Dual-Stack solution provides the following system-level features, which helps the user integrate it as a full IoT solution.

1. FOTA

FOTA provides the following:

* 1. Facility to check for the availability of new upgrades on the WLAN firmware
  2. Securely download the image into flash
  3. Check the validity of the downloaded image
  4. Set the new image as the boot image.

In conjunction with SSBL, it enables booting the latest downloaded image. The firmware is downloaded into application image partition in flash.

FOTA can be extended to support the upgradation of the host application. This helps achieve complete product solution.

The solution also supports serial FOTA, in which the host can upgrade the Talaria TWO Wi-Fi module firmware over SPI/SDIO interface. This feature is provided through connection manager.

1. Device Provisioning over BLE

Provisioning is a method to configure parameters required for the Wi-Fi Connection and cloud details. This can be achieved via Talaria TWO BLE provisioning method. Mobile-based provisioning application can be used for the same. This feature is provided through connection manager.

1. Connection Manager

Connection Manager is a utility which is a stripped version of Wi-Fi utilities like iwconfig that enables the application to use Wi-Fi connection/disconnection and static/dynamic IP settings.

For more details on the connection management features and commands, refer: [Connection Manager Commands](#_Connection_Manager_Commands)

1. Low Power

This solution allows the host and/or Talaria TWO to be put to sleep. There are two GPIOs available, one of which is used as a wakeup source of host and other is used for the host to interrupt Talaria TWO.

In idle mode, the host can go to sleep and can be woken up by Talaria TWO using the GPIO. The advantage of this solution is, even if the host is in sleep mode, Talaria TWO running on low power keeps the device (keepalive) in an always connected state. Talaria TWO can wake the host up by using the GPIO when it receives the wake-up command from the cloud or from predefined events.

1. Keepalive/Shadow service

This is a feature supported by the Dual-Stack solution to achieve maximum power saving without losing cloud connectivity.

It enables the device to stay connected to the cloud even when the host is in sleep mode. When the host processor is in the sleep mode, Talaria TWO acts as the shadow of the host. With the keepalive/heartbeat mechanism, it keeps the device in an always connected state. This ensures device availability even when the host processor is in sleep.

The main advantage of this ultra-power saving option is in high-performance devices like video/audio processing solutions.

Dual-Stack solution supports both MQTT and TCP based keep alive connections. The entire operation can be described as two states:

* 1. Normal State:
     1. Host processes the data (video/audio/sensor) and streams the data to the cloud using Talaria TWO.
     2. Host triggers Talaria TWO for the keepalive (heartbeat) process.
     3. Host closes the cloud data stream connection.
  2. Power save/keepalive state:
     1. Host goes to sleep.
     2. Talaria TWO sends/receives the keepalive (heartbeat) packets to the cloud.
     3. Talaria TWO wakes the up host when it receives a wake-up request from the cloud using GPIO.
     4. Talaria TWO goes back to normal state.

1. Heartbeat

Under normal working, if Talaria TWO crashes or hangs, host application will not be able to detect this. The heartbeat feature helps avoid this situation. Every 10 seconds, the host sends a heartbeat signal to Talaria TWO and Talaria TWO acknowledges by sending an indication of its normal working. If Talaria TWO stops responding, the host detects the issue and notifies this in the custom application: heartbeat\_monitor.

By default, the heartbeat feature is disabled. To run this feature along with tunadapter, provide heartbeat=1 as one of the parameters. Heartbeat message frequency is set to 10 seconds.

Run the custom application (heartbeat\_monitor), to monitor heartbeat feature. When Talaria TWO crashes or is out-of-sync with the host, the host notifies the custom application and displays the same. The custom application is available at: *hapi/dual\_stack/bins*. The custom application waits for the indication message from the host and once received, prints the message.

1. Port-range Configuration

Since Dual-Stack provides sockets on both host and Talaria TWO, the source port needs to be partitioned and allocated to both Talaria TWO and host. Based on this, Talaria TWO routes the packet to host or sends it to LwIP.

Following boot arguments configures the source port ranges for both host and Talaria TWO:

|  |  |  |
| --- | --- | --- |
| **Boot argument** | **Description** | **Default Values** |
| ds.host\_src\_port\_start | Host starting source port number | 70 |
| ds.host\_src\_port\_end | Host ending source port number | 40000 |
| ds.local\_udp\_port\_range\_start | Talaria TWO starting UDP source port number | 49152 |
| ds.local\_udp\_port\_range\_end | Talaria TWO ending UDP source port number | 65535 |
| ds.local\_tcp\_port\_range\_start | Talaria TWO starting TCP source port number | 49152 |
| ds.local\_tcp\_port\_range\_end | Talaria TWO ending TCP source port number | 65535 |
| ds.dns\_port\_start | Talaria TWO starting DNS source port number | 49152 |

Table 1: Boot arguments to configure source port ranges

1. Packet Forward Configuration

The packet forward configuration in the Dual-Stack solution extends the flexibility to configure multiple rules for packet forwarding.

The packet forward module provides the following features:

* 1. Packet forwarding based on multiple local port/port ranges
  2. Packet forwarding based on multiple remote IP/ports
  3. Ability to be configured dynamically, providing the control to have product specific packet forwarding rule
  4. Ability to define the packet direction

Following boot argument helps configure the source port ranges for both Host and Talaria TWO:

|  |  |  |
| --- | --- | --- |
| **Boot argument** | **Description** | **Default Value** |
| ds.pf\_method | Packet forward approach | 2 |

Table 2: Boot argument for packet forwarding configuration

1. custom\_fos application

This application demonstrates the use of Firmware Upgrade Over Serial. Using this application, Talaria TWO ELF can be upgraded from the Host. Host provides the Talaria TWO ELF to be upgraded. The ELF will be sent over serial using FOS HAPI commands.