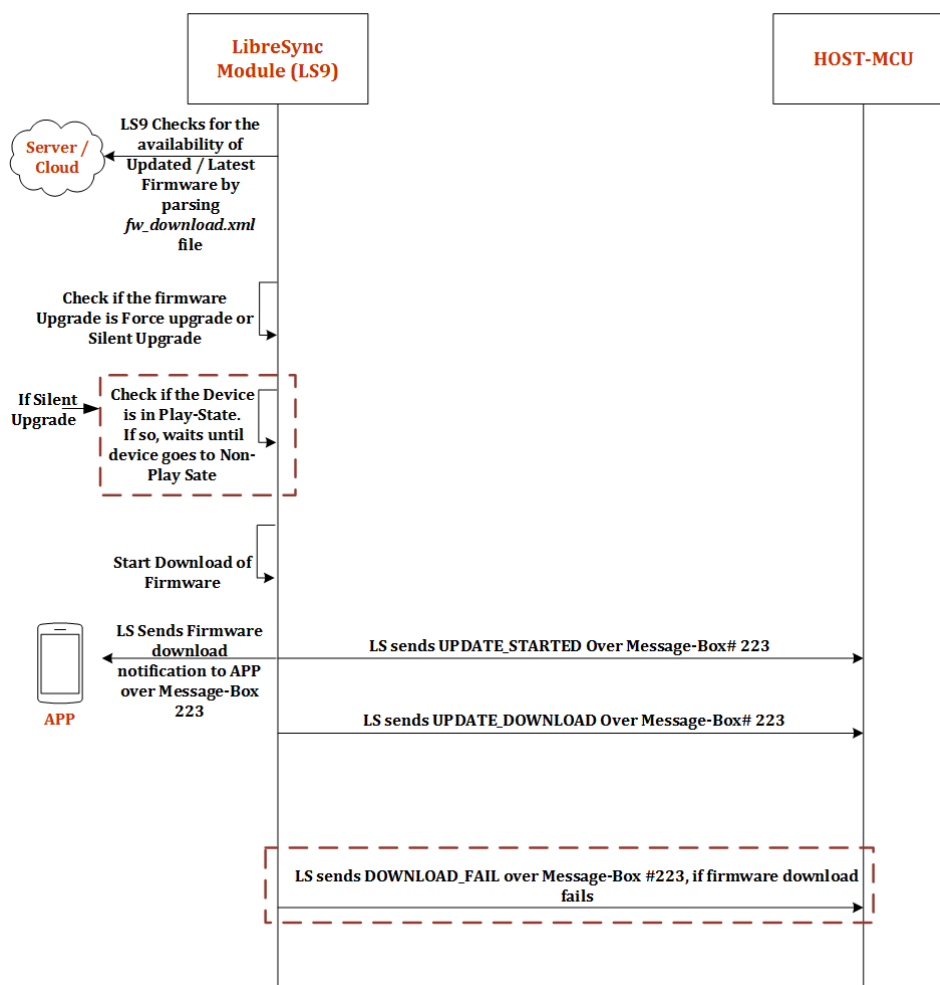


Figure 3-4: Internet Method- Download Failure Error Case

### 3.3.5. Internet Method: CRC-Check-Error Case

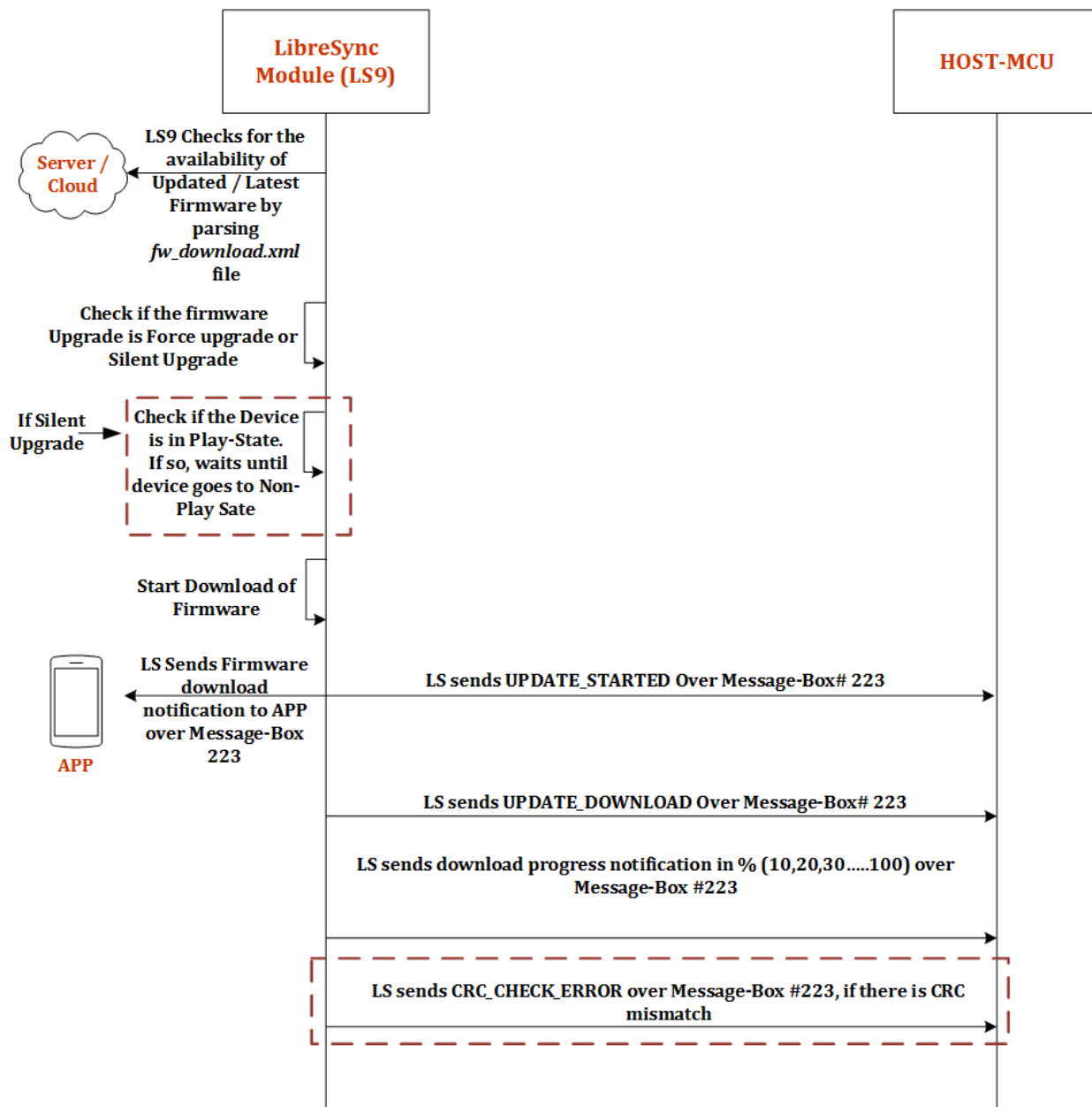


Figure 3-5: Internet Method- CRC Check Error Case

### 3.3.6. USB Method

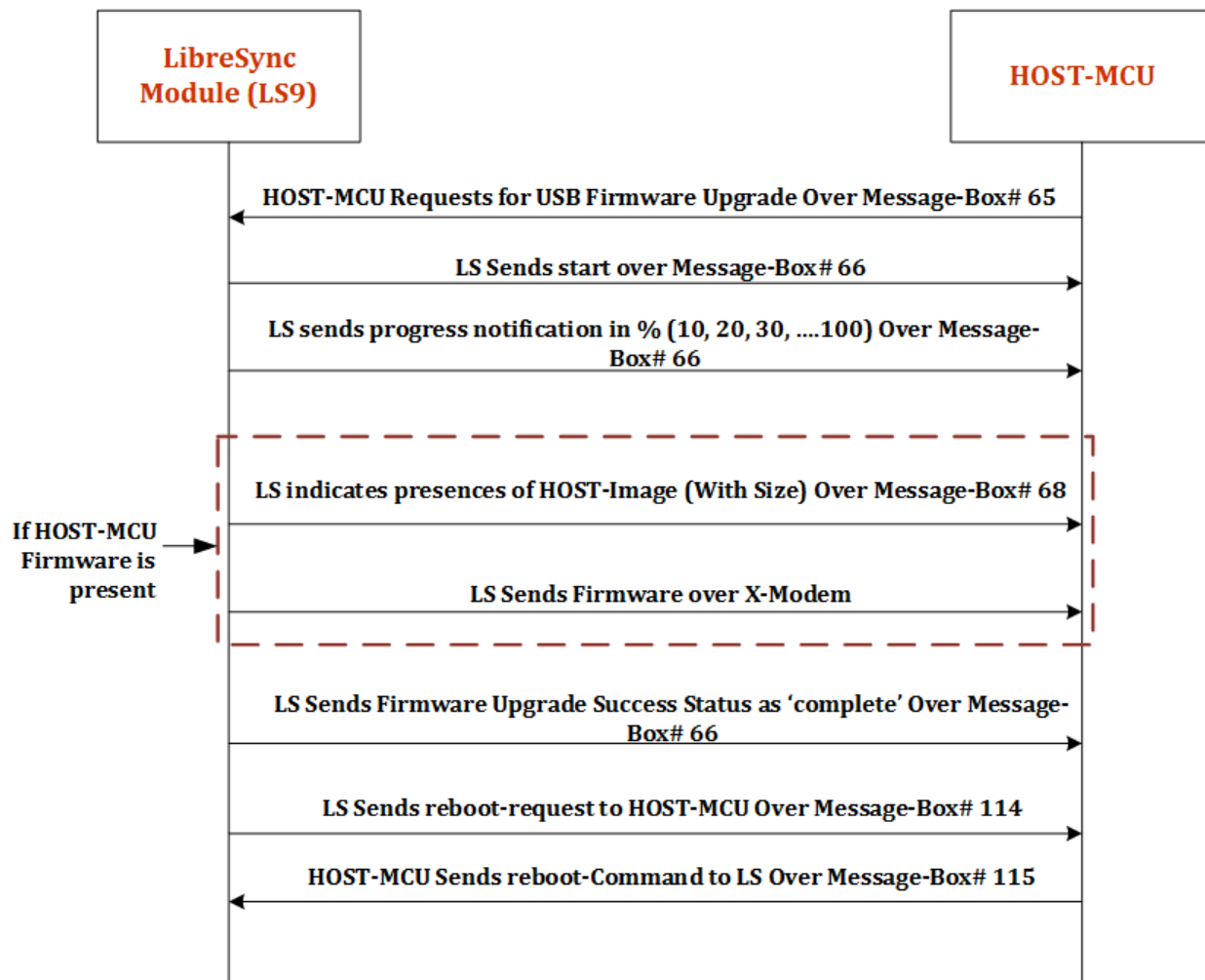


Figure 3-6: USB Method of Upgrade

## 4. Appendix

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### 4.1. Acronyms and Abbreviations

For details on acronyms and abbreviations used in the document see  
***"LibreWirelessTechNote\_Acronyms\_And\_Abbreviations\_1.0"***