

## Getting started with the ST BLE Mesh Android application

### Introduction

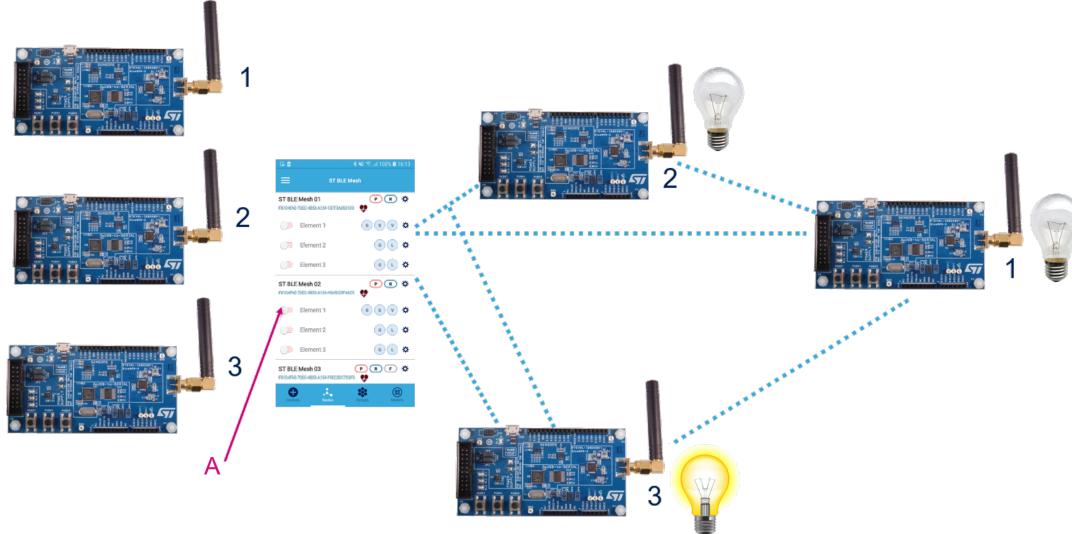
The ST BLE Mesh Android App is designed to help you evaluate the ST Bluetooth low energy mesh solution.

The application works with ST BLE devices running the embedded mesh over Bluetooth low energy (MoBLE) library. You can use it to evaluate provisioning, un-provisioning and controlling MoBLE embedded nodes in a mesh network over the Bluetooth low energy protocol to create distributed control system such as smart lighting and home automation.

Communication between the Android App and the mesh network is secured by encryption and authentication. The underlying standards of secured communication are compliant with the BLE Mesh technology standards.

**Figure 1. ST BLE Mesh scenario**

A. Button to turn the light ON or OFF



## 1 ST BLE Mesh Android App overview

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The ST BLE Mesh App allows performing the following tasks in a BLE mesh network:

- Add new devices to the network via the provisioning process
  - View and configure nodes in a BLE mesh network
  - Control the nodes (Vendor, Generic, Lighting and Sensor model commands)<sup>(1)</sup>
  - Remove nodes from the network using the un-provisioning procedure
  - Create and manage groups of nodes
  - Set subscription and publication addresses on nodes
  - Upgrade firmware of compatible nodes
1. *The App includes a subset of model commands for demonstration purposes. More commands are available in the customer application using the ST BLE Mesh SDK.*

Bluetooth® Mesh Profile can be used for home, office and industrial applications.

## 2 Getting started with the App

### 2.1 Hardware and software requirements

The App is tested on various Android phones (for details, refer to [STSW-BNRG-Mesh](#) software package release notes in the Android folder) and works with the following boards running the BLE mesh firmware:

- [NUCLEO-L152RE](#) STM32 Nucleo-64 development board with the [X-NUCLEO-IDB05A1](#) Bluetooth® low energy expansion board based on the [SPBTLE-RF](#) module
- [STEVAL-IDB007V1](#) evaluation platform based on the BlueNRG-1 low power BLE single-mode system-on-chip
- [STEVAL-IDB008V2](#) evaluation platform based on the BlueNRG-2 Bluetooth® low energy wireless system-on-chip

Refer to the [STSW-BNRG-Mesh](#) firmware SDK for the default evaluation board support. The SDK can also be ported on any board based on [BlueNRG-MS](#), [BlueNRG-1](#), [BlueNRG-2](#) and [STM32WB](#) devices.

### 2.2 Installing and running the App

Follow the instructions below to install the ST BLE Mesh Android App on a compatible Android (6 or later versions) device.

**Step 1.** Download and install the application in one of the following ways:

- Follow the [link](#) to Google Play® store to install the app directly to your Android device  
or
- Copy the APK file provided in the [STSW-BNRG-Mesh\Android\apk](#) folder to your smartphone via USB cable

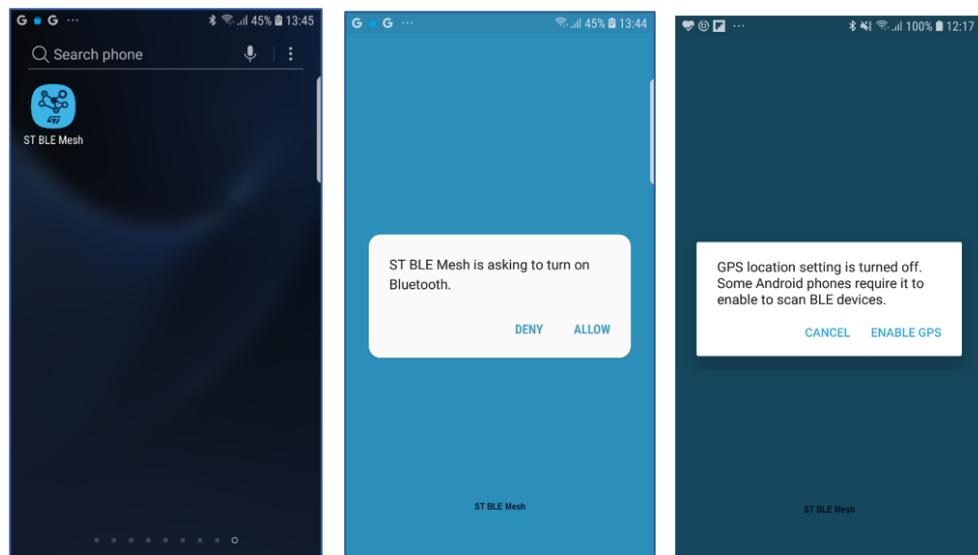
**Step 2.** Click on the ST BLE Mesh icon to launch the App and accept the request prompt to allow Bluetooth radio and location turn on.

*Note:*

*From Android 6.0 onwards, you must allow the location services (GPS) to work with BLE.*

*Therefore, it is recommended to keep the GPS location on.*

**Figure 2.** Turning the Bluetooth radio and location on



## 2.3

## Introduction to the App controls

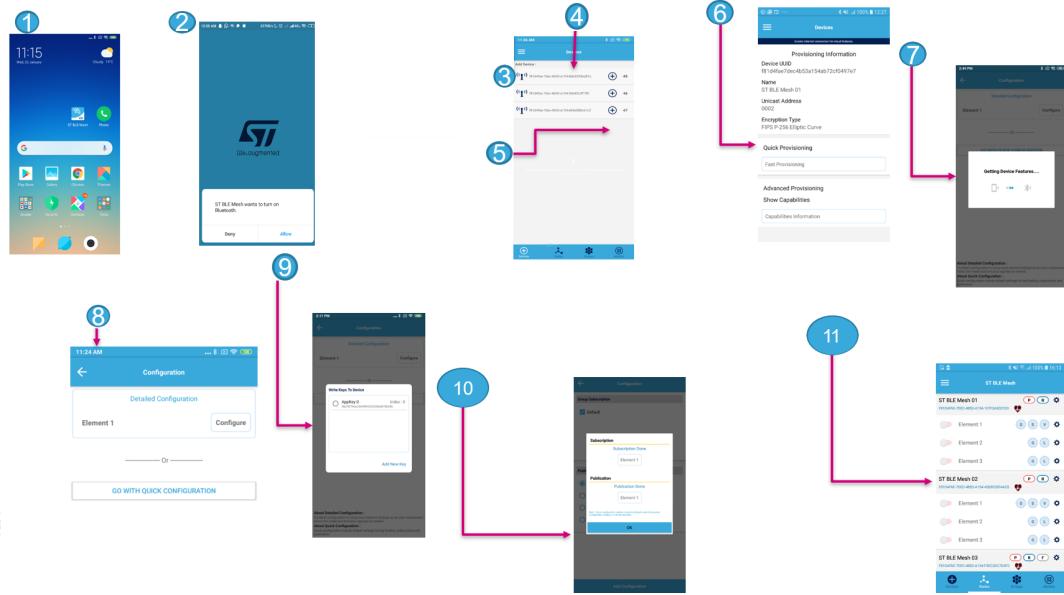
The app has following tabs:

1. **Devices**: opens the Provisioning View which allows adding new provisioned mesh capable devices into the mesh network
2. **Nodes**: is the app home page and allows opening the Network View to show the list of all the nodes and their elements in the current mesh network
3. **Groups**: opens the Groups View which shows the list of all the groups in the network
4. **Models**: opens the Model View which shows the list of nodes supporting the selected model. It allows sending specific messages to the nodes

The figure below shows the overview of the app control panels and the flow from the app launching to the device connected into a mesh network.

Figure 3. ST BLE Mesh app flow

1. ST BLE Mesh app launching
2. Prompt message to turn the Bluetooth on
3. Un-provisioned node identification
4. Device UUID for node identification
5. Adding a device
6. Quick provisioning
7. Loading device features: getting all the information and models supported by the device
8. Quick configuration to configure your device in less time and directly control it
9. Adding default key and starting configuration
10. The device is ready to be used by pressing OK
11. Provisioned devices: you can control the device and change settings

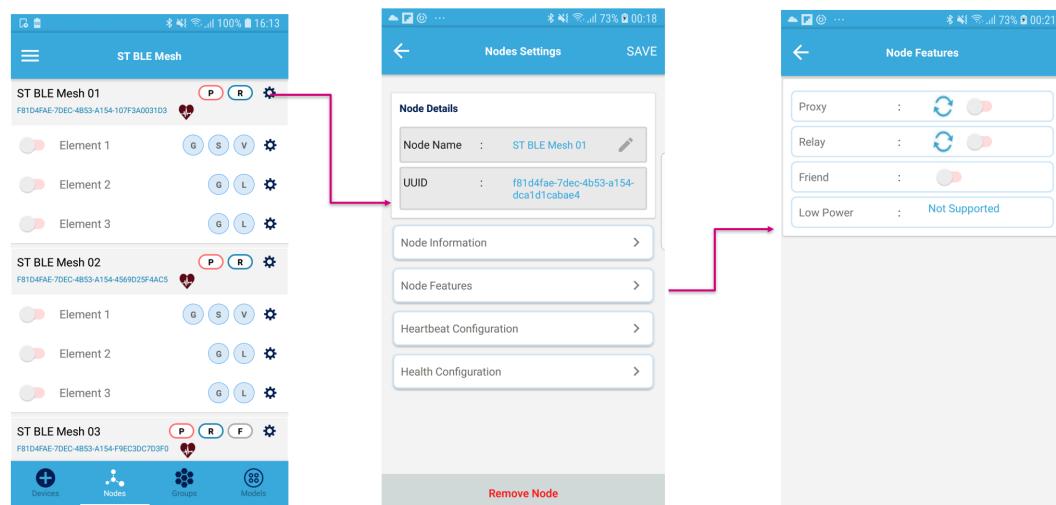


Node features are the network features supported by the node and displayed close to each node name in the app. If a feature is supported, it is possible to enable or disable it from node settings.

The network features defined in Mesh specifications are:

1. **Relay**: a node that supports this feature can relay the messages destined for other nodes in the network. If there are few relay nodes, a message may not reach its destination; on the contrary, too many relay nodes may cause network congestion.
2. **Proxy**: the current generation of smartphones do not fully support sending and receiving mesh packets over advertising bearer. So, a proxy node is necessary to communicate with the smartphone over Bluetooth® low energy using the GATT protocol. The proxy node forwards the messages received on GATT to the mesh network and vice versa.
3. **Low Power**: low power nodes are battery-operated nodes which wake up occasionally to send packets and to check any incoming packet.
4. **Friend**: as low power nodes are sleeping most of the time, a friend node is necessary to receive messages on their behalf. When low power nodes wake up, they can retrieve the pending messages from the mailbox maintained by their friend node.

Figure 4. ST BLE Mesh node features



You can also enable/disable any network feature supported by the node:

- by tapping on the refresh icon to read the current status
- by tapping on the switch icon to enable/disable the feature

Note:

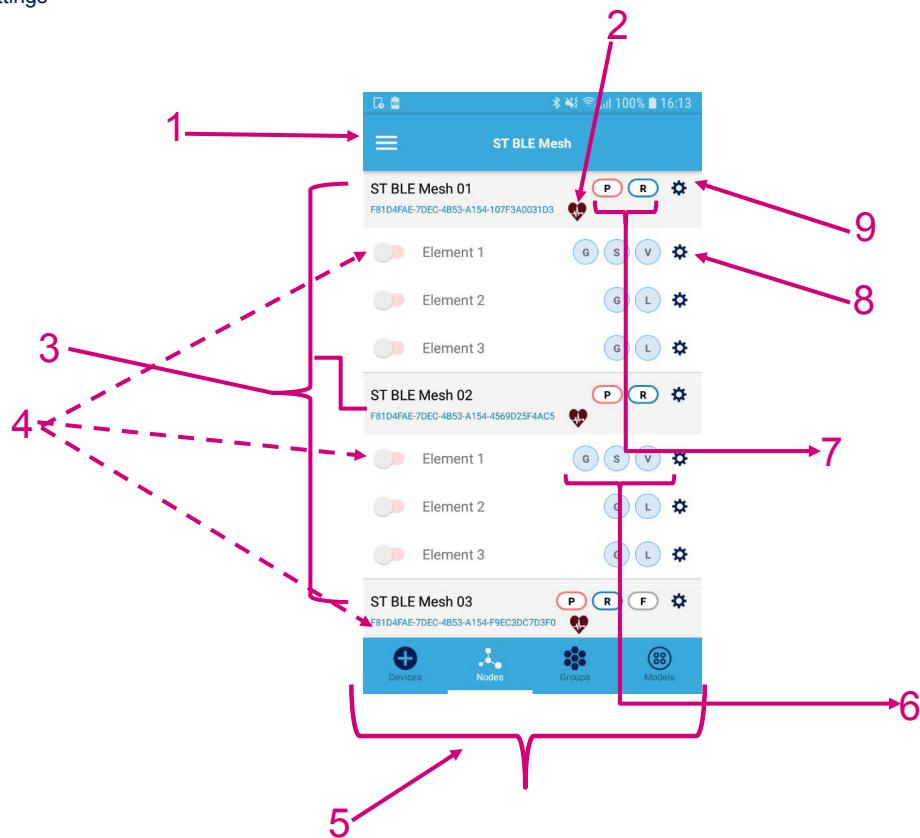
If you disable the proxy feature in the supporting nodes, your smartphone can communicate with the node only through another proxy node in the network. If you have only one node in the network and you disable the proxy feature, the smartphone cannot communicate with that node at all. In this case, the only solution is to reset the node manually.

Tapping the gear icon next to any element, the Element settings page is displayed.

When enabling/disabling a network feature, the information is not stored in the non-volatile memory (NVM) and reverts to default when powering the node.

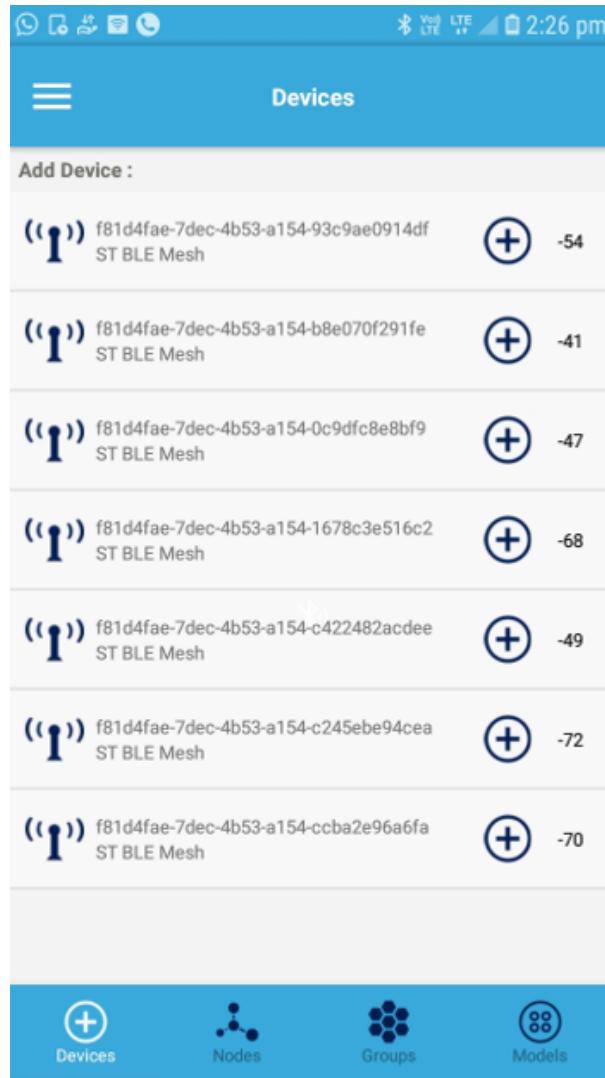
**Figure 5.** ST BLE Mesh app controls

1. Navigation bar
2. Heartbeat
3. Provisioned nodes
4. Node elements
5. Devices, Nodes, Groups and Models tabs
6. Models:
  - G - generic
  - L - lighting
  - S - sensor
  - V - vendor
7. Node features:
  - P - Proxy
  - R - Relay
  - LP - Low Power
  - F - Friend
8. Element settings
9. Node settings



When you open the Provisioning View, the app scans for un-provisioned mesh capable devices in the proximity. The devices are listed with RSSI values and identified by their UUIDs (or MAC address in Android only) and advertised names. The provisioning process starts by clicking on the (+) icon next to each device name.

Figure 6. ST BLE Mesh - Provisioning View



After the provisioning process, it is necessary to disconnect from the provisioning service and connect to the proxy service of any node in the network. By default, this option is enabled to ensure the phone connects to the proxy service of the just provisioned node and not to any other node. The post provisioning configuration process involves transfer of a relatively high number of large messages. It is more reliable and efficient to transfer this data over GATT connection instead of mesh network. If the “Node Identity Proxy” options are disabled, the configuration is performed over the mesh network, which would be slow. In some cases, where the node does not support proxy service nor node identity option, the option must be disabled.

## 2.4

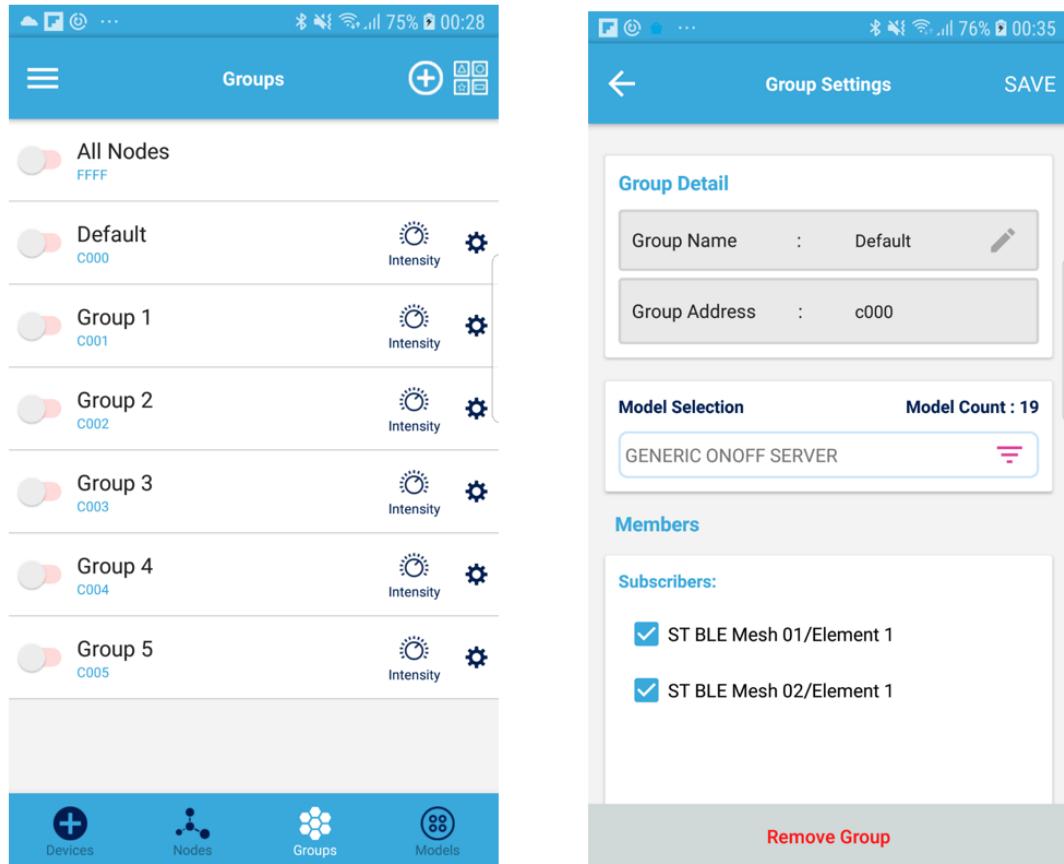
### Group, node and element settings

In the Groups View, each group is identified by group address and you can:

- toggle a group on and off with the switch button close to the group name
- add a new group with the plus button
- open the Group Settings menu

This view displays the list all the configured groups and allows sending messages to a group of nodes. The gear icon close to each group is used to access its publication and subscription settings.

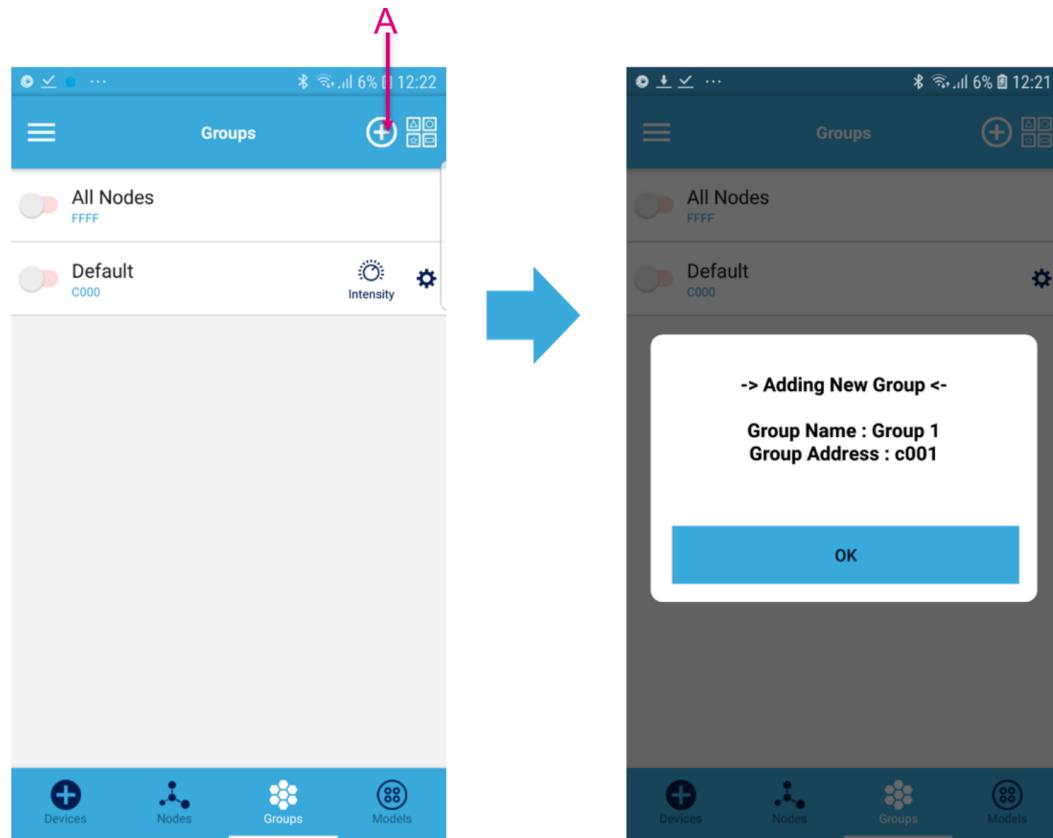
Figure 7. ST BLE Mesh - Group View



The (+) icon on the top is used to create a new group. It creates the group starting from address C001 and the default name Group 1. You can change the name from Group Settings.

Figure 8. ST BLE Mesh - adding a new group

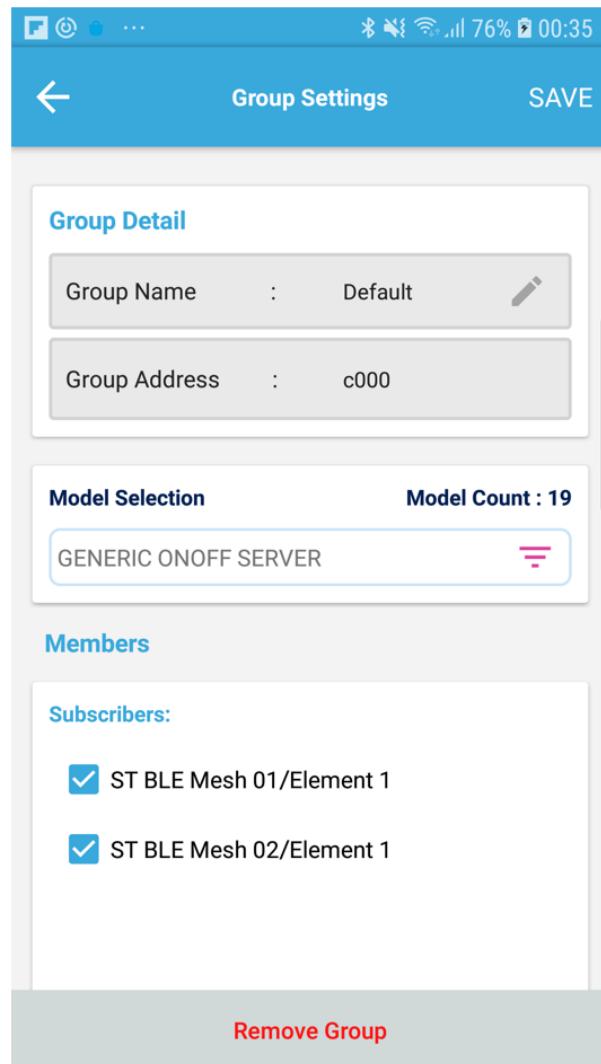
- A - Click the plus button to add a new group



From the Group Settings view, you can:

- edit group names
- set the subscription address for a given model (in the drop down list) by enabling the check box next to the group address
- remove the subscription address for a given model (in the drop down list) by disabling the check box next to the group address
- remove groups

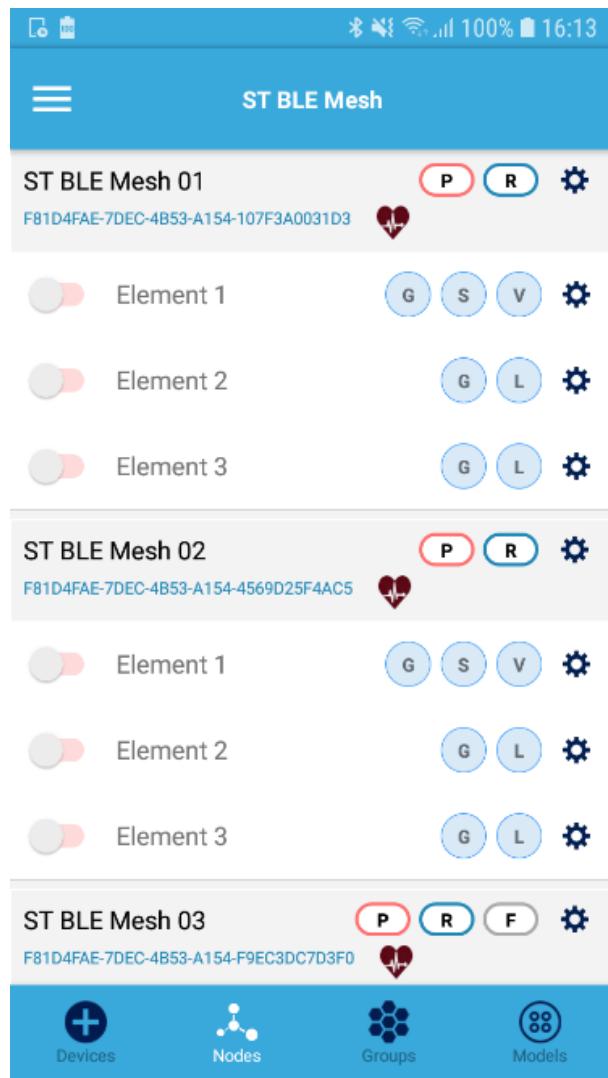
Figure 9. ST BLE Mesh - Group Settings



The network view lists all the nodes (and elements) in the mesh network and allows configuration of various parameters as shown below.

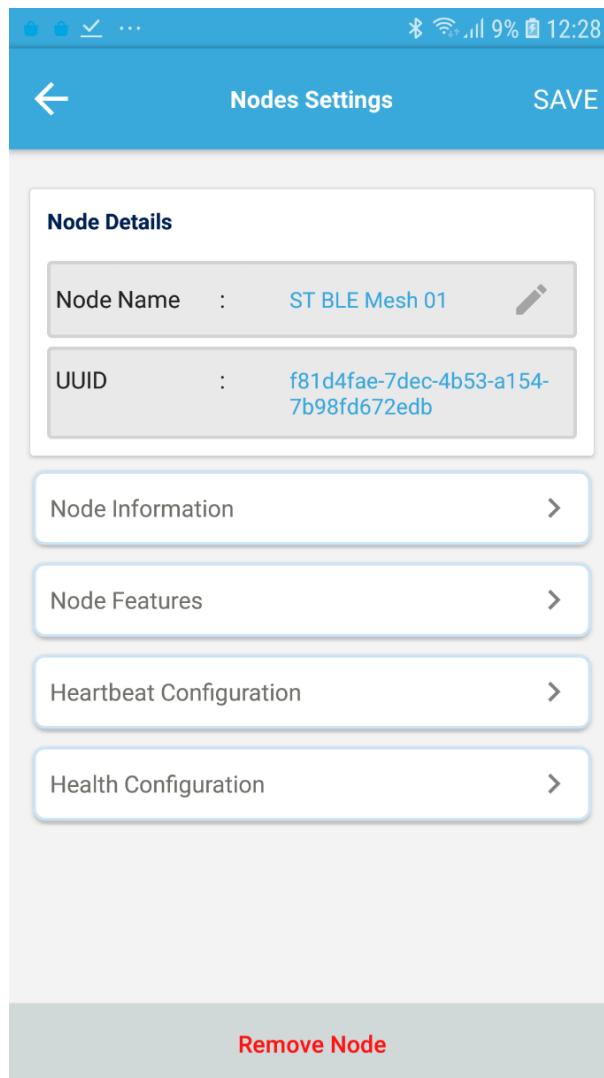
The switch on each element can be used to send on/off commands to the element.

Figure 10. ST BLE Mesh - Nodes



Tapping the gear icon close to any node, the Node Settings page is displayed.  
This view allows updating the node display name, subscription and publication settings.

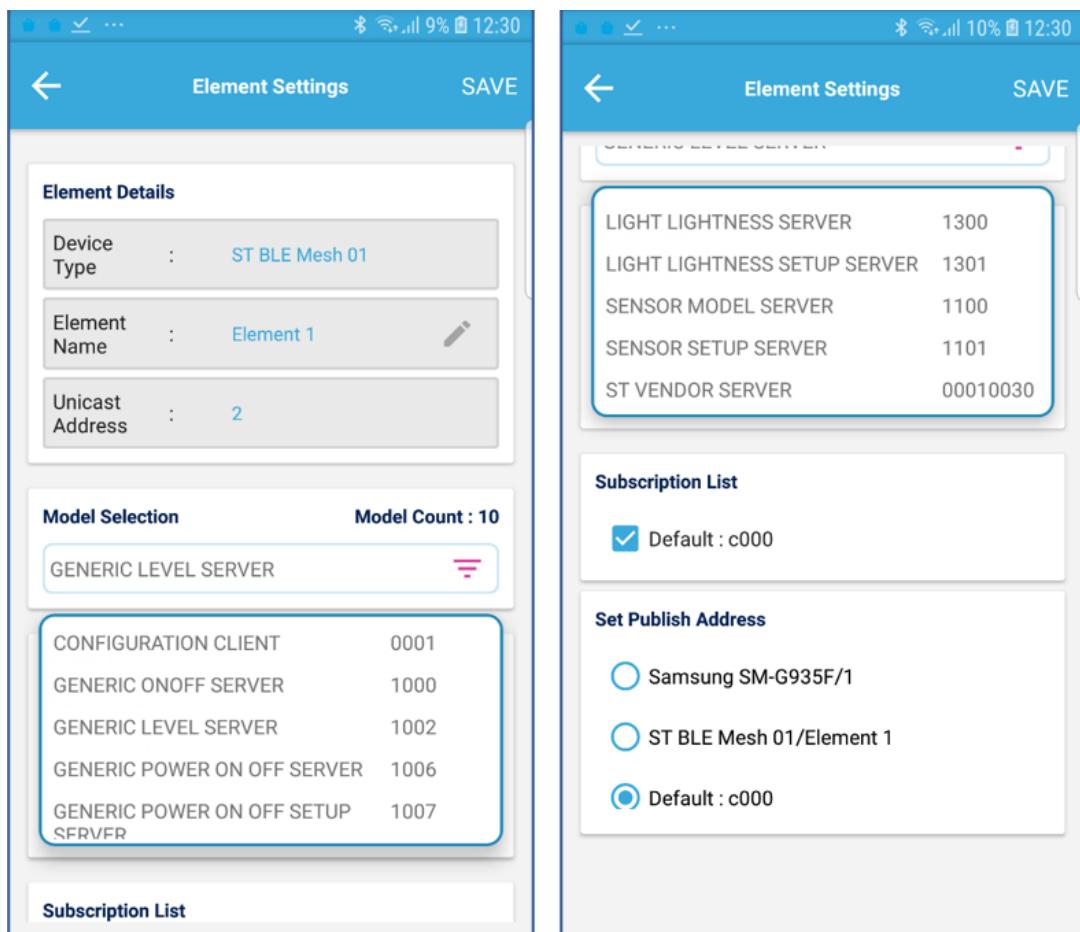
Figure 11. ST BLE Mesh - Node Settings



From the Element Settings view, you can :

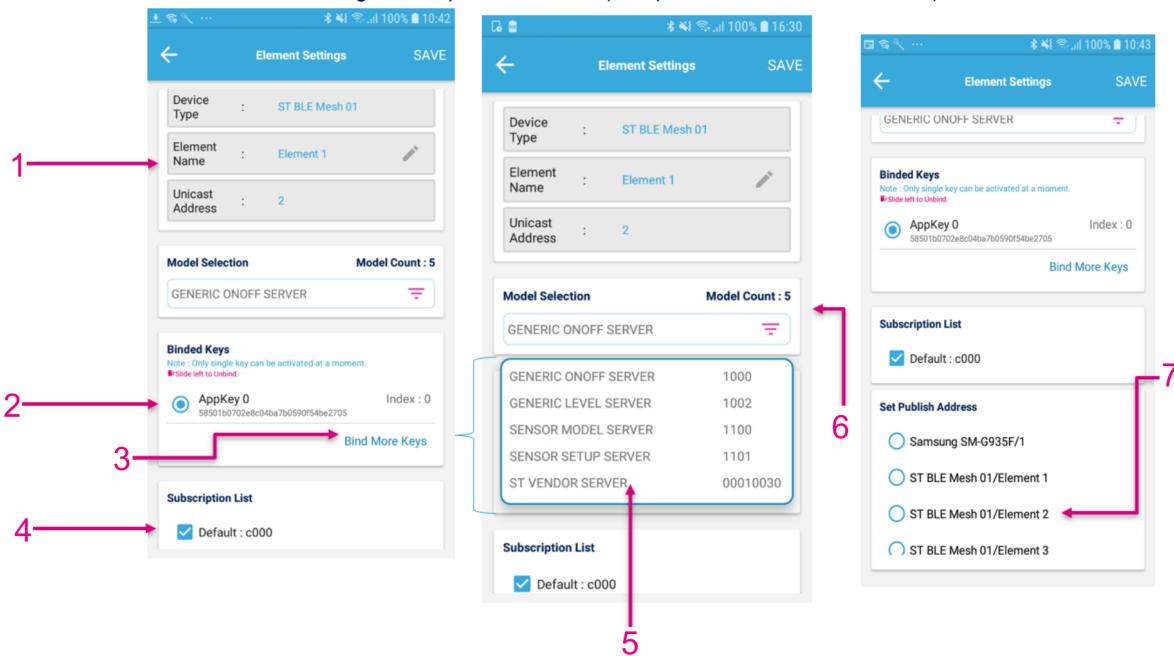
- edit the element name
- bind more app keys and select the key set for a given model (in the drop down list) by enabling the check box next to the group address
- remove the subscription address for a given model (in the drop down list) by disabling the check box next to the group address
- set the publication address for a given model (in the drop down list) by enabling the check box next to the group address

Figure 12. ST BLE Mesh - Element Settings



**Figure 13. ST BLE Mesh - Element Settings (commands)**

1. Edit Element Name
2. Select Bindeds Keys
3. Bind more app keys
4. Select the subscription address
5. Drop down list to select model
6. Select model
7. Select the element which will be given the publish address (multiple elements can be selected)



## 3 ST BlueNRG-Mesh Android App functionality

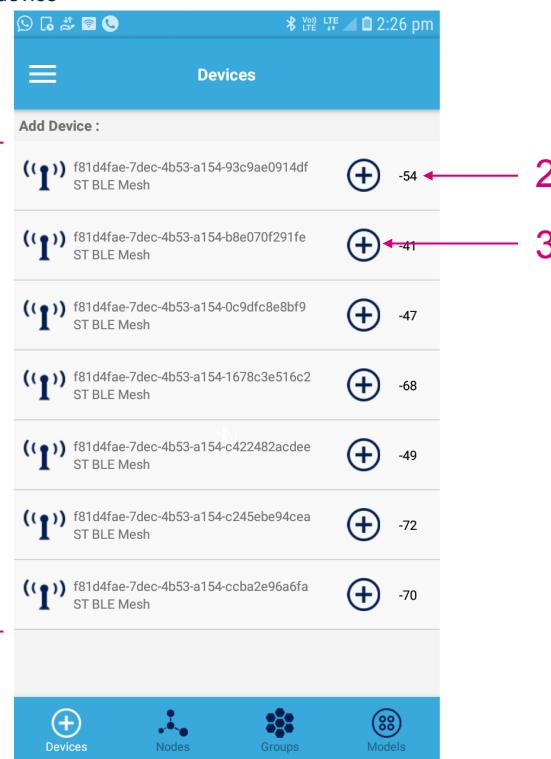
### 3.1 Provisioning the node

Provisioning is a process of authenticating the un-provisioned devices and bringing them into the BLE Mesh network.

**Step 1.** Launch the app.

**Figure 14. Un-provisioned device view**

1. Un-provisioned devices
2. RSSI value
3. Click button to provision the device



**Step 2.** Ensure the device you want to add to your mesh network is powered and in signal range.

**Step 3.** Go to the provisioning page.

The page lists un-provisioned devices in the signal range and their UUID.

The RSSI number on the right of each device indicates your approximate distance from it.

**Step 4.** Click the add (+) button to begin provisioning.

Once the provisioning starts, you will see a window showing the provisioning status.

During this process, the device identity is verified by its public key and/or OOB data. After verification, a secure channel is created using ECDH algorithm over BLE GATT connection. Using this secure channel, the provisioner distributes encryption keys and allocates a unique unicast address to the device which becomes a mesh network node. The node can now send and receive encrypted and authenticated packets on the mesh network.

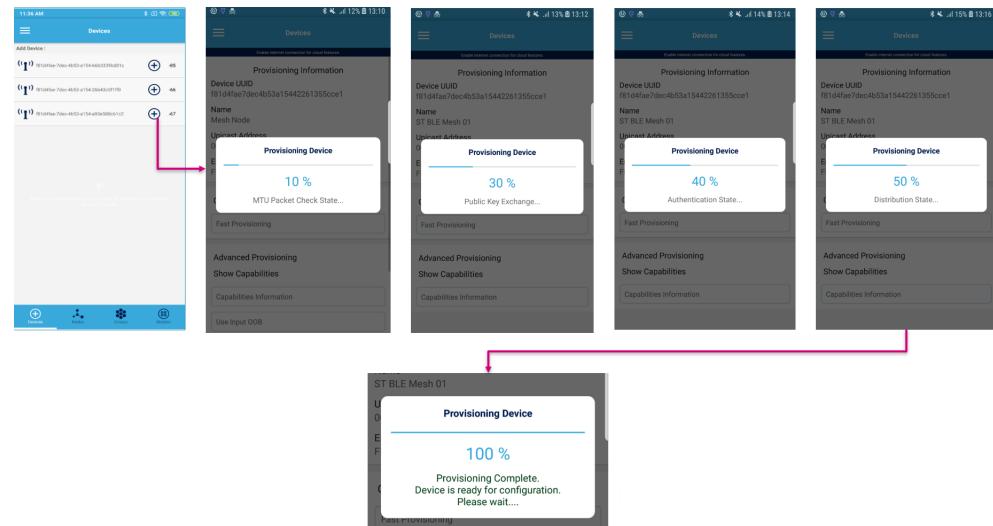
**Step 5.** Keep the device near your Android smartphone during provisioning procedure.

The provisioning takes 10 to 12 seconds depending on the smartphone.

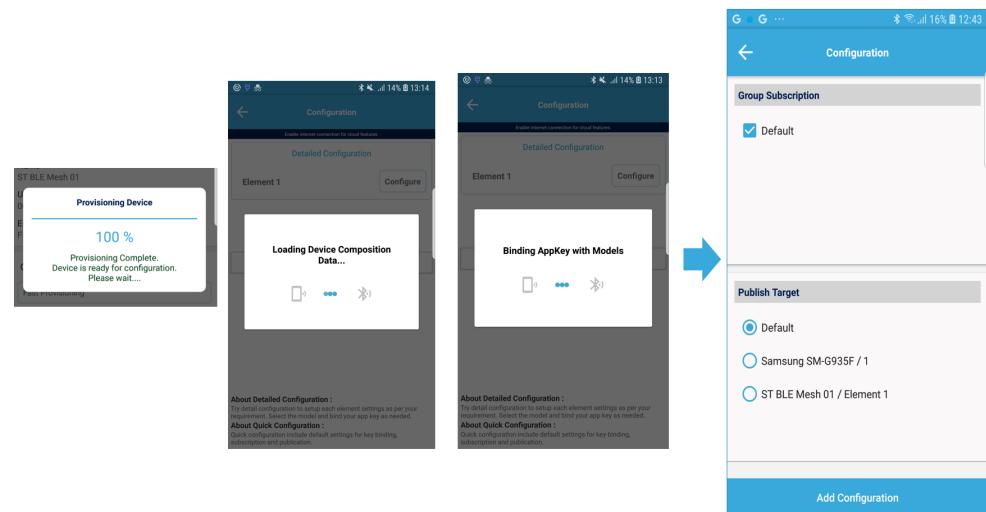
The provisioned node is listed with a default node name as New Node YY along with the UUID and setting icon for individual node.

**Step 6.** Toggle the switch near the Element right to left to turn the LED on (or left to right to turn it off). The proxy node is indicated in bold. The provisioned node is listed with a default New Node NN and all the Elements within the node as Element ZZ (New Node 01 and Element 01 in this example).

**Figure 15. Provisioning process**



**Figure 16. Configuration process**

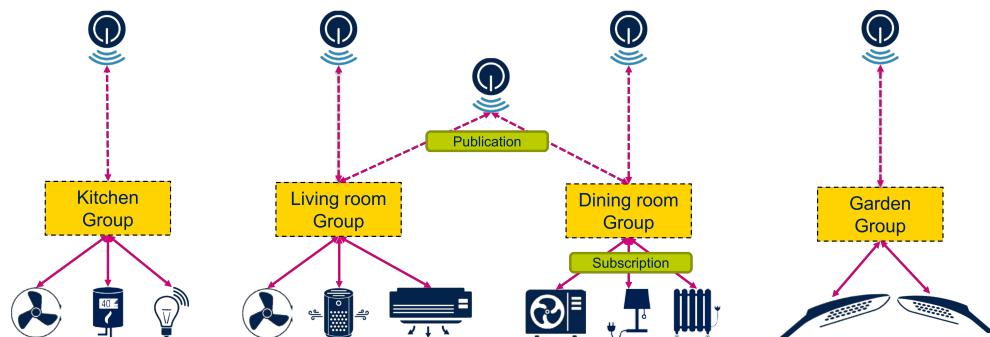


**Step 7.** Configure the element group subscription settings.

Each element can subscribe to a group to receive the messages addressed to it. The elements appear in that group subscription list and each of them can be part of multiple groups.

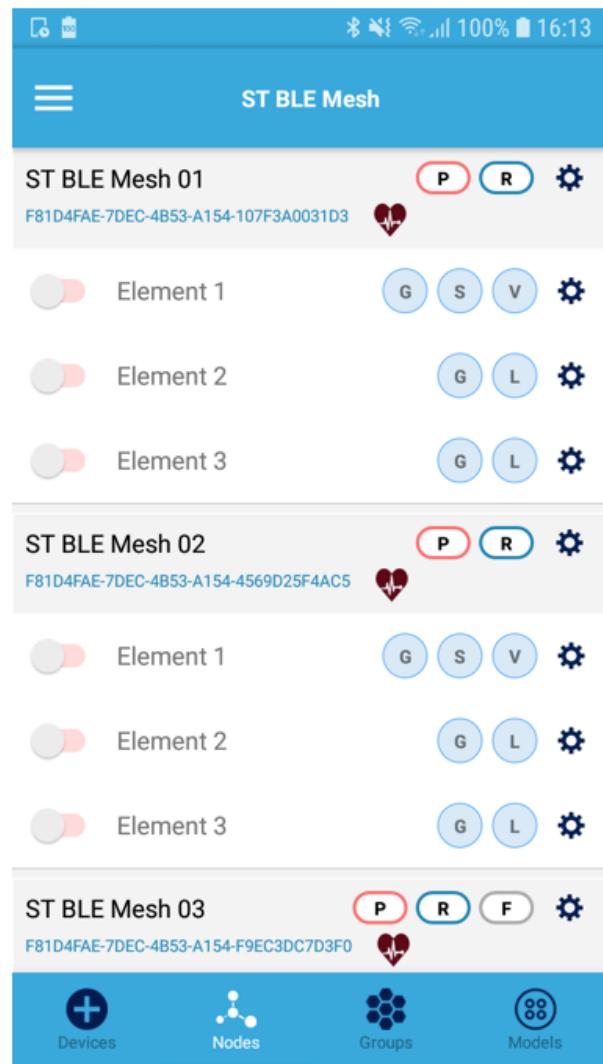
**Step 8.** Configure the element group publication settings.

An element can publish to a group address or element address. By default, all messages generated by an element target its publish address. All the elements publishing to a group appear in that group publisher list. For example, when you toggle a switch on a Bluetooth® Mesh enabled board, the switch publish address determines the appliances or group of appliances to be controlled. Publish and subscription addresses are reconfigurable allowing very flexible control scenarios.

**Figure 17. Publication and subscription scenario**

Once the node is provisioned, it appears in the Nodes tab which shows the information on the models and features supported by the nodes. It also shows the toggle control next to each node to send generic on/off and vendor commands.

Figure 18. Provisioned node view



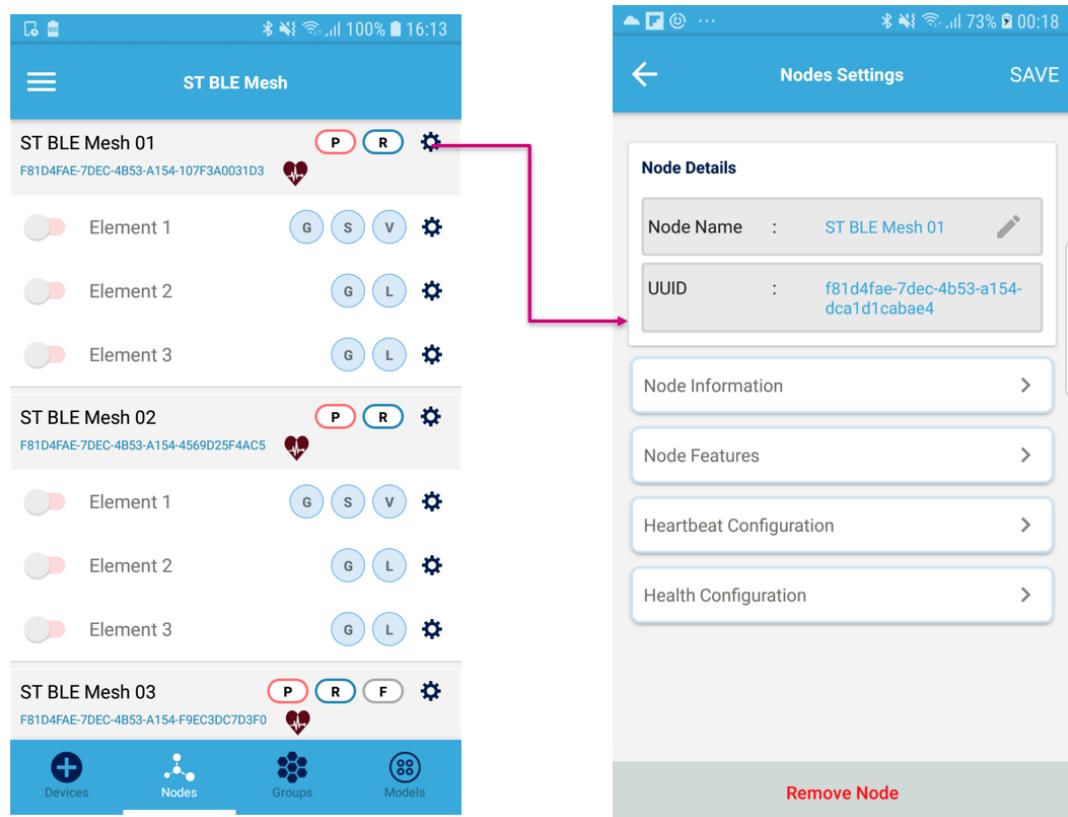
### 3.2

### Un-provisioning the node

Un-provisioning the node involves removing the node from the BLE Mesh network.

**Step 1.** To un-provision the nodes, go to the node settings and click the “Remove Node” button.

**Figure 19. Node un-provisioning**



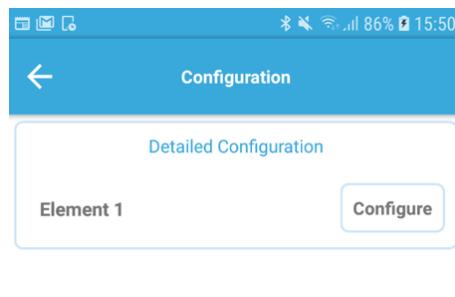
### 3.3 Configuration

To configure a node, you have to add an app key, bind the node to a given model and assign subscription and publication address to the node. During the provisioning, the node is configured as per the default configuration.

There are the following types of configuration:

- quick configuration: every element of a node is provided with a default app key (random), subscription and publication address (C000)

Figure 20. Quick configuration



----- Or -----

GO WITH QUICK CONFIGURATION

**About Detailed Configuration :**

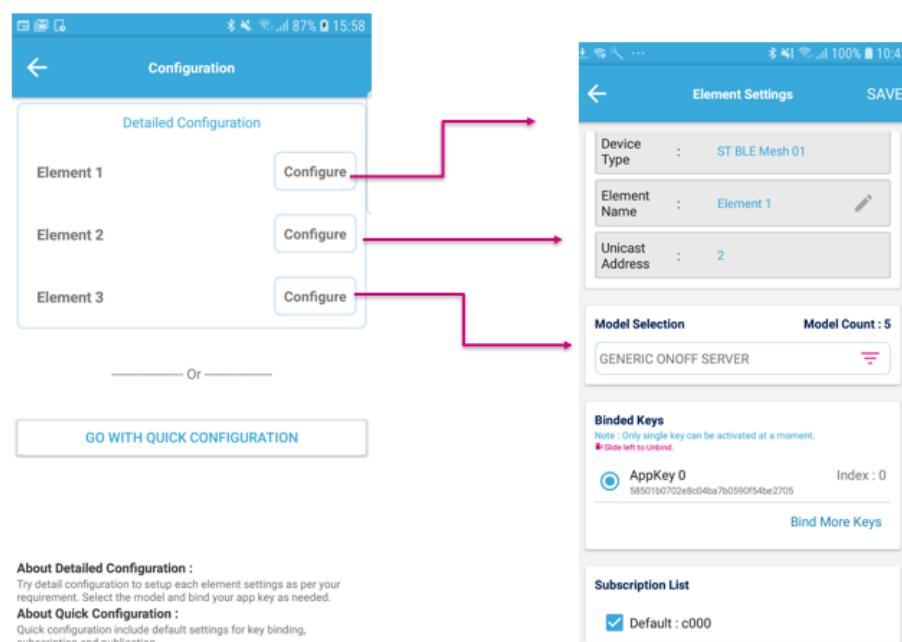
Try detail configuration to setup each element settings as per your requirement. Select the model and bind your app key as needed.

**About Quick Configuration :**

Quick configuration include default settings for key binding, subscription and publication.

- detailed configuration: each element of a node can be selectively provided with an app key, subscription and publication address

Figure 21. Detailed configuration



## 3.4 Subscription

Subscription is a process of providing a Node, a Subscription or Group Address, so that it becomes part of that group. Multiple nodes can be subscribed to the same group address and can be controlled by sending messages to that group address (C000 is the default group address).

### 3.4.1 Adding or deleting subscription

You can assign subscription (or group) address to any node. A node can have multiple subscription addresses and a group can have any number of nodes (ST BLE Mesh supports 10 nodes per group).

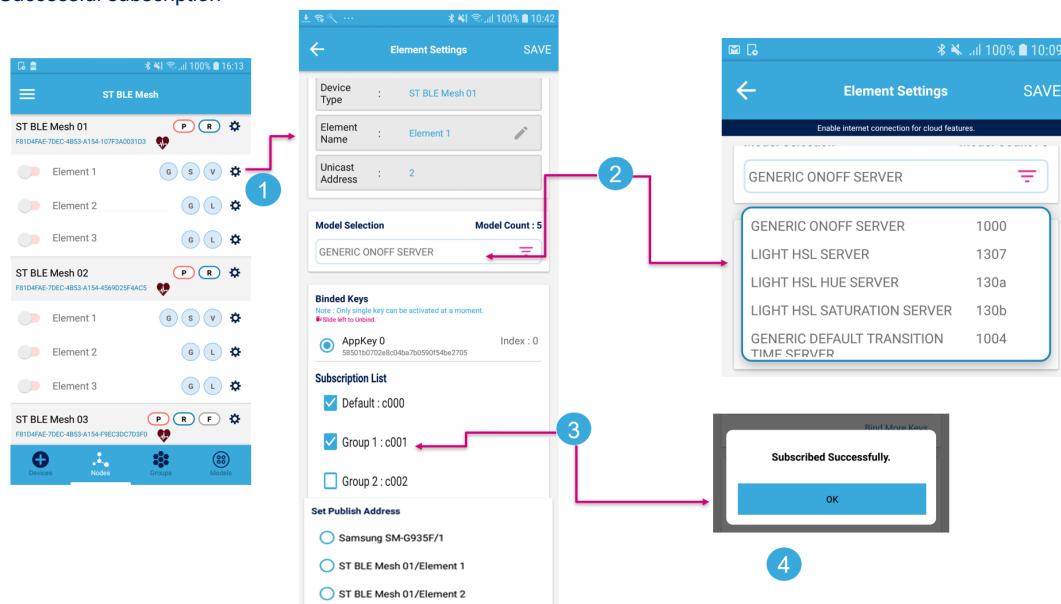
A node can be removed from a group by deleting the subscription. For each subscription address you have to select a given model which has at least one key bound.

In the default configuration a default key is applied to all the supported models.

You can add or delete a node from a group through the element or group setting pages.

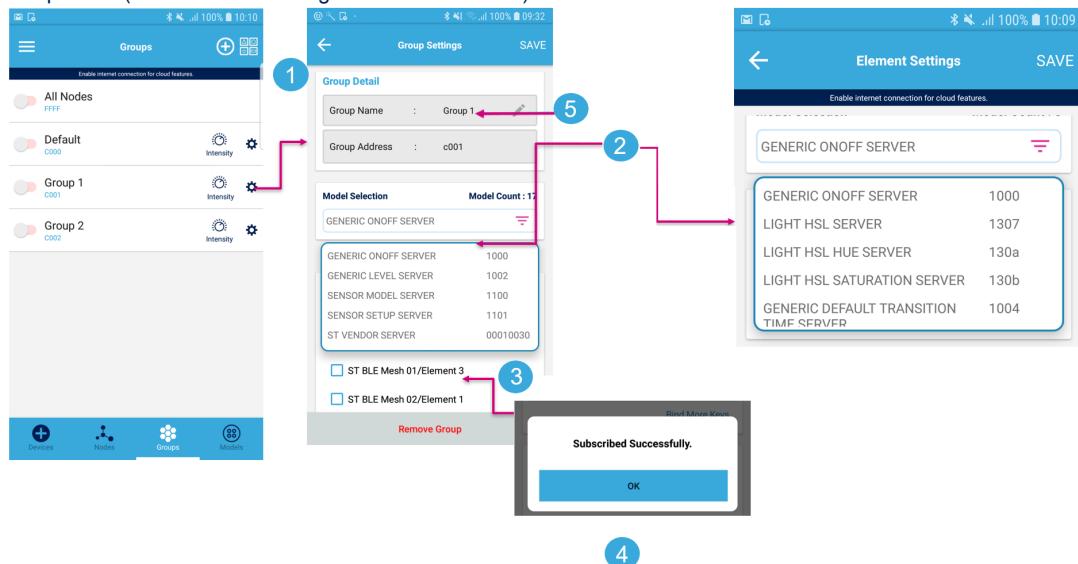
**Figure 22. Adding/deleting a node from the Element Settings page**

1. Element selection
2. Model selection
3. Check/uncheck to add/delete the element from the group
4. Successful subscription



**Figure 23. Adding/deleting a node from the Group Settings page**

1. Group selection
2. Model selection
3. Check/uncheck to add/delete the element from the group
4. Successful subscription
5. Group name (editable after clicking on the SAVE button)



### 3.5 Publication

Publication is a process of providing a publication address to a node. By default, the node broadcasts the message to its publication address. The publication address can be set for a node from the Element Settings and the Group Settings pages. If a node is given a publication address for a given model, the node can publish the message of that model to that address.

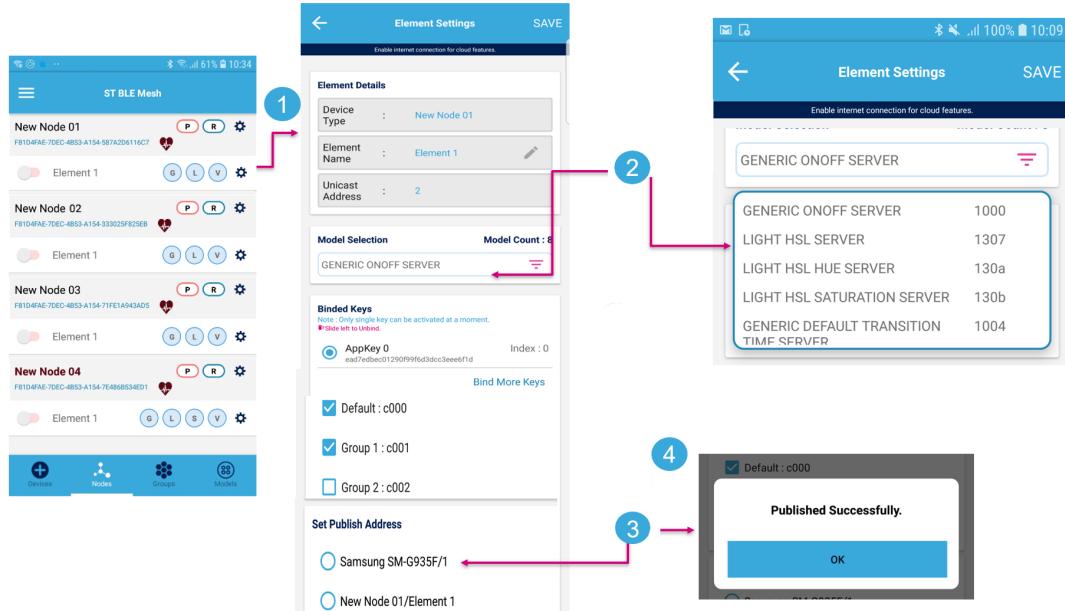
For example, a hallway has two light bulbs and their addresses are given as a publication address to a given switch as shown in [Figure 17. Publication and subscription scenario](#). By pressing the switch messages of the light bulb, the publication address messages will be published to all the lights in the hallway (two light bulbs).

A publication address (group or unicast address) can be assigned to any node acting as a switch. Once the publication address has been assigned, it cannot be deleted unlike the subscription (with delete subscription) but it can be changed to a different publication address.

For each publication address, you have to select a model which must have at least one key bound. In the default configuration, a default key is applied to all the supported models.

**Figure 24. Publication process**

1. Node selection
2. Model selection
3. Check/uncheck to set the publication address to the address indicated here (in this case, provisioner address)
4. Successful publication



## 4

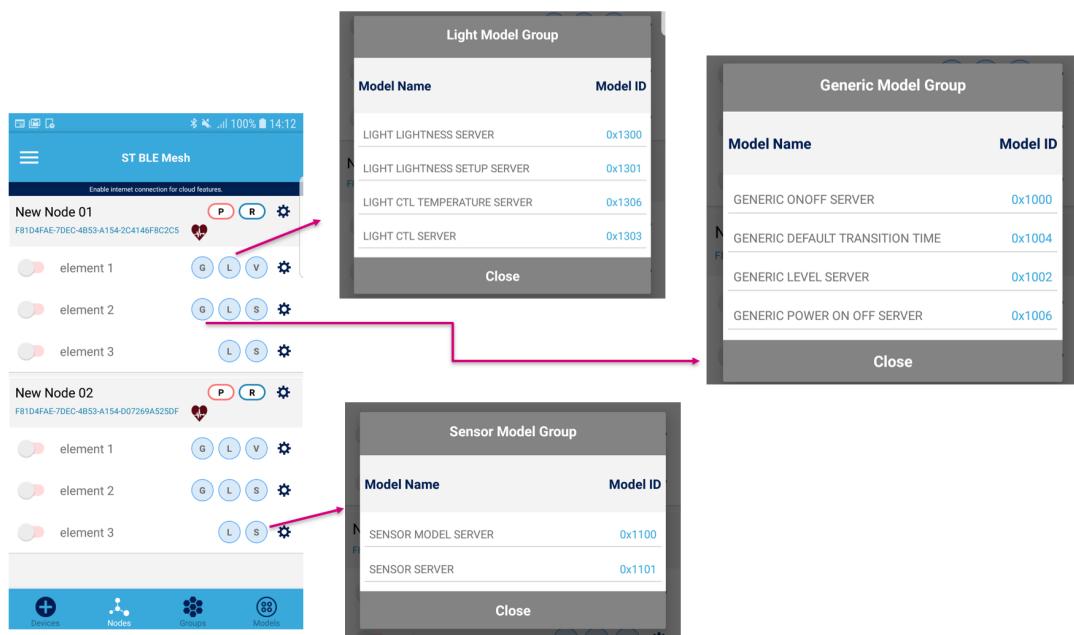
## Models

Models and their required states and messages are defined by the Bluetooth Mesh Profile specification to perform basic functions on the nodes in a mesh network.

In the STSW-BNRG-Mesh model view allows accessing a model specific functionality. Mesh models define a node basic functionality in a mesh network relevant to a specific application category (for example, lighting model defines basic functionality covering common lighting use cases). Supported models support publication and subscription.

STSW-BNRG-Mesh provides the information of the supported models in an element by clicking on the circles next to its name.

**Figure 25. Model information**



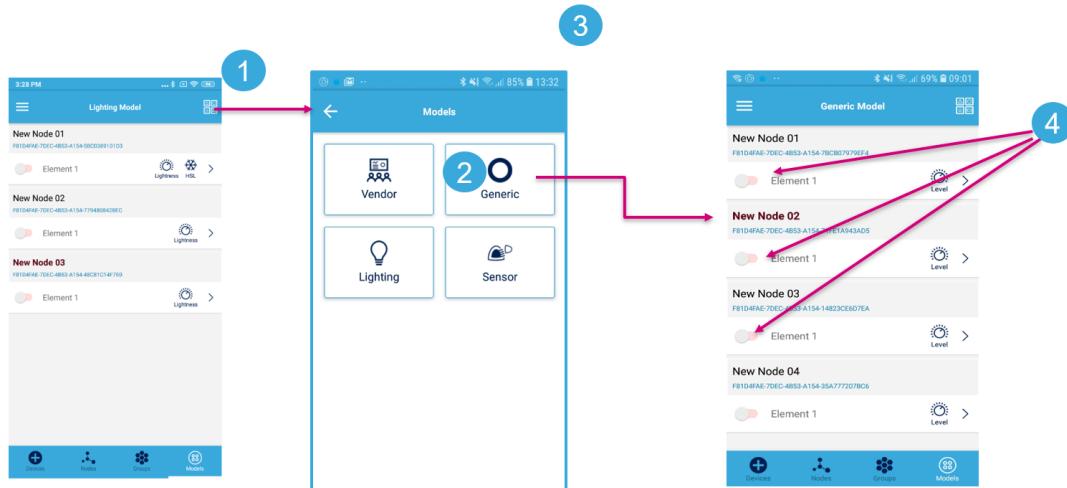
### 4.1

### Generic ON/OFF model

Generic ON/OFF model is used to send the ON and OFF commands.

**Figure 26. Generic ON/OFF model control**

1. Model selection
2. Generic model
3. Switch to slide for sending generic ON/OFF commands

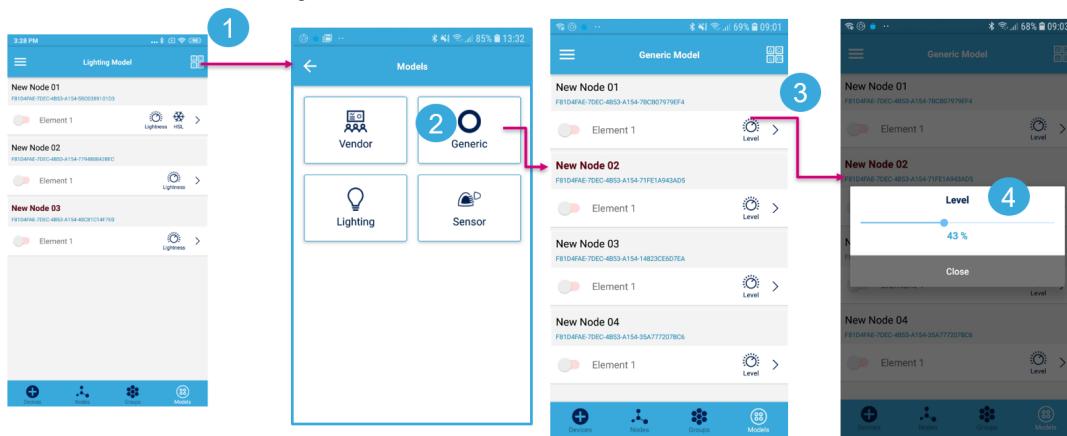


## 4.2 Generic level model

Generic Level is a base model for sending the level or intensity messages in percentage (0-100).

**Figure 27. Generic level model control**

1. Model selection
2. Generic model
3. Level intensity
4. Slide over the slider to send the generic level values

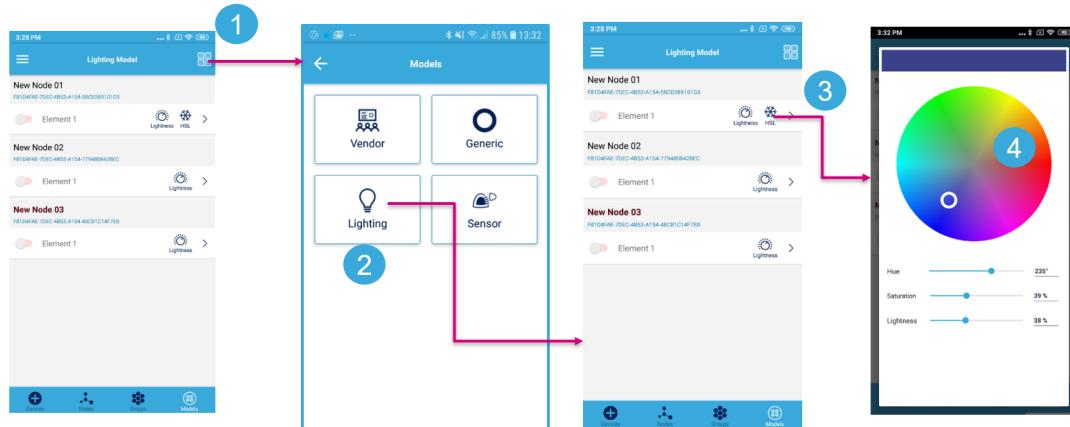


## 4.3 Light HSL model

Light HSL model is used to change the color of the RGB lights. It sends the RGB color values in HSL (hue, saturation and lightness) format. You can hover over the color wheel to get the RGB values to be sent to the node (RGB capable device).

Figure 28. Light HSL model control

1. Model selection
2. Lighting model
3. Level intensity
4. Hover on the color circle to send the HSL values

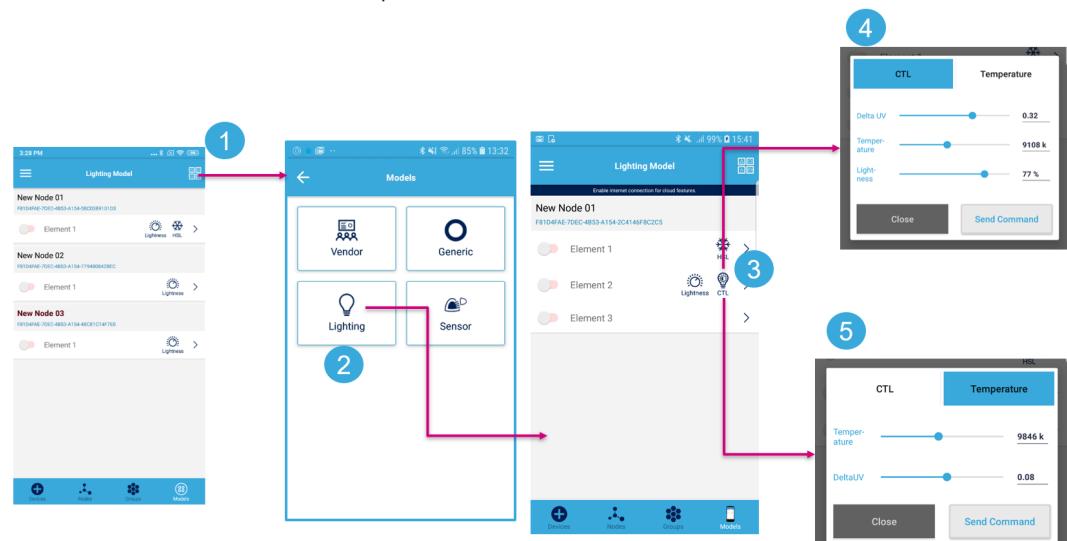


## 4.4 Light CTL model

Light CTL model is used to control the color temperature of a tunable white light along with the delta UV value. The color temperature corresponds to a curve on the color temperature chart and is equivalent to black body radiation at different temperatures (expressed in Kelvin).

Figure 29. Light CTL model control (delta and temperature)

1. Model selection
2. Lighting model
3. Color temperature control
4. Slide over the slider to send the CTL delta values
5. Slide over the slider to send the CTL temperature values

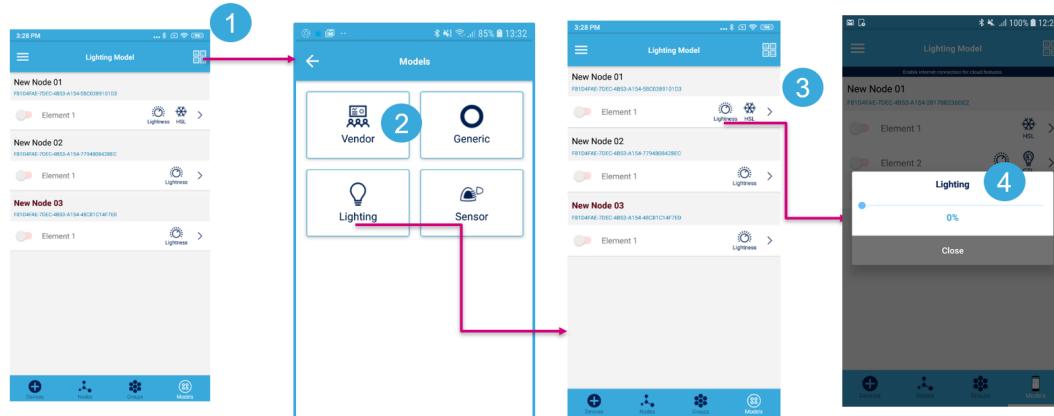


## 4.5 Light Lightness model

Light Lightness model is used to send the lighting level values.

**Figure 30. Light Lightness model control**

1. Model selection
2. Lighting model
3. Lightness control
4. Slide over the slider to send the lighting values

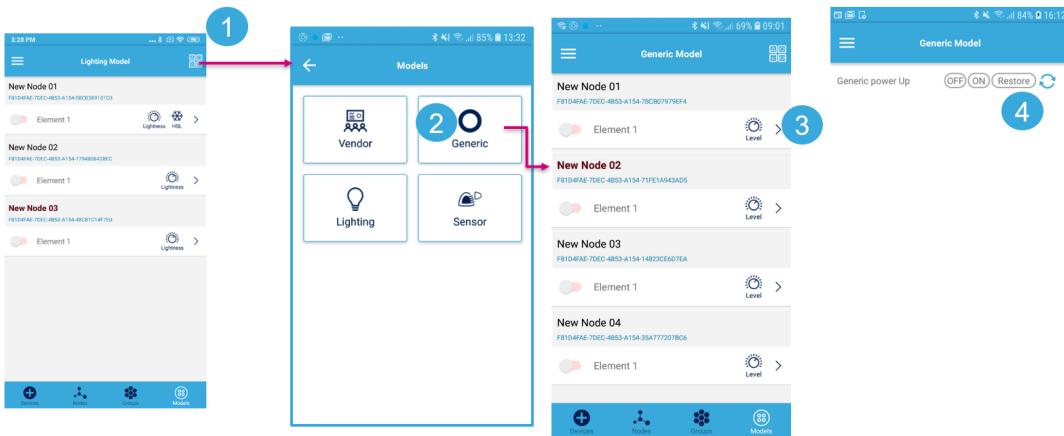


## 4.6 Generic power ON/OFF model

Generic power ON/OFF model is based on generic ON/OFF model and is used to send the generic power ON/OFF model messages.

**Figure 31. Generic power ON/OFF model control**

1. Model selection
2. Generic model
3. Click on the > symbol to open the generic model power up page
4. Press on/off to send the message and refresh icon to get the state

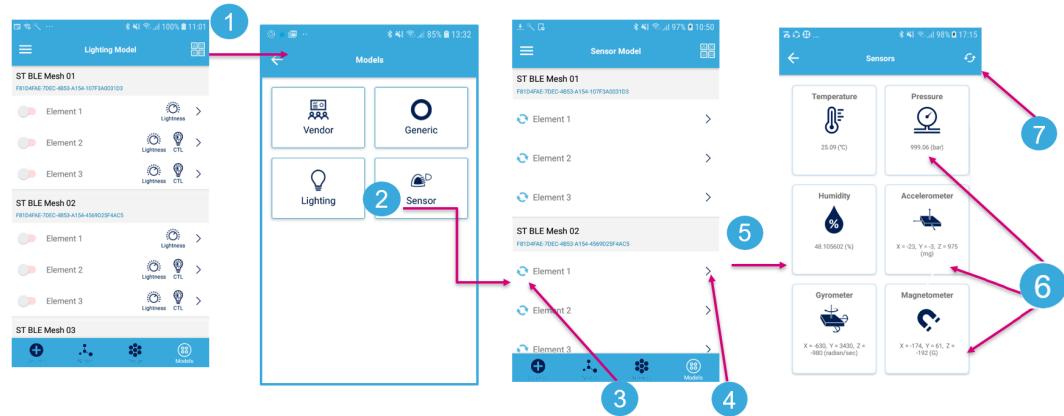


## 4.7 Sensor model

Sensor model is used to retrieve the values from the sensors (environmental, inertial, etc.) supported by the node.

**Figure 32. Sensor model control**

1. Model selection
2. Sensor model
3. Click on the refresh icon
4. Or click on the > symbol
5. The Sensor page opens
6. Click on an icon to get data from that sensor
7. Refresh to get data from all available sensors

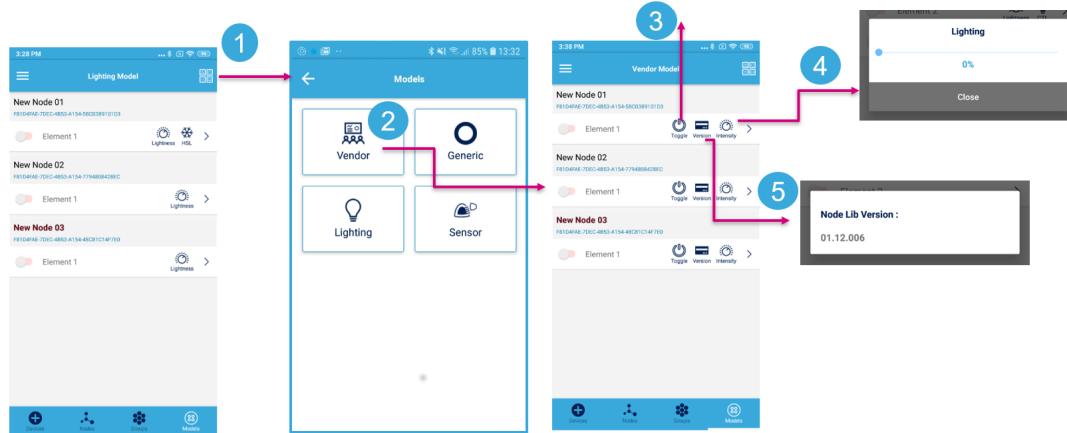


## 4.8 Vendor model

Vendor model is a custom model with Custom Opcode and Vendor ID.

**Figure 33. Vendor model control**

1. Model selection
2. Vendor model
3. Click this button to send a toggle command to the vendor
4. Slide over the slider to send the lighting values
5. Node library version



## 5 Database exchange configuration

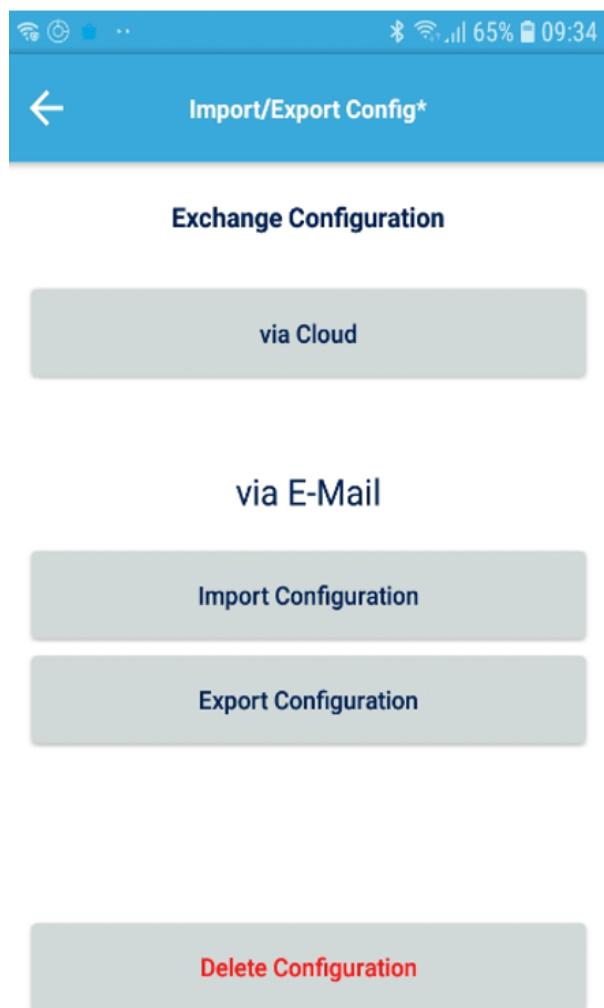
ST BLE Mesh app provides multiple options to share the network configuration with other smartphones and allow you to use and manage the mesh network created by other users and vice versa.

During the provisioning process, “Network Key” and “Unicast Address” are transferred to the newly provisioned node over a secure channel created using ECDH algorithm over BLE GATT connection. A “Device Key” is independently computed. The device becomes a mesh network node after provisioning.

During the configuration phase, other configuration items (such as “Application Key”) are created.

To operate and manage nodes in the network, a smartphone must have the configuration shown below.

Figure 34. Network configuration sharing

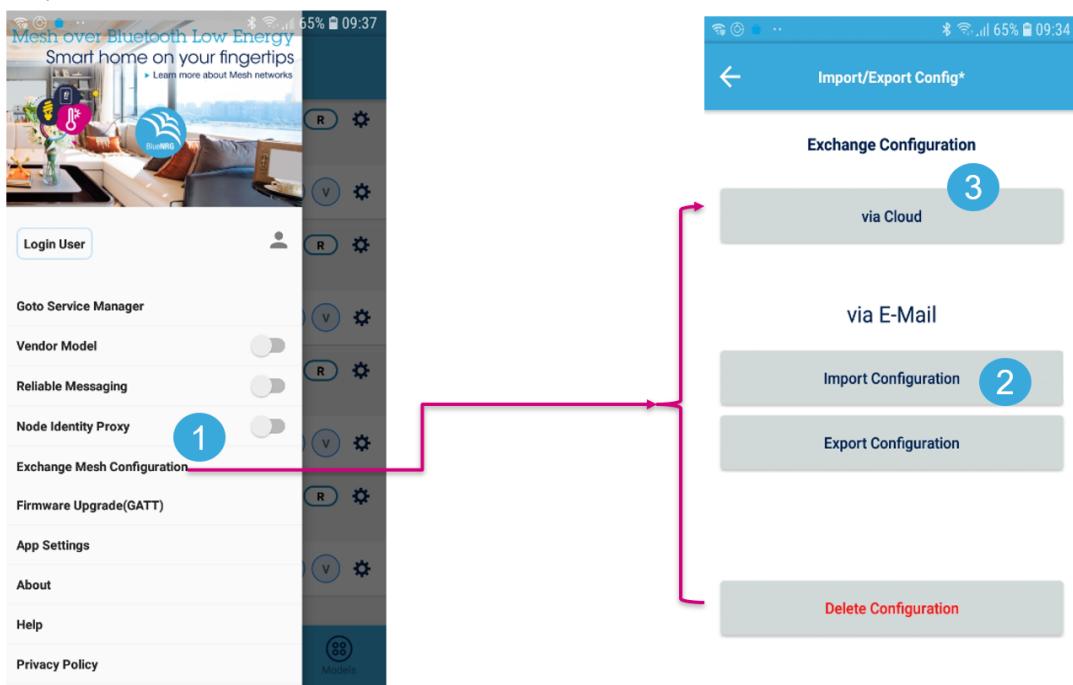


The network configuration information can be shared via:

1. e-mail: suitable only for simple one-time sharing scenarios
2. cloud app: synchronization is automatic after the first sharing. Other users can be invited through an invitation code. The cloud app also validates the information shared by other users and protects the configuration file integrity.

**Figure 35. Mesh configuration exchange**

1. Mesh configuration exchange
2. To import JSON configuration from the download folder (containing the JSON previously downloaded)
3. To import JSON files via cloud

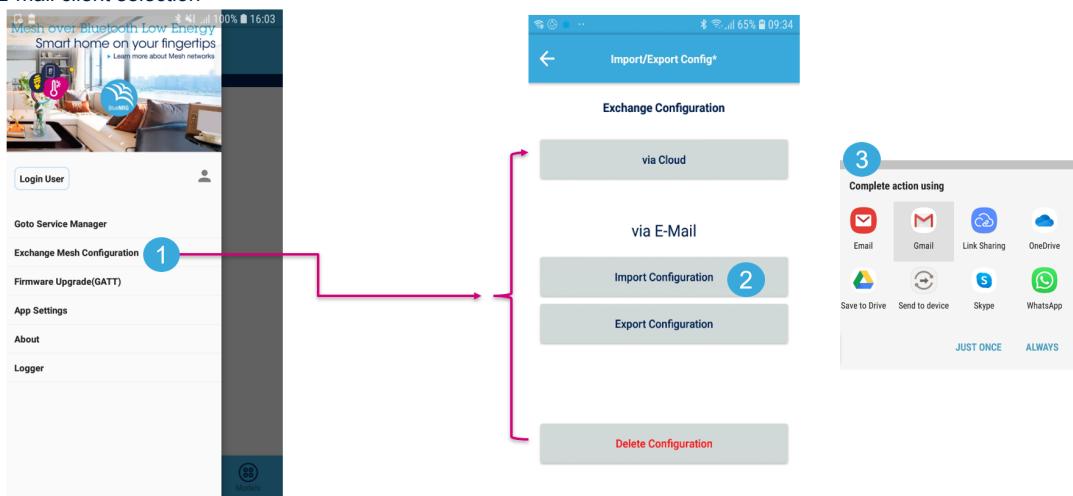


## 5.1 Sharing via e-mail

E-mails are used for sharing only in simple one-time sharing scenarios.

**Figure 36. Configuration database sharing setting - export**

1. Exchange mesh configuration
2. Open the e-mail application and export the JSON configuration
3. E-mail client selection

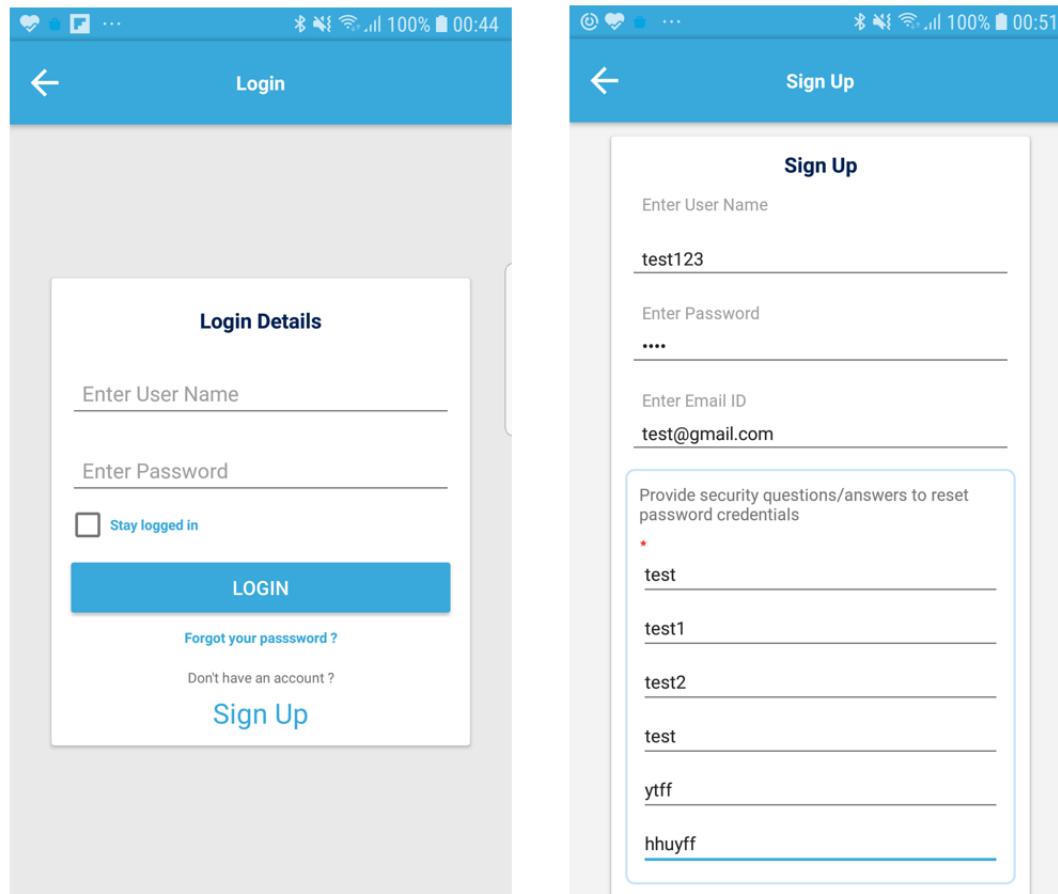


## 5.2 Sharing via cloud

A cloud app allows you to share your network configuration with other users. This feature permits automatic synchronization after the first sharing and inviting other users through an invitation code.

The cloud app also validates the information shared by other users and protects configuration file integrity. You have to create an account to enable sharing via cloud and provide one or more security questions with the corresponding answers to help recover the account in case the password is lost.

**Figure 37. Sharing via cloud**

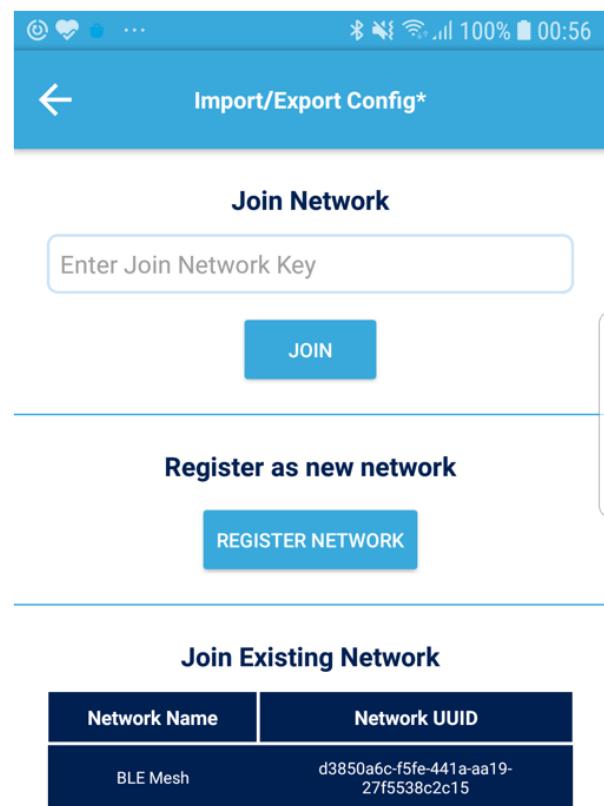


Once registration is complete, you can log into the account.

In cloud-based network sharing, you can:

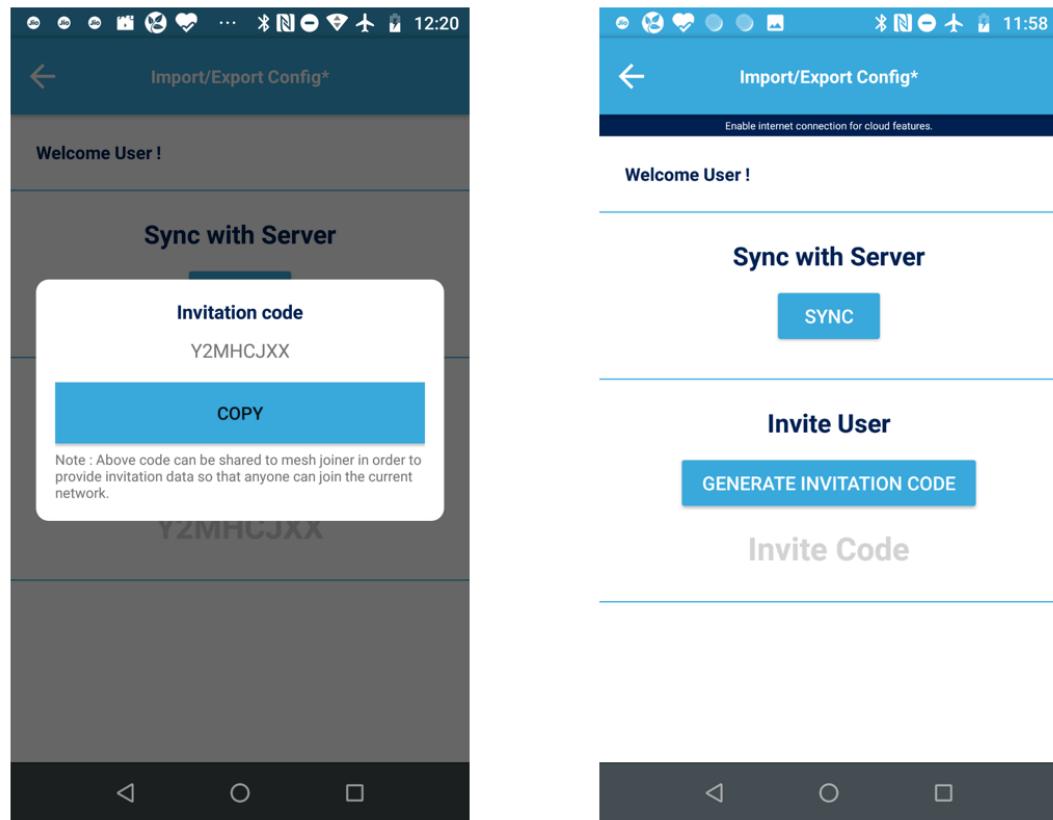
- register a new network and invite other users to join it

**Figure 38. Registering a network**



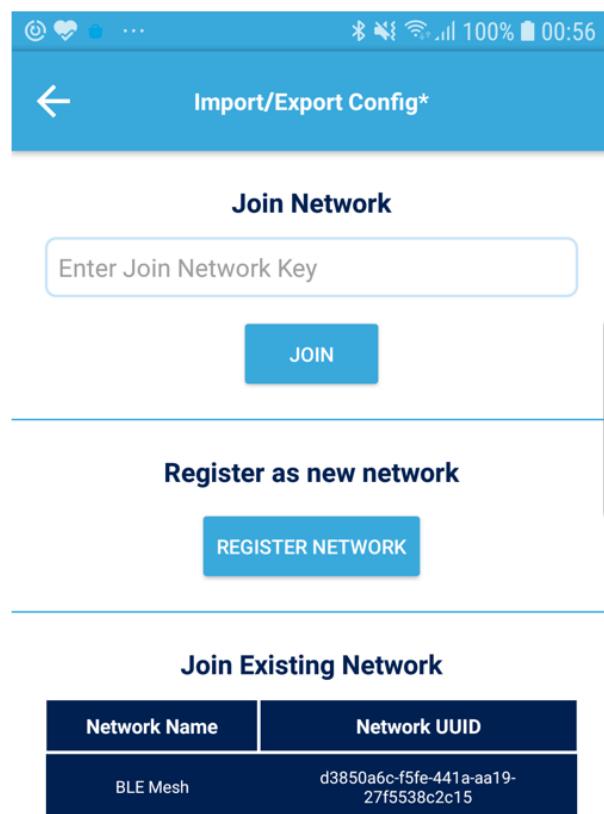
- join an existing network using an invitation code shared by the network creator

Figure 39. Joining a network



- re-join a previously created network. It is used as a backup option, useful when you reinstall the app or change smartphone

**Figure 40. Re-joining a previously created network**

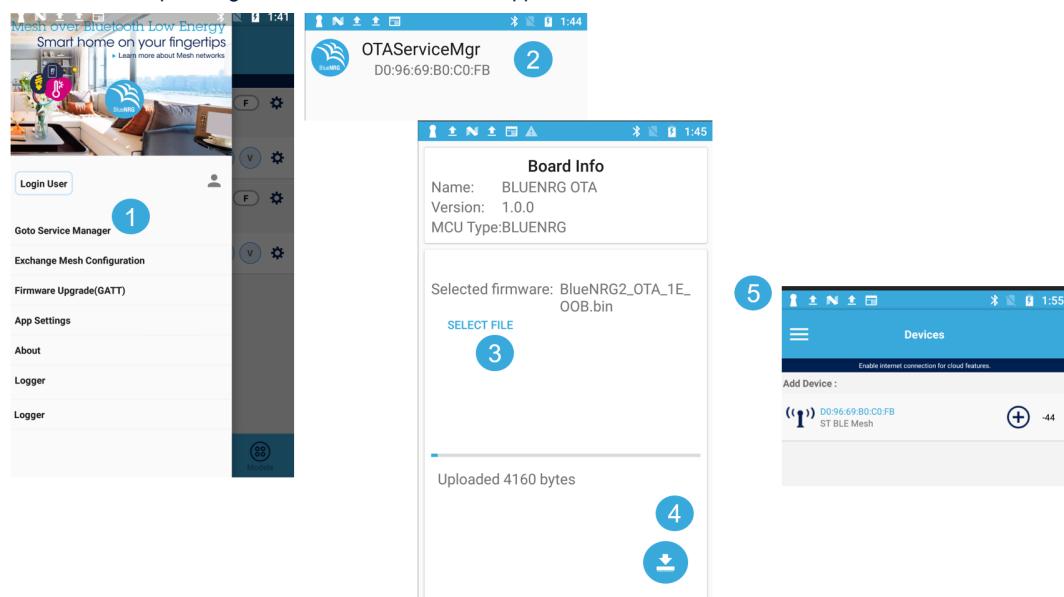


## 6 Firmware over the air (FOTA) update

ST BLE Mesh app updates ST BLE mesh firmware using the [BlueST-SDK](#) DFU protocol for firmware over the air (FOTA) update. You have to copy the BlueNRG2\_OTA\_X.bin into the smartphone file system via USB cable and browse it as shown below.

**Figure 41. FOTA over GATT**

1. Go to service manager to flash the new binary
2. OTA service manager
3. Browse the bin file
4. Upload in progress
5. After successful uploading, the device is visible in the app



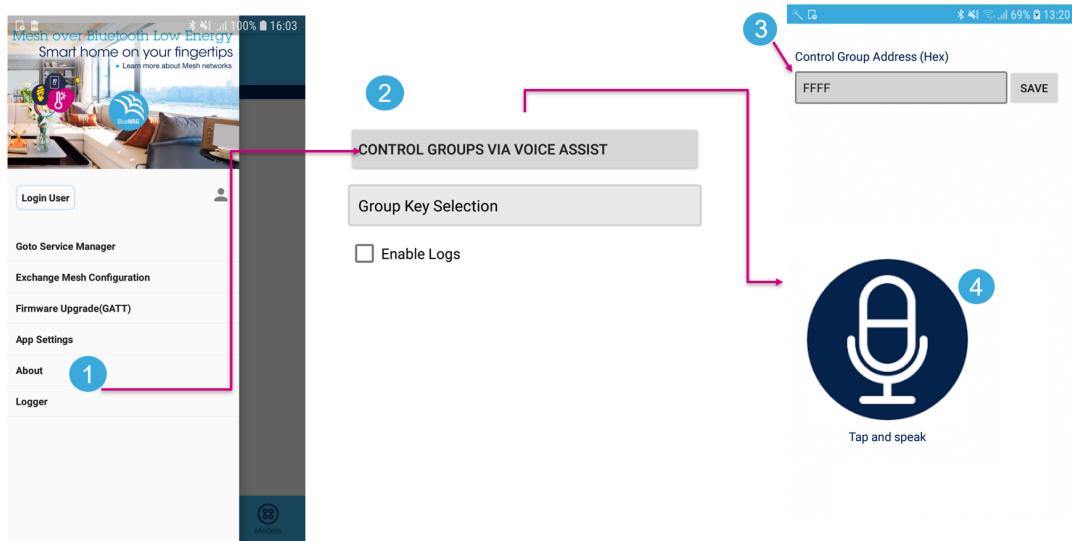
## 7

## Voice control over mesh

Voice control feature is enabled in the mesh solution. The mesh messages are invoked using voice commands. The lights, with a specific group address, can be controlled by saying “Lights On” or “Lights Off”.

Figure 42. Voice control over mesh

1. Select About
2. Go to control groups via voice assist
3. Write the broadcast address to which the voice message is going to be sent
4. Tap on the microphone icon and speak



## 8 Miscellaneous app settings

The cloud app has many other settings (Reliable/Unreliable message sending, Vendor/Generic On/Off Model selection) that can be changed as shown in the figures below.

Figure 43. Miscellaneous app settings (1 of 2)

1. Mesh network name
2. Mesh provisioner's name
3. Toggle to send Vendor or Generic ON/OFF model messages from the Node tab
4. Toggle to send reliable/unreliable messages
5. Toggle to use node identity for proxy connection
6. Mesh control by voice
7. Check the box to generate debug logs

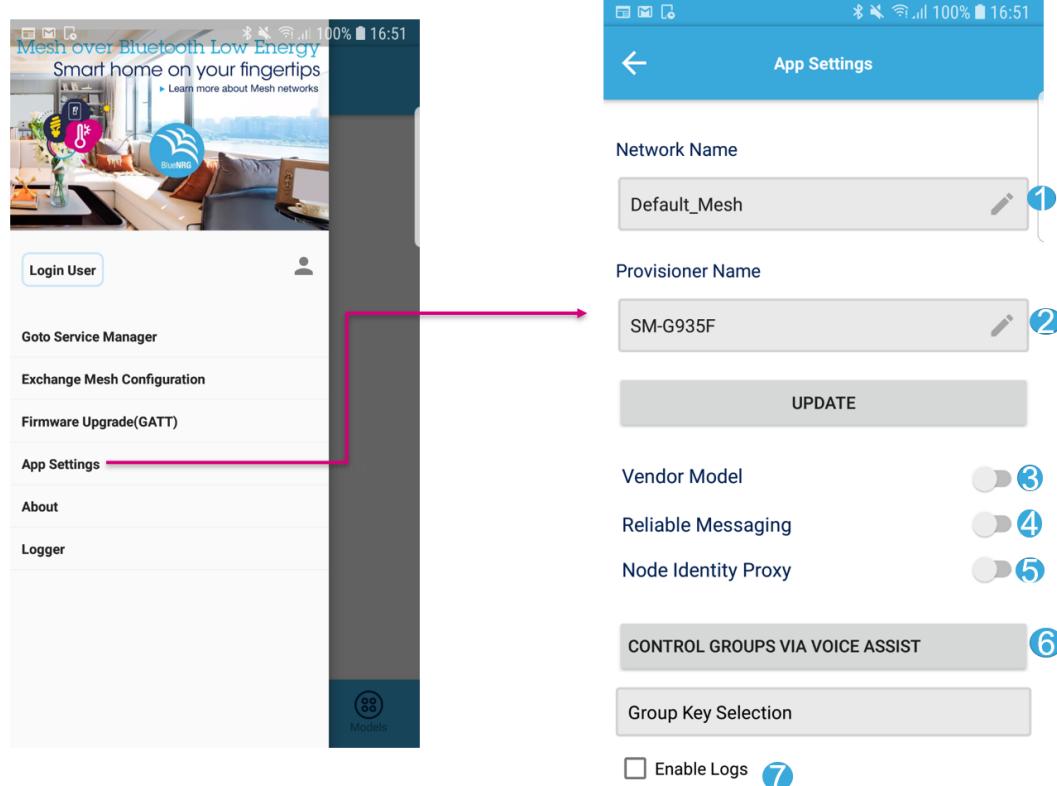
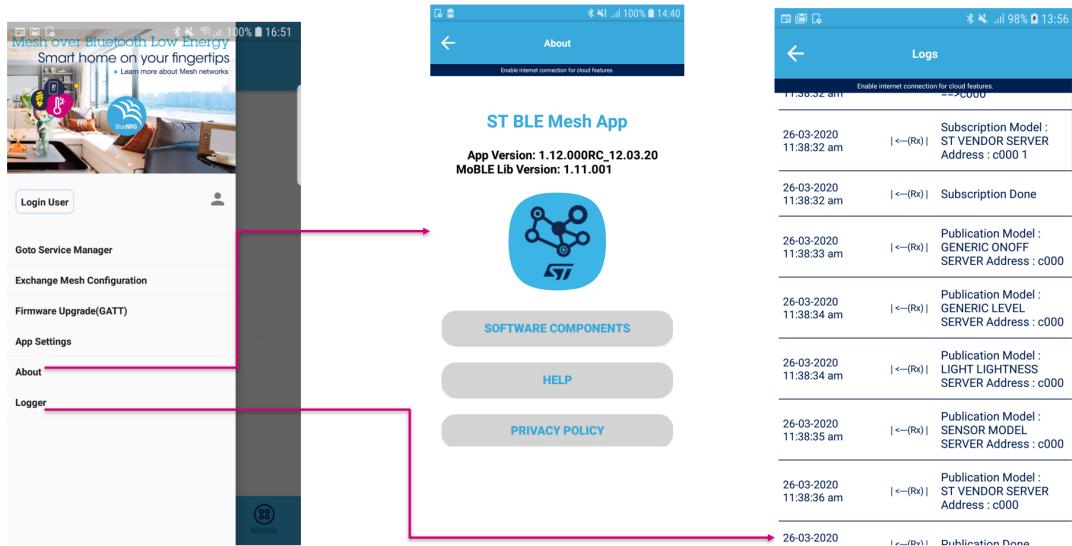


Figure 44. Miscellaneous app settings (2 of 2)



## Revision history

**Table 1. Document revision history**

Date	Version	Changes
01-Feb-2018	1	Initial release.
13-Sep-2018	2	Updated Figure 1. ST BlueNRG-Mesh scenario, Section 1.1 Installing and running the App, Section 1.2 Introduction to the App controls, Section 2.1 Provisioning the node and Section 2.2 Un-provisioning the node. Added Section 2.3 Publication address, Section 2.4 Model selection and Section 2.5 Provisioner database sharing.
15-Sep-2020	3	Updated all document to reflect GUI new release.

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