Getting started with the ST BlueNRG-Mesh iOS application

Introduction

The BlueNRG-Mesh iOS app is the Bluetooth® LE Mesh implementation for iOS. The app implements BLE Mesh Profile 1.0 specifications to allow iOS devices to communicate with BLE mesh nodes based on BlueNRG-1, BlueNRG-2 and BlueNRG-MS platforms.

The app lets you evaluate the functionality of the ST Mesh solution. You can use it to provision and control BlueNRG-Mesh nodes in a distributed control system for applications such as smart lighting and home automation.

Figure 1. ST BlueNRG-Mesh scenario

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1   STSW-BNRG-Mesh iOS app overview

The BlueNRG-Mesh iOS app lets you perform 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 and Lighting model commands[1]).
- Remove nodes from the network using the unprovisioning procedure.
- Create and manage groups of nodes.
- Set subscription and publication addresses on nodes.

1. *The app exposes a subset of model commands for demonstration purposes. More commands may be accessed using the BlueNRG-Mesh SDK.*
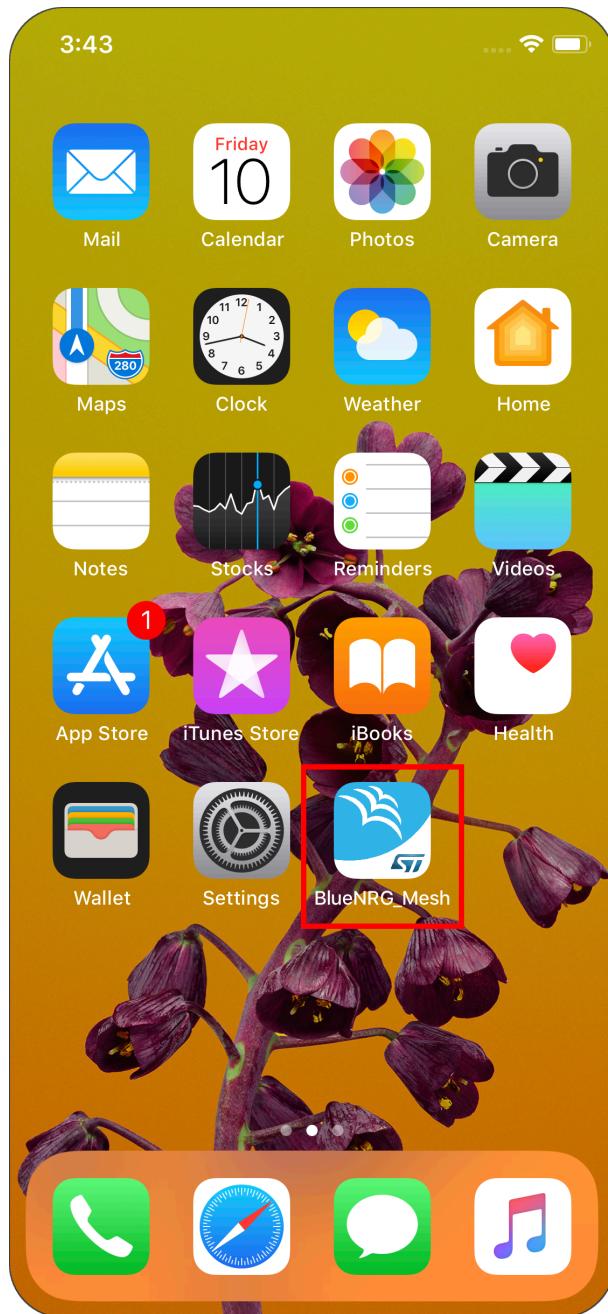
Bluetooth® Mesh Profile can be used for various home, office and industrial applications.

2 How to install and launch the app

Follow the instructions below to install the STSW-BNRG-Mesh app on a compatible iOS device.

Step 1. Follow the link to Apple Store at STSW-BNRG-Mesh to download the app directly to your iOS device or search for BlueNRG-Mesh.

Step 2. Ensure that Bluetooth radio is enabled.

Step 3. Launch the app by clicking on the icon.
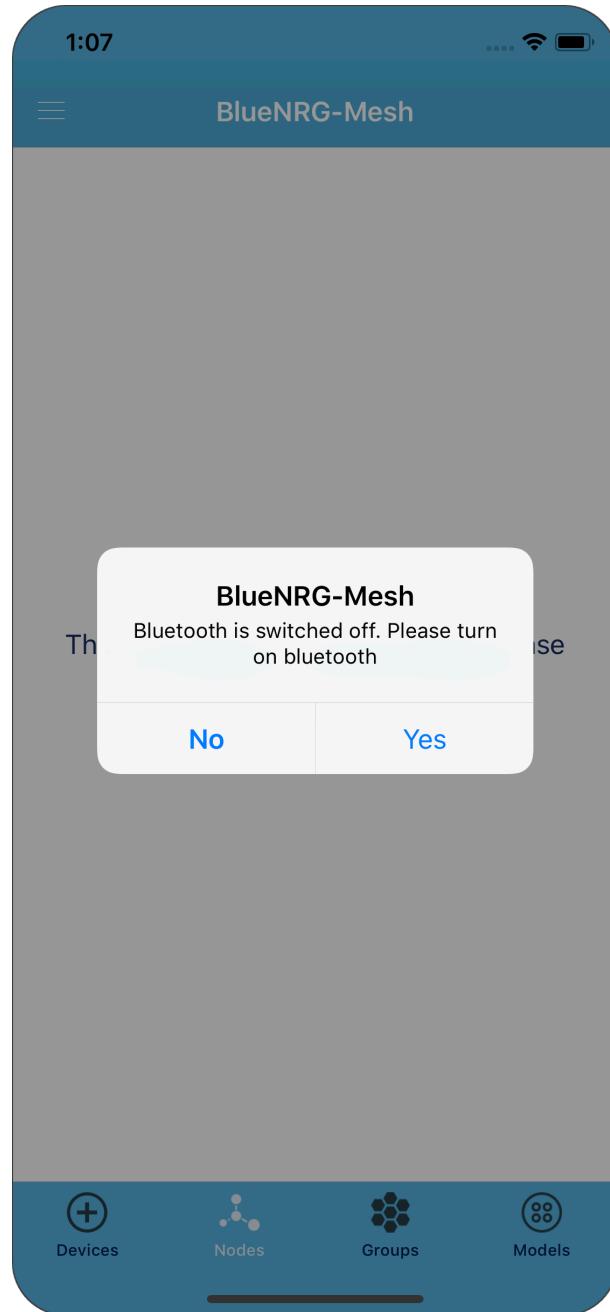
Figure 2. BlueNRG-Mesh iOS App

Step 4. If Bluetooth is off or not supported, you are presented with a dialog box that prompts you to enable Bluetooth on your device. At this stage, you can either:

- – go to settings and switch Bluetooth on, or
- – run the app in dummy mode, which simulates the functionality of the app without actually communicating with nodes over BLE
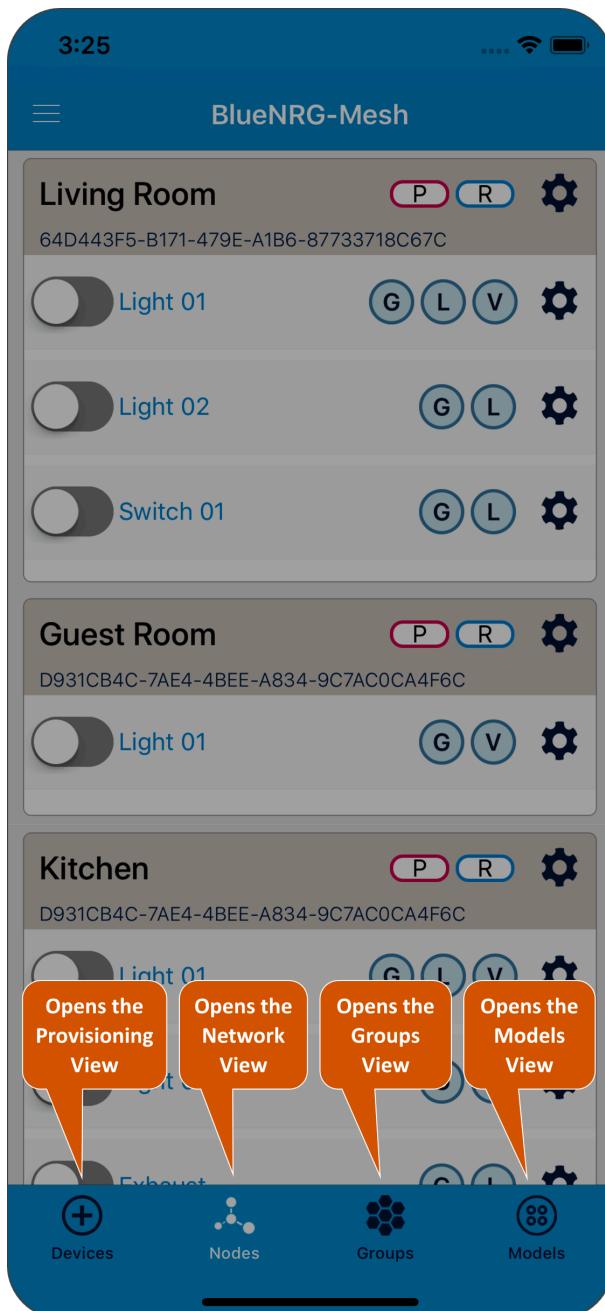
Figure 3. First launch

2.1 Introduction to the app controls
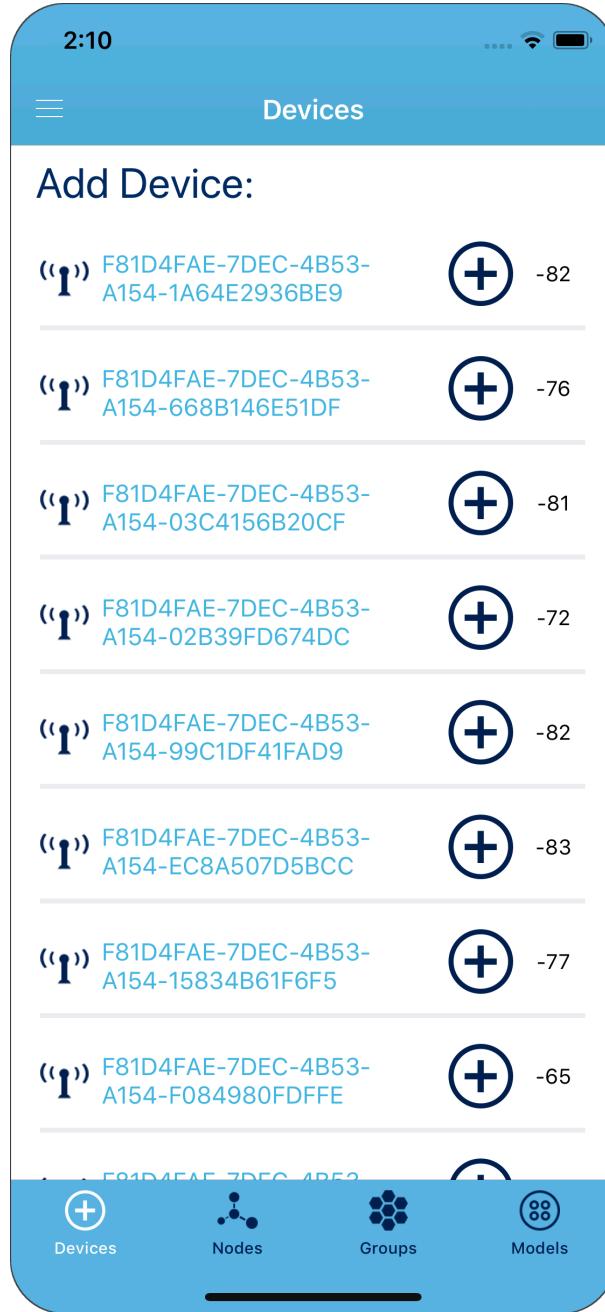
Figure 4. **BlueNRG-Mesh App interface**

The App has following sections:

1. Devices Tab: opens the "Provisioning View", which allows adding new provisioned mesh capable devices into the mesh network;

2. Nodes Tab: opens the "Network View", which shows the list of all the nodes in the mesh network. This is the default view (that is, the home page) of the App.

3. Groups Tab: opens the "Groups View", which shows the list of all the groups in the network.

4. Models Tab: opens the "Model View", which shows the list of nodes supporting the selected model. It allows sending specific messages to the nodes.

5. Side Menu: contains global settings which affects the App as a whole.
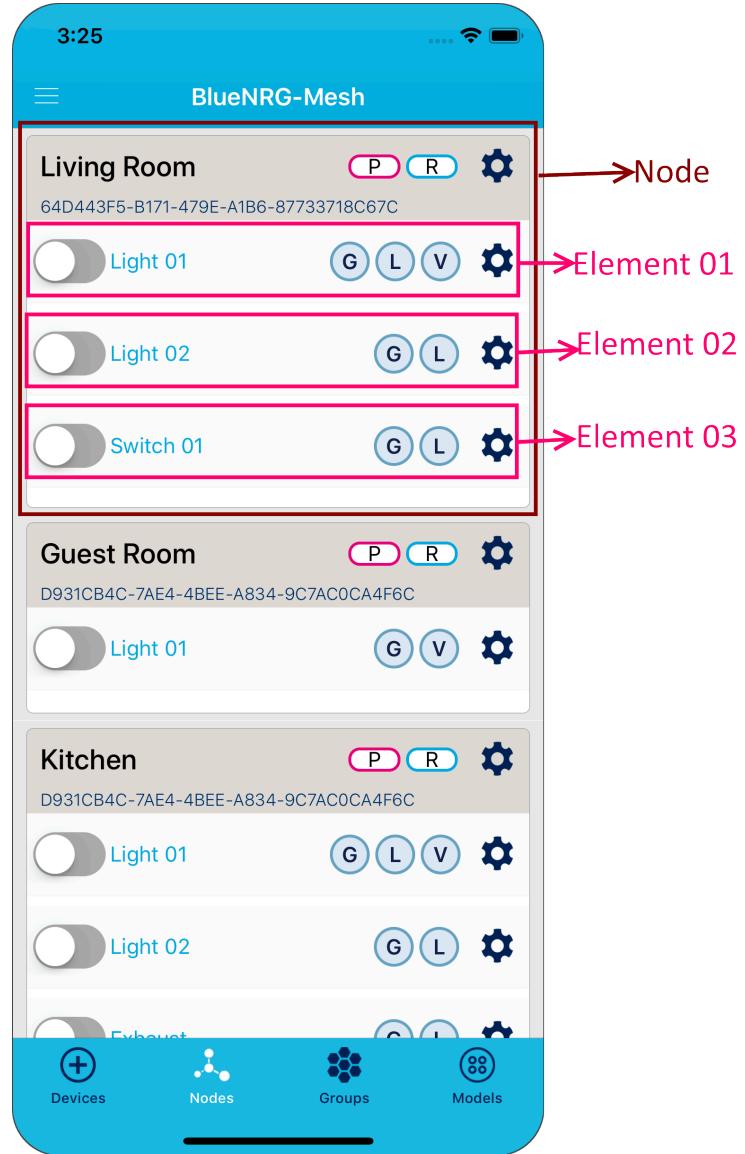
Figure 5. Provisioning view

When this view is opened, the App starts scanning for unprovisioned mesh capable devices in the proximity. The devices are identified by their UUIDs and are listed with RSSI values.

The provisioning process is started by clicking on the (+) icon in front of each device name.
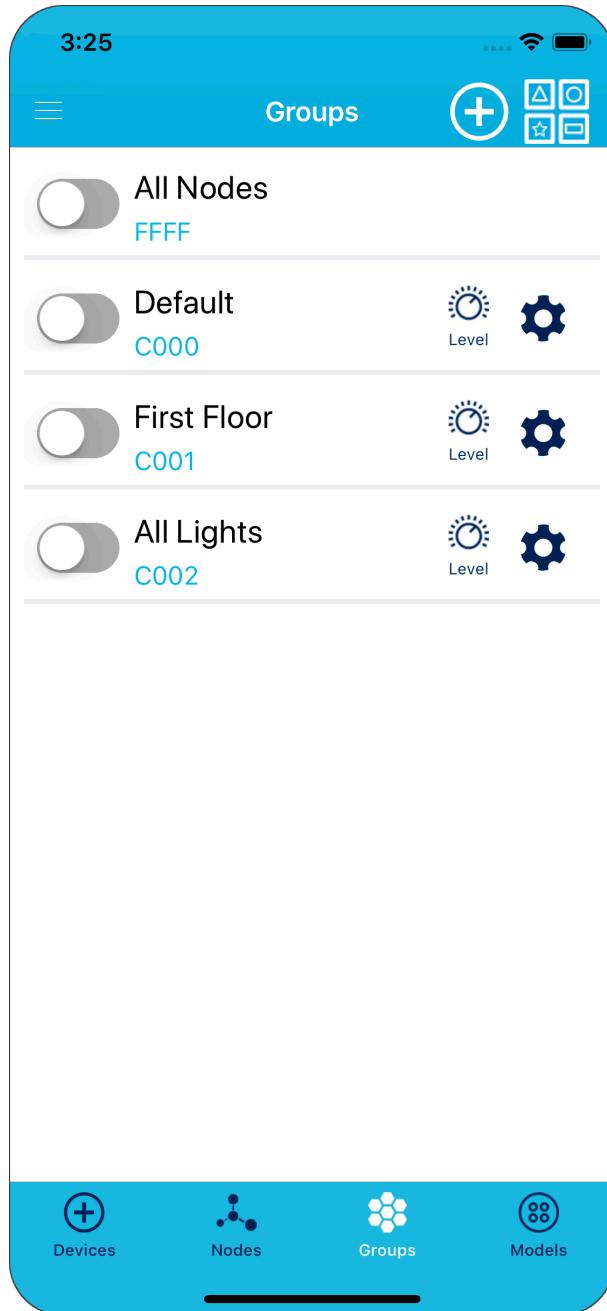
This is the default view of the BlueNRG-Mesh iOS app which shows the overall network status with a summary of the node type and features.

The list of nodes in the network is displayed.

You can also view or update the node settings or configuration.

Each node element has a toggle button used to send on/off commands, which can be "Vendor Model" or "Generic Model" depending on the global settings (accessible from the side menu).

Figure 7. Groups view

This view displays the list all the configured groups and allows sending messages to a group of nodes.
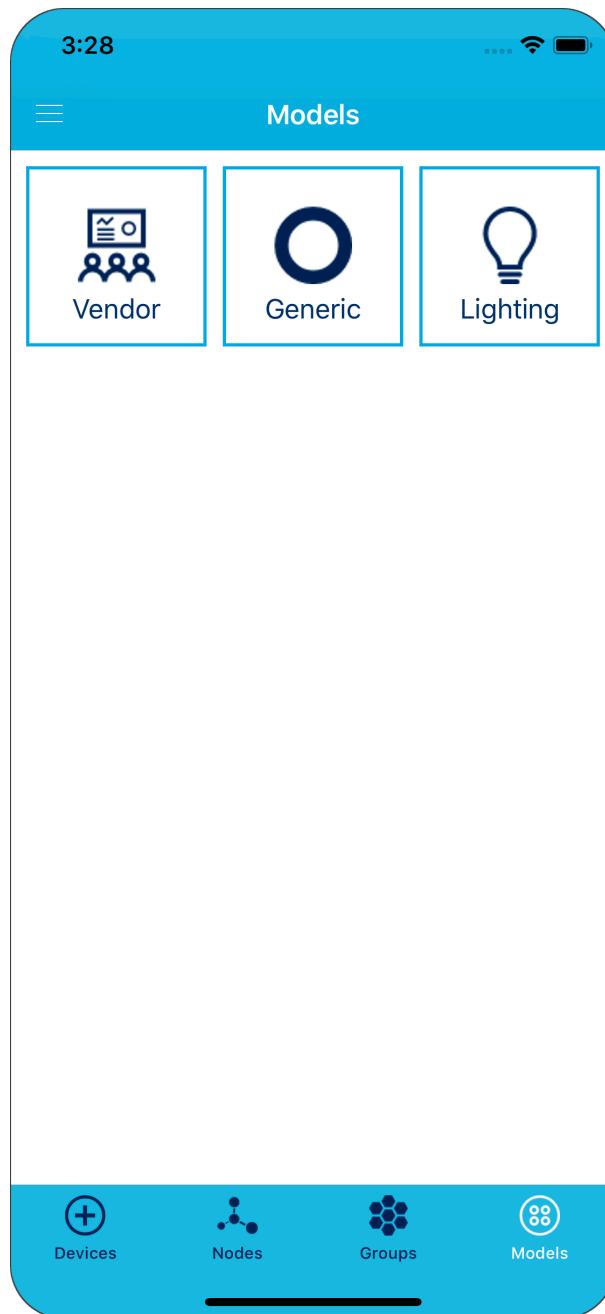
The (+) icon on the top is used to create a new group.

The gear icon close to each group is used to access its publication and subscription settings.

When an element is added to a group subscription list, it can receive the messages addressed to that group.

When an element is added to a group publication list, it starts sending publishing (sending) messages with destination address set as the group address.

Figure 8. Models view selection

Models view allows users to access a model specific functionality.
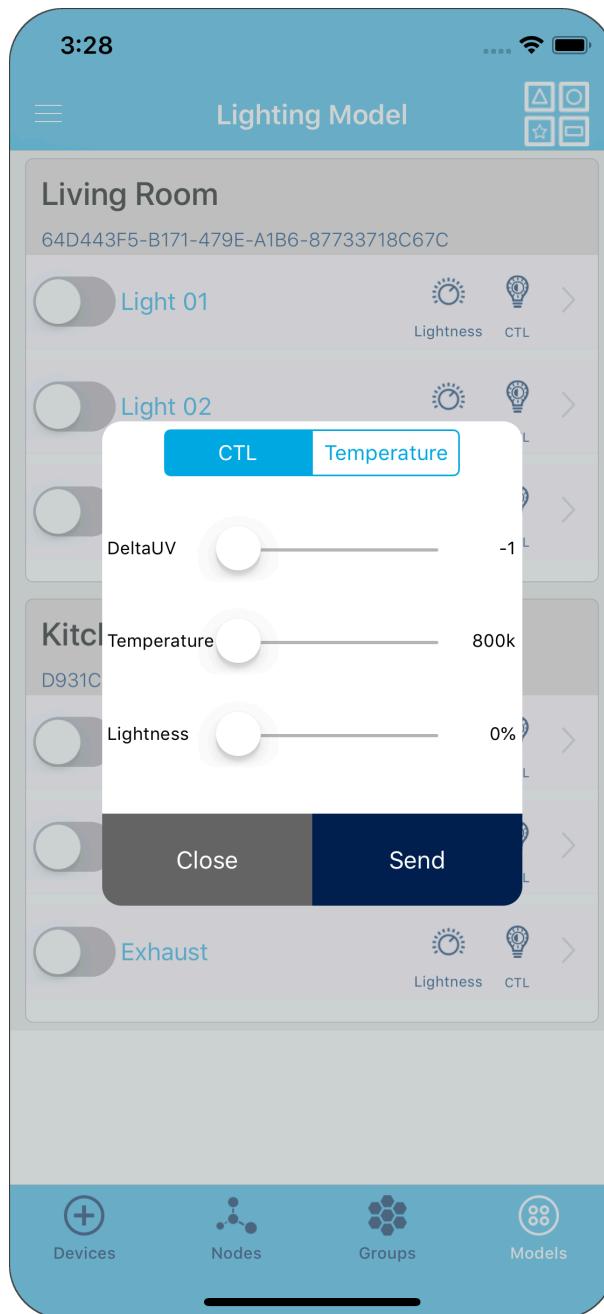
Mesh models define the node basic functionality of a mesh network relevant to a particular application category (for example, lighting model defines basic functionality covering common lighting use cases).

When the Models Tab is tapped for the first time, it opens the "Model Selection View" to choose a specific model. After selection, the view specific to the chosen model is displayed.

The app remembers the selected model, so that, the next time you select the Models Tab, the last chosen model view is displayed.

You can switch the model view to any other model by tapping the "Model Selection" icon at the top right of each model view.

Figure 9. Models view: lighting model

The BlueNRG-Mesh iOS app current version (1.02.xxx) supports the following models:

- Vendor model: ST vendor model is provided as an example of vendor model implementation which defines messages to switch on/off, toggle on/off state, change light intensity, fetch the node firmware version.

- Generic Model (Bluetooth® SIG defined model): allows switching on/off elements and changing light intensity

- Lighting Model (Bluetooth® SIG defined model): allows switching on/off elements, changing lightness and controlling color tunable lights via CTL messages.

Note: *The BlueNRG-Mesh iOS app showcases are a subset of the BlueNRG-Mesh iOS SDK functionality. Developers can access more models and message types in their app built using the SDK.*

2.2 Hardware and software requirements

The app is tested for iPhone 5s or above, with iOS version 10.0 or above. The device should be 64-bit capable with BLE support.

The app works with the following boards running ST BlueNRG-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 board
• STEVAL-IDB008V2 evaluation platform based on the BlueNRG-2 board

Refer to the BlueNRG-Mesh Firmware SDK for the default evaluation board support. In addition, the SDK can be ported on any boards based on BlueNRG-1, BlueNRG-2 and BlueNRG-MS devices with STM32.

3 How to use the app

3.1 Provisioning a node

Provisioning is a process of authenticating the nodes and bringing them into the BLE Mesh network.

Step 1. Launch the app.
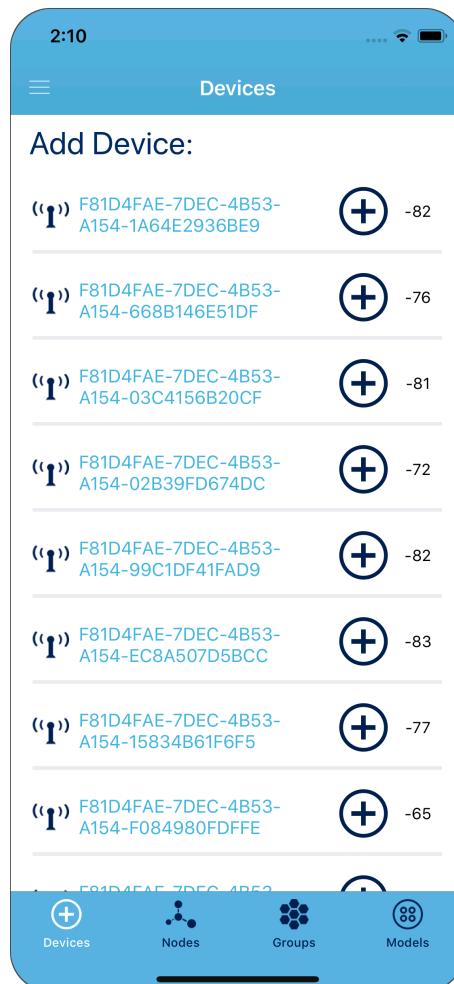
Step 2. Ensure the device you want to add to your mesh network is powered and in signal range.

Step 3. Go to the provisioning page.

The page lists any unprovisioned devices in signal range, along with their UUID.

The RSSI number on the right of each device indicates your approximate distance from it.
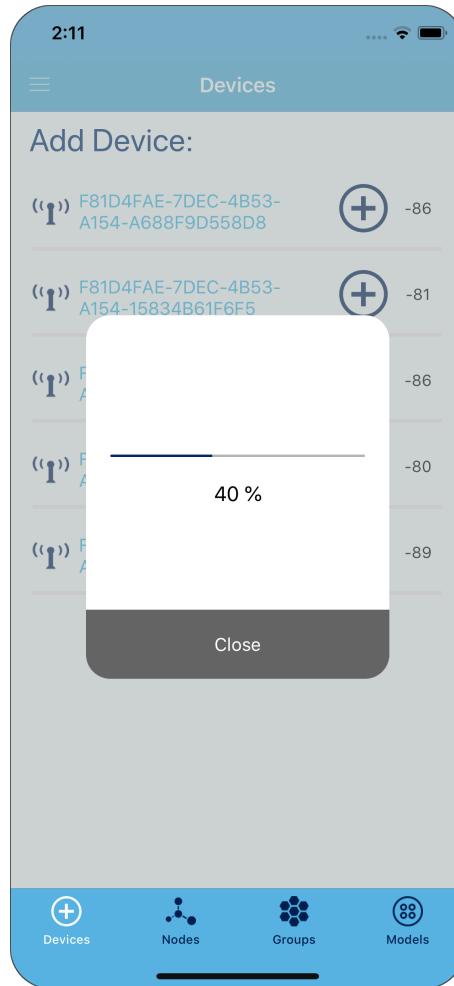
Figure 10. Provisioning view

Step 4. Tap the circled plus (+) button on a listed device to start provisioning.

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

Figure 11. Provisioning progress

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.
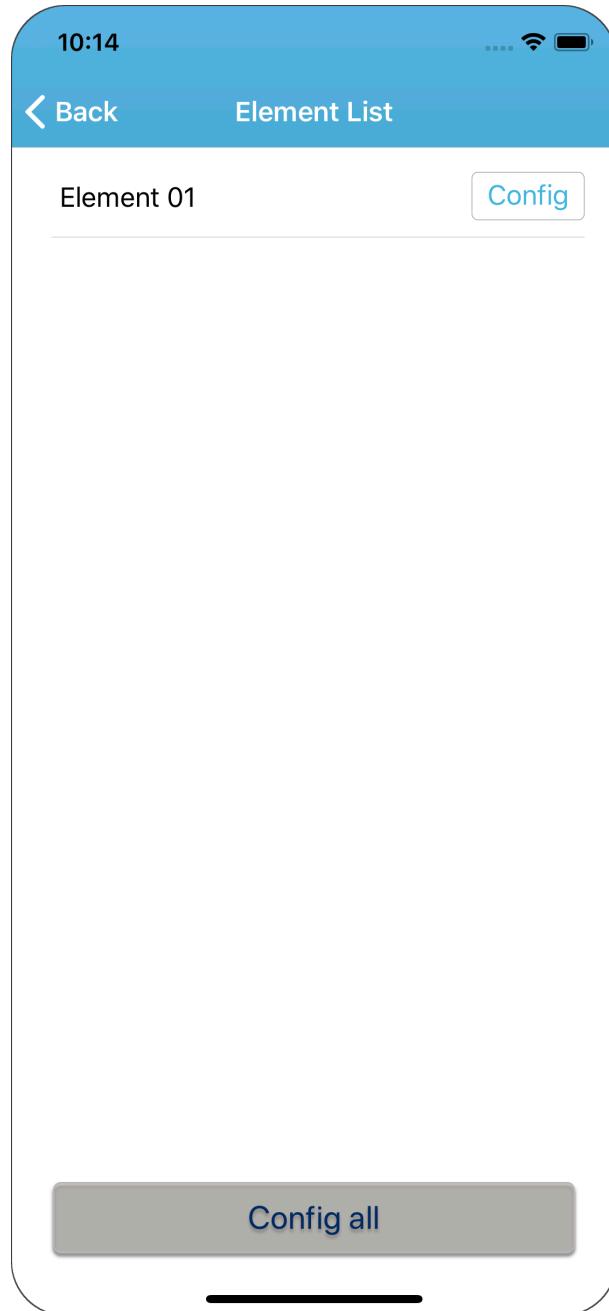
Step 5.   Keep the kit stationary and near your iOS device during provisioning.

Provisioning may take around 10 seconds depending on the smartphone hardware, channel congestion and other apps running on the phone.

Step 6.   After provisioning, the list of elements present on the node appears.
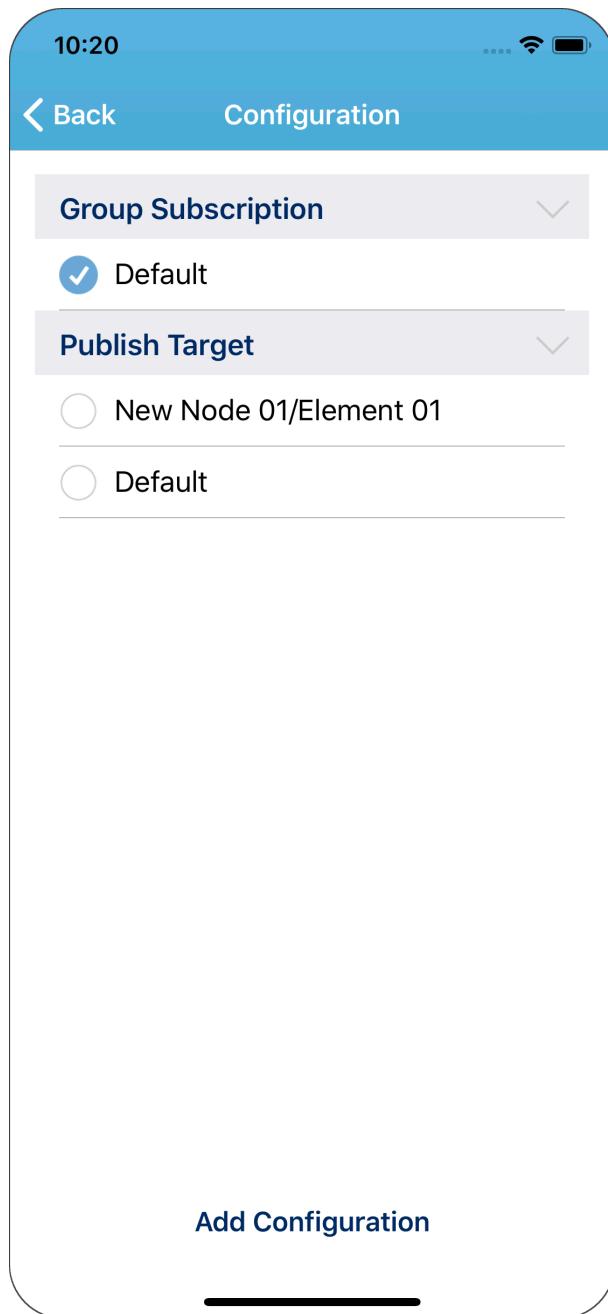
While provisioning adds a node to the mesh network, it must be configured to allow it to send and receive application messages.

Figure 12. Element list

You can configure each element separately using the "Config" button on the side of each element or you can configure all the nodes at once using the "Config All" button at the bottom. When the configuration starts, the configuration page appears.

Step 7. Configure the element group publication and subscription settings.

Step 7a. Group subscription: when an element subscribes to a group, it starts accepting messages sent to that group. Each element can be part of multiple groups which can be overlapping (i.e. some elements can be part of multiple groups) or part of only one or even no group. This feature allows grouping elements in a very flexible manner.

Step 7b. Publication: each element has a single publish address, to which it sends its messages. The address can be of a group or a single element.
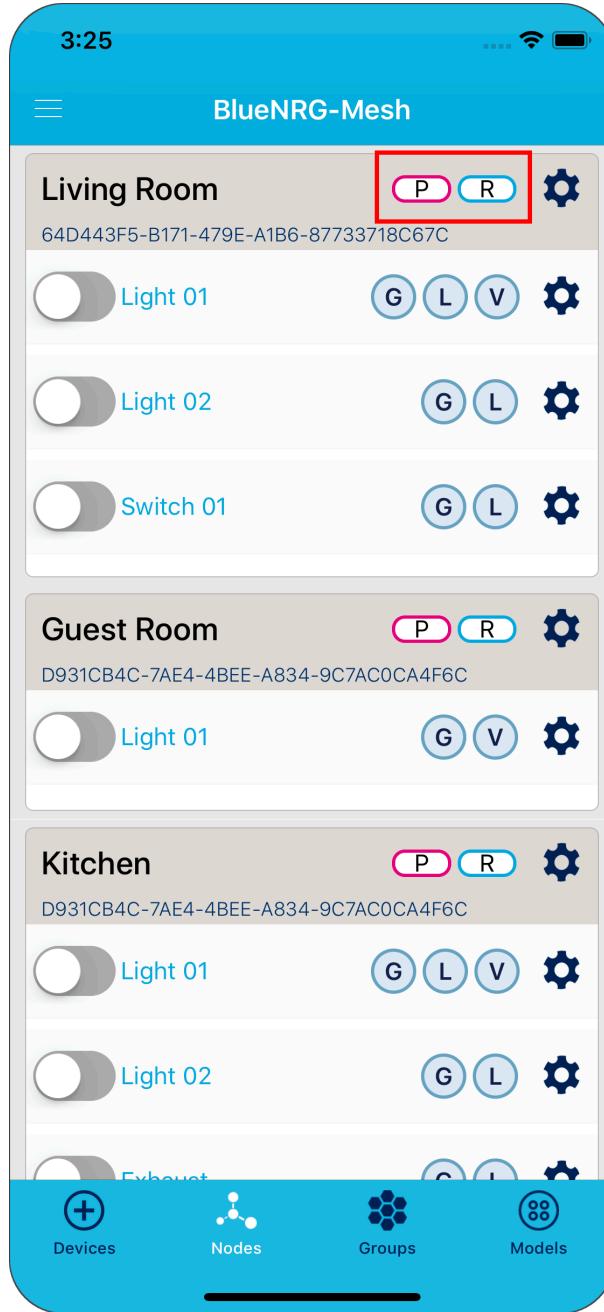
3.2 Using network view

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

The "switch" icons close to each element can be used to send on/off commands to the element itself.

Figure 14. Node features

Network features supported by the node are displayed (highlighted in the figure) close to each node name. A node may or may not support any of these features. If a feature is supported, it is possible to enable or disable it.

The supported features are:

1. **Relay**: a node that supports this feature can relay the messages received for other nodes in the network. If there are too 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 smartphone operative systems do not fully support sending and receiving mesh packets over advertising bearer. So a proxy node is necessary to communicate with the smartphone
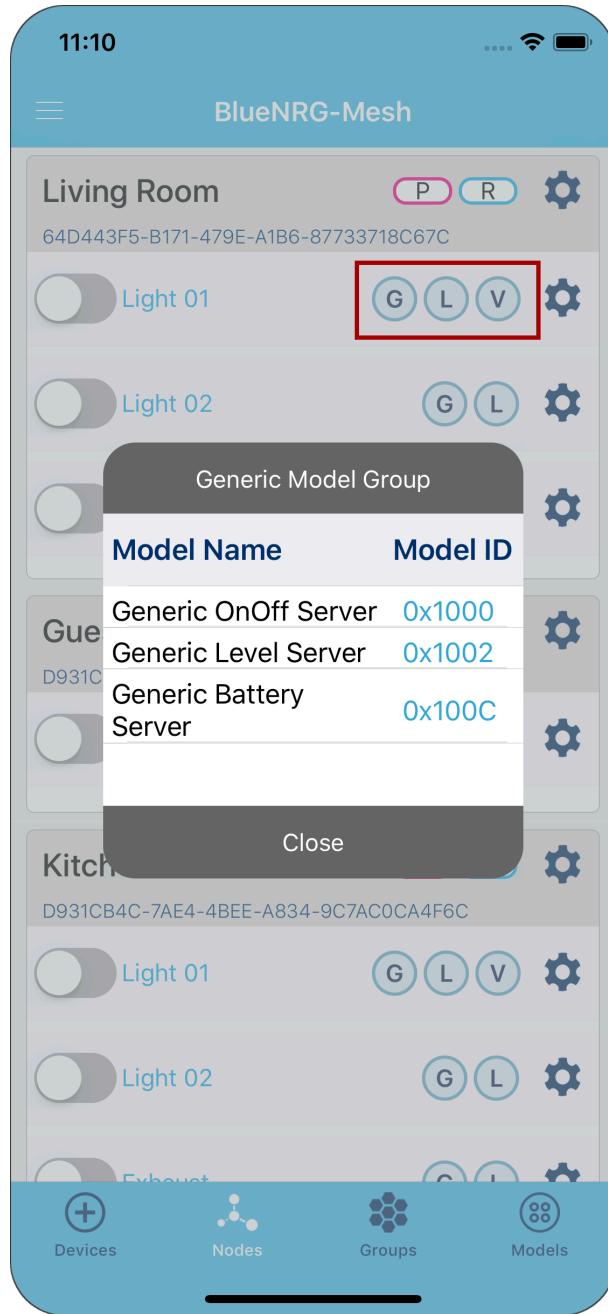
over Bluetooth ® low energy using the GATT protocol. The proxy node forwards the messages received on GATT to the mesh network and vice versa.

3. **Low Power**: low power nodes are battery-operated nodes which wake up occasionally to send packets and to check any incoming packet. An on/off switch for example is a good candidate for low power node.

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 "mail-box" maintained by the friend node. Thus low power nodes cannot operate in a mesh network without the help of friend nodes.

Bluetooth® SIG standardizes several common application use cases in form of Mesh models, grouped in categories like generic, lighting, sensor and vendor models.
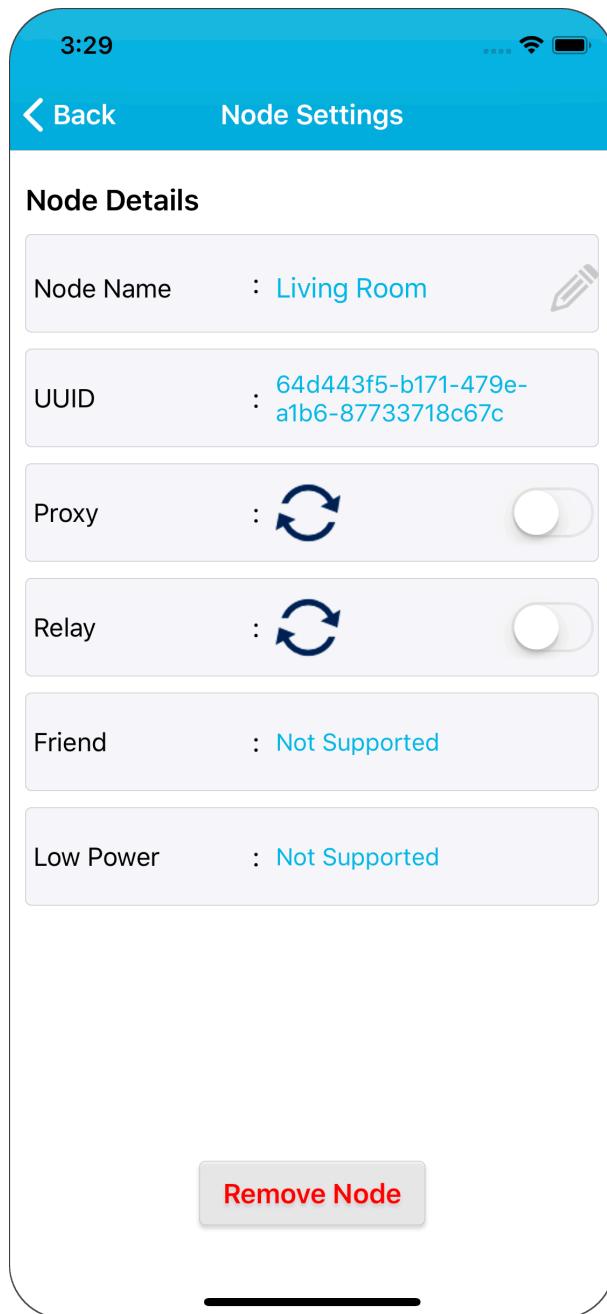
The model group supported by each element is displayed next to each element as icons like "G", "L", "V" (see the figure below). Clicking any of the icons, a list of all the models supported within that model group is displayed.

Figure 15. **Model support**

Tapping the gear icon close to any node, the "node settings" page is displayed.

Figure 16. **Node settings**

This view allows updating the node display name.

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

- tap on the "refresh" icon to read the feature current status
- tap on the "switch" icon to enable/disable the feature
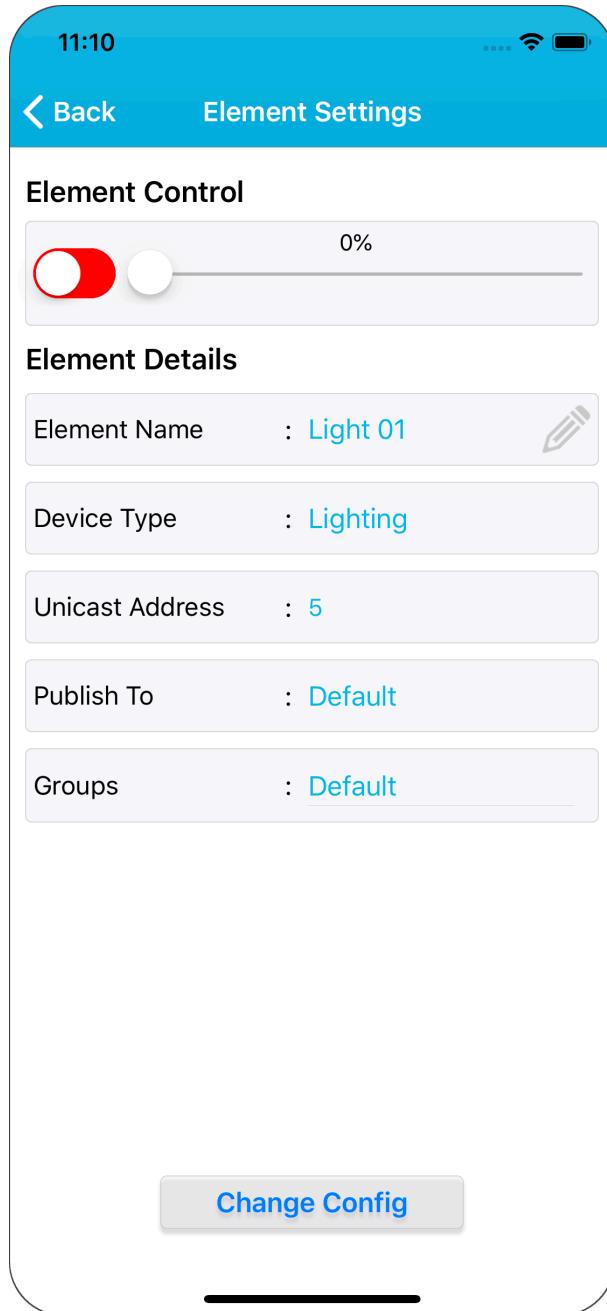
Note: *If you disable the proxy feature in the supporting nodes, your smartphone can communicate with the node only through another proxy node in the network.*

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.

On enabling / disabling a network feature, the information is not stored in the NVM and reverts to default upon power cycling the node.
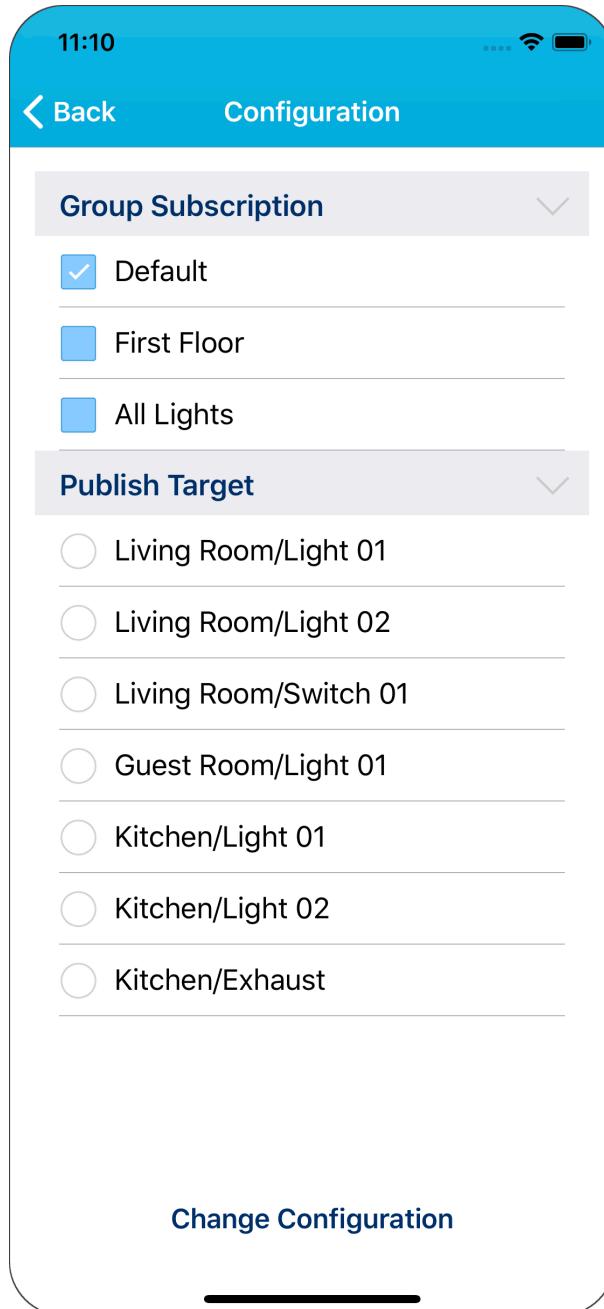
Figure 17. Element settings

Tapping the "Change Config", the "update configuration" view appears and is similar to the configuration after provisioning.

It allows updating the node publication and subscription settings.

Figure 18. Update configuration

3.3 Using groups view

In this page, you can view and manage the node groups. Here each group is identified by group address.

From this view, you can perform the following actions:

- Toggle a group on and off with the switch button next to the group name
- Add a new group with the circled plus button
- Open the Group Settings menu with the settings symbol

Figure 19. Groups view
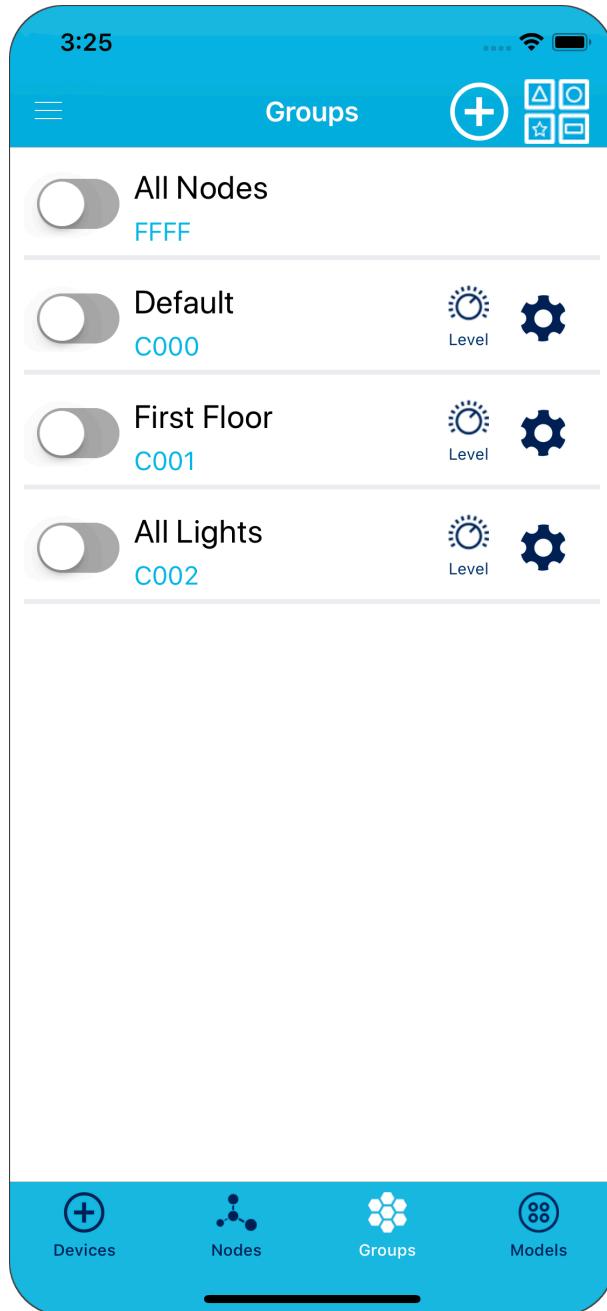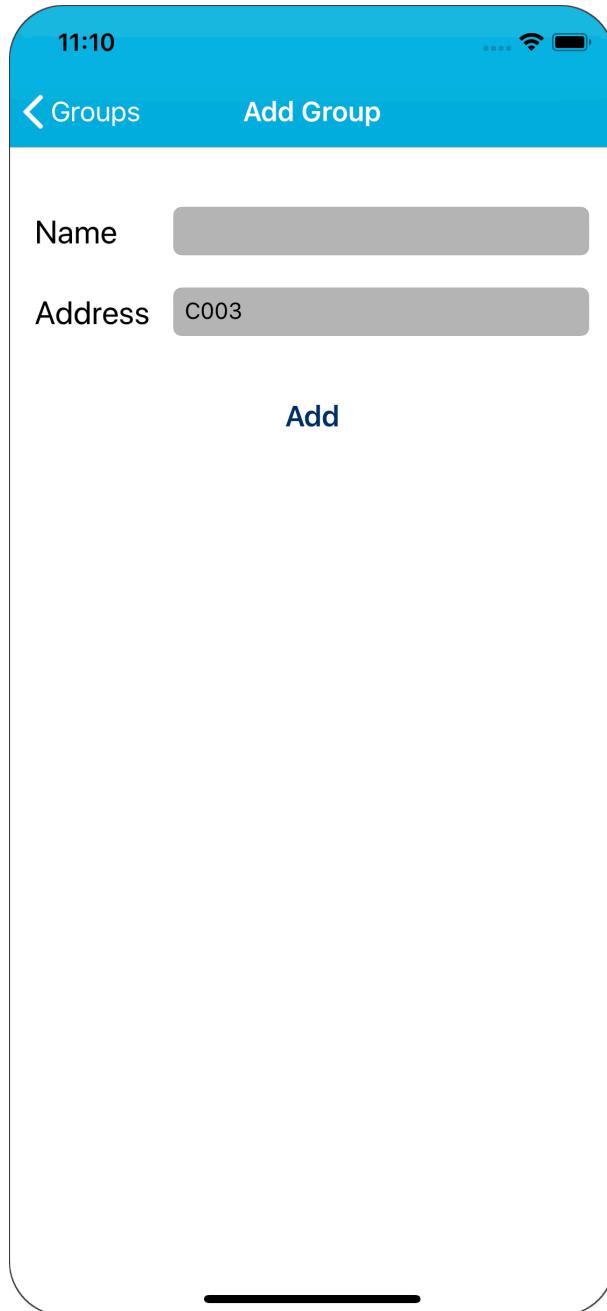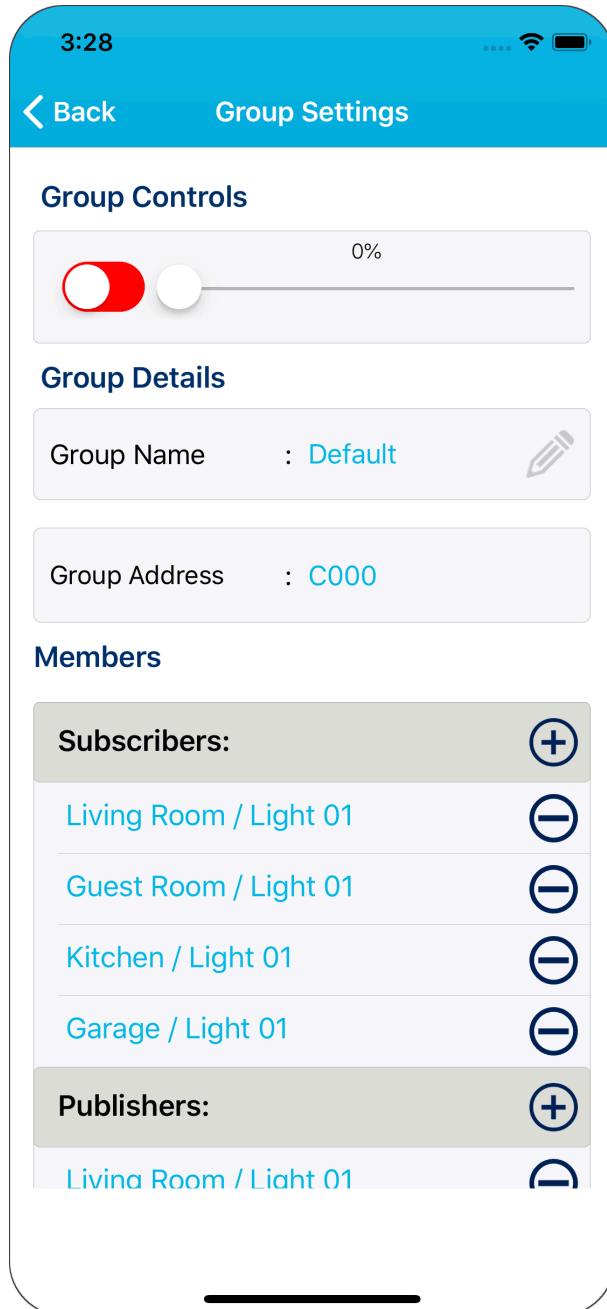
Figure 20. Add new group

You can create a new group by clicking the plus symbol on the Groups View page. You can enter a logical name for your group in the name field. The Address field will have a default value which you can change.

The new address should be a valid group address not in use by another group.

Figure 21. Group Settings view
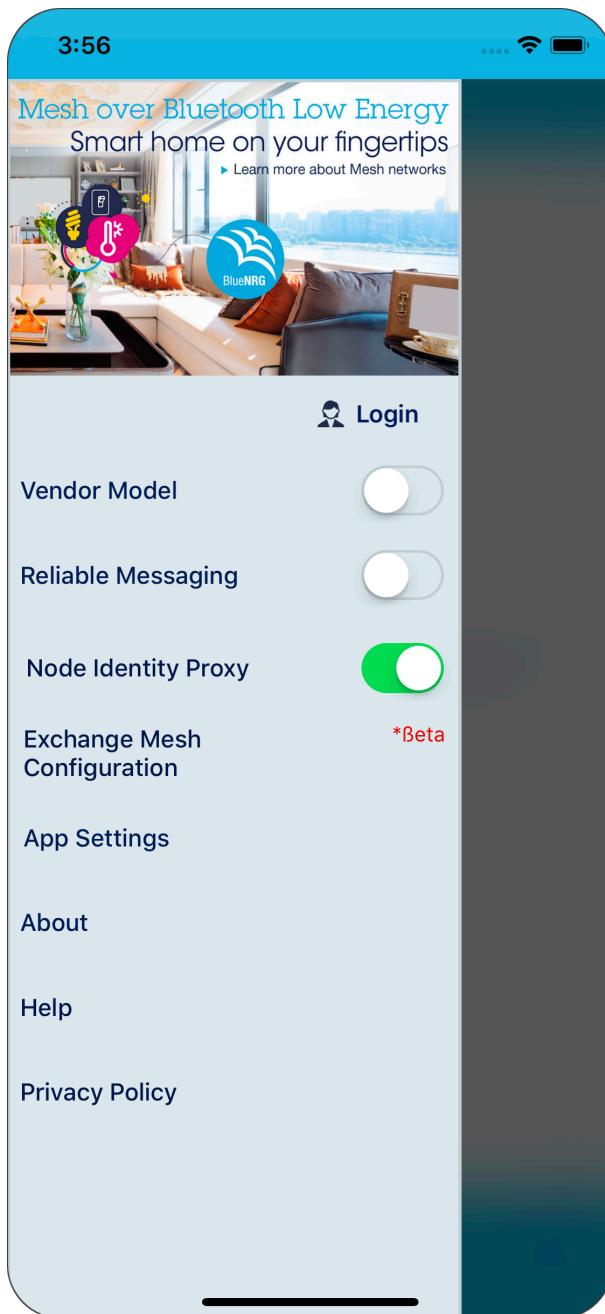
From the group settings view, you can perform the following actions:
- Send on/off command by tapping the "switch" icon.
- Edit group names.
- Add or remove mesh elements from the group subscribers (nodes that subscribe to the group) and group publishers (elements that publish to the group) list.

3.4 Side menu

The side menu provides access to the global settings and miscellaneous items.

Figure 22. Side menu

Vendor Model: the on/off switch in the network view sends a generic model on/off message by default, however if this option is active, a vendor model on/off command is sent instead. Vendor model command allows custom payload options.

Reliable Messaging: by default all on/off commands are sent in unacknowledged mode to avoid network congestion. In some scenarios, acknowledgement of messages is required. Tap the "switch" to the "on" position to enable reliable messaging.

Node Identity Proxy: 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 any other node. The post provisioning configuration process involves transfer of 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

is disabled, the configuration would happen over the mesh network, which would be slow. In some cases, where the node does not support proxy service, or node identity option, the option has to be disabled.

Exchange Mesh Configuration: used to share network configuration with other smartphones.

App Settings: used to access miscellaneous settings. "Network Name" and "Provisioner Name" are used fully when sharing network configuration with other smartphones.

Figure 23. App Settings
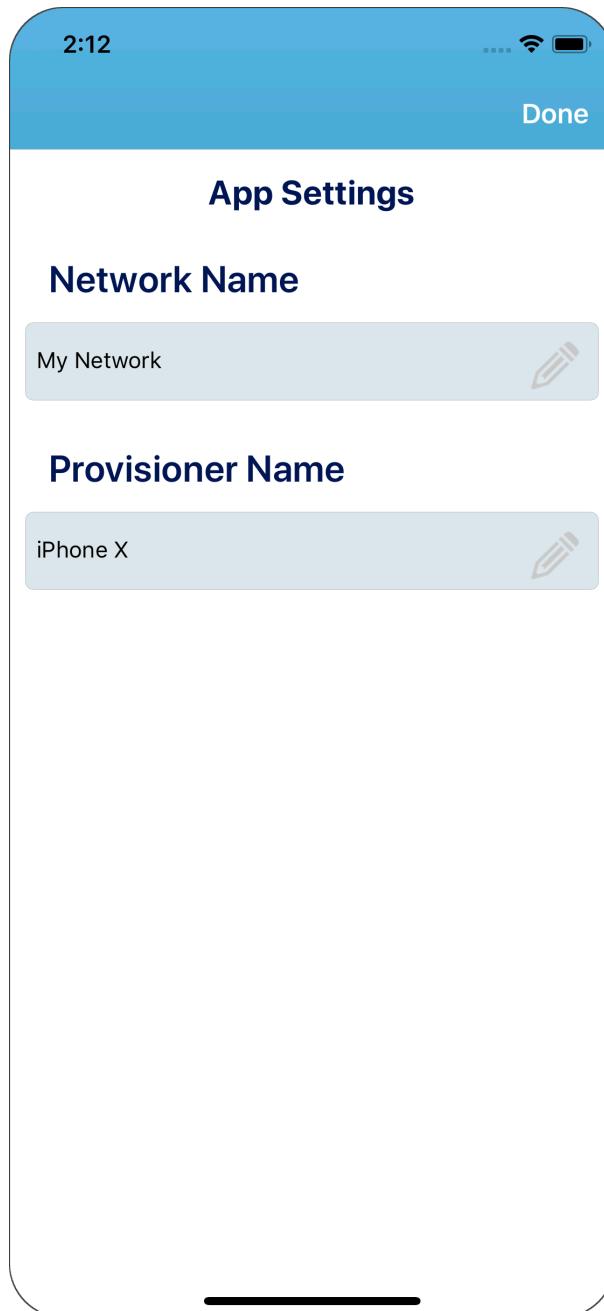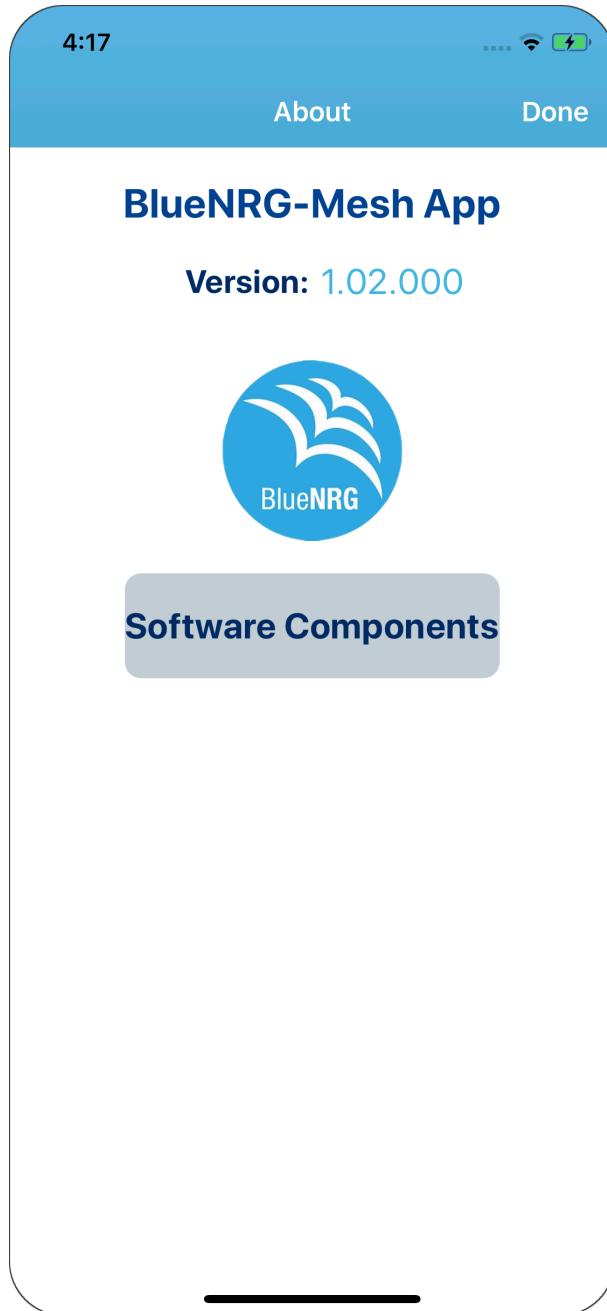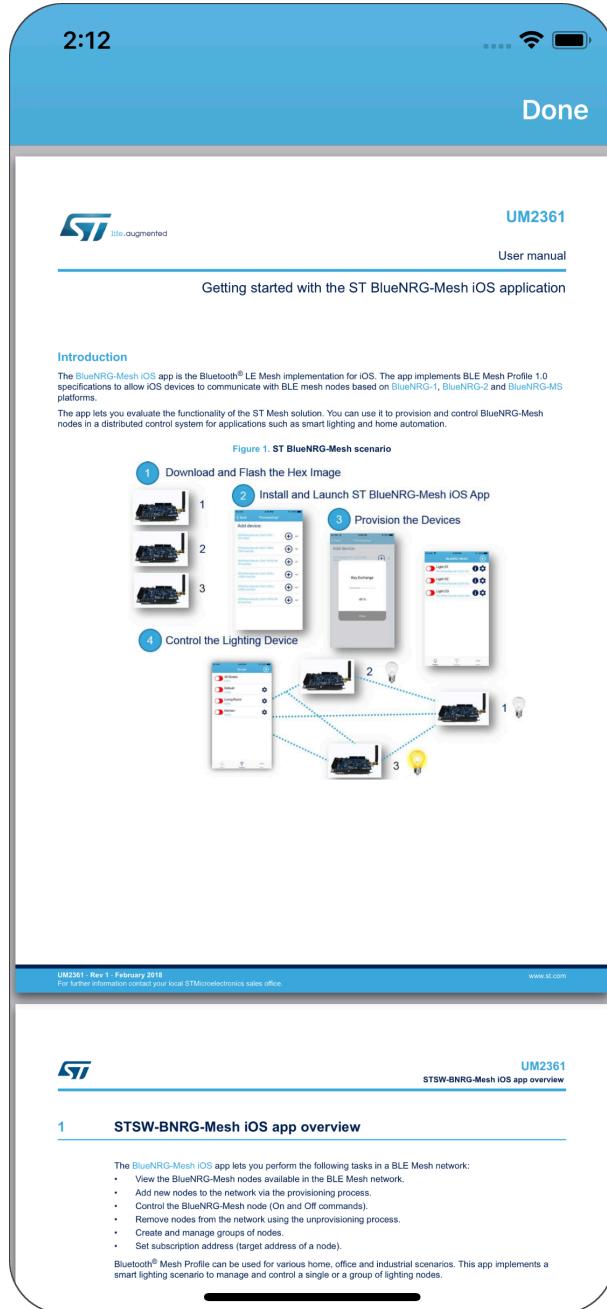
Figure 24. About view
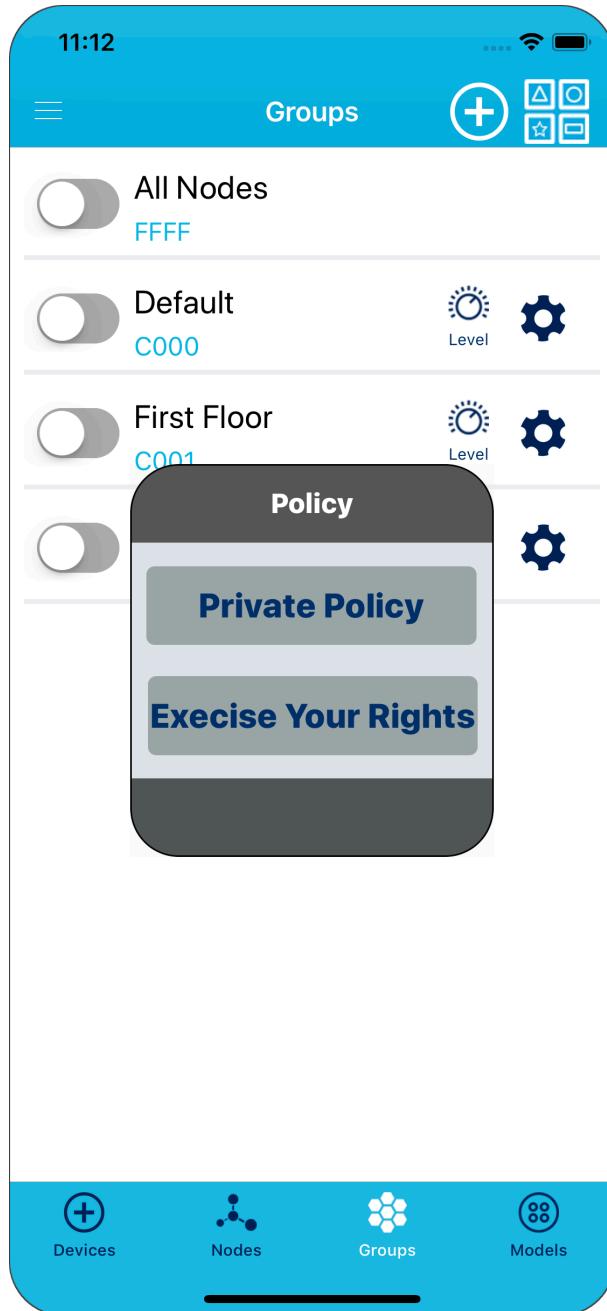
The About view displays the app version identification and information.

Figure 25. **Help view**

The Help view displays the pdf help file.

Figure 26. **Privacy policy view**

The Privacy Policy view allows users to view ST privacy policy and exercise rights with respect to data collected by ST.

4   Network configuration sharing
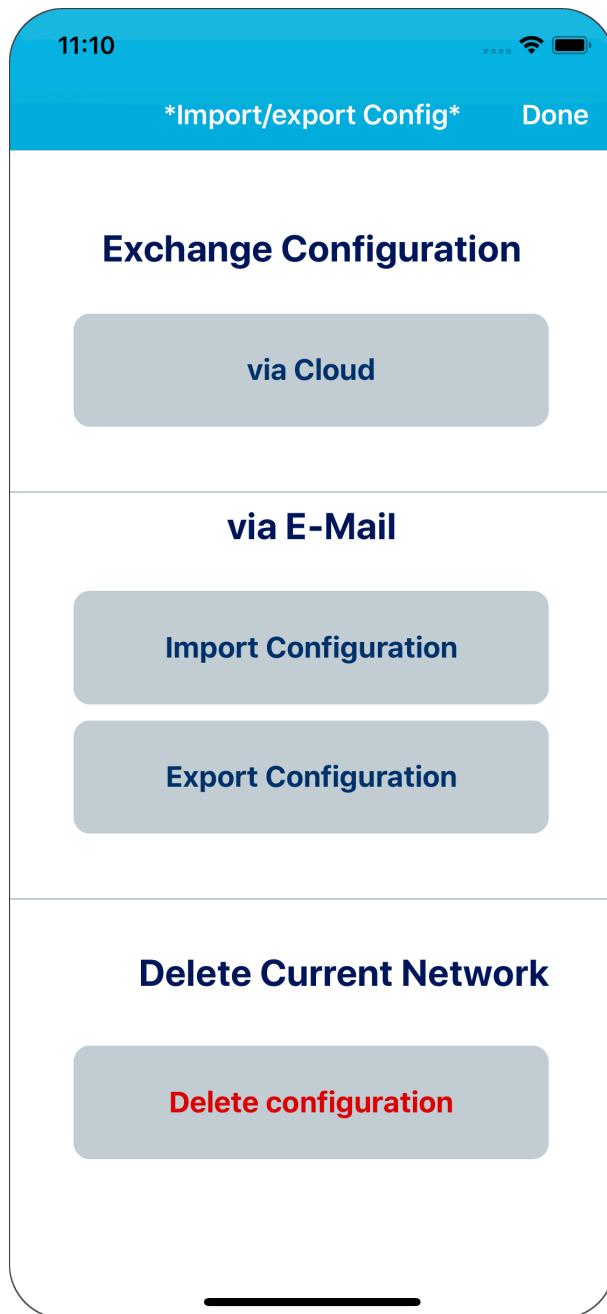
BlueNRG-Mesh iOS app provides multiple options to share the network configuration with other smartphones to allow you to use and manage the mesh network created by other users and vice versa.

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 by both parties. The device becomes a mesh network node after provisioning.

During the configuration phase, more configuration items like "Application Key" are created.

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

Figure 27. Network configuration sharing

The network configuration information can be shared via:

1. **e-mail**: e-mail messages are used as a medium for sharing (suitable only for simple one time sharing scenarios).

2. **cloud**: a cloud app is used to help sharing network configuration with other users. This feature allows automatic synchronization after the first sharing. It is also possible to invite other users using an invitation code. The cloud app also validates the information being shared by other users and protects the configuration file integrity.

4.1 Sharing via cloud

You have to create an account to enable sharing via cloud.

You should provide one or more security questions and the corresponding answers to help recover the account in case you loose the password.

Figure 28. Sign up
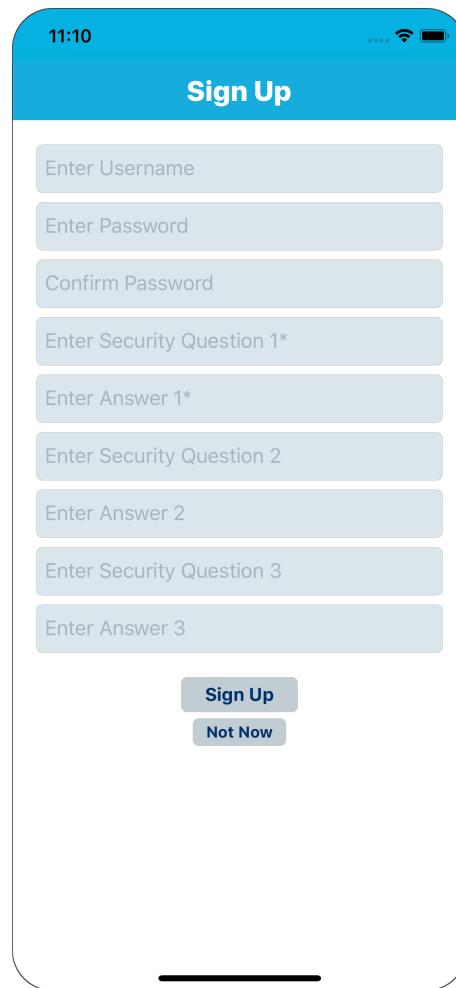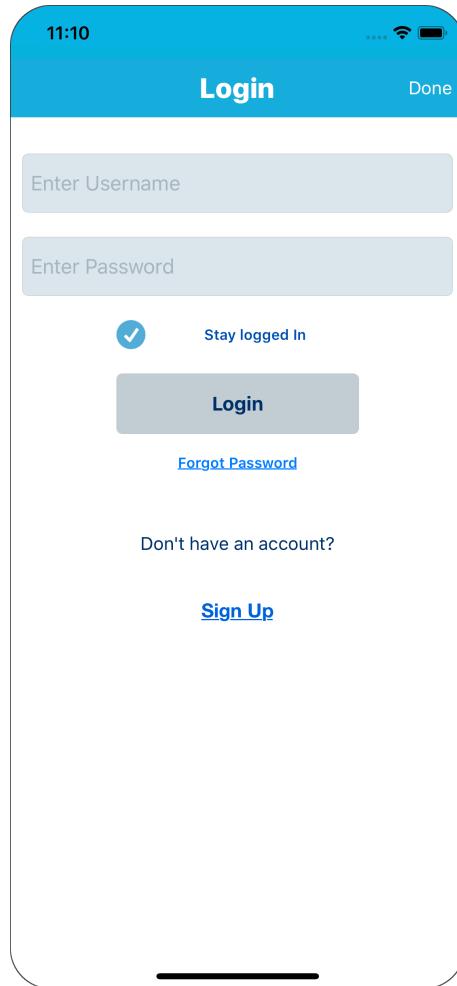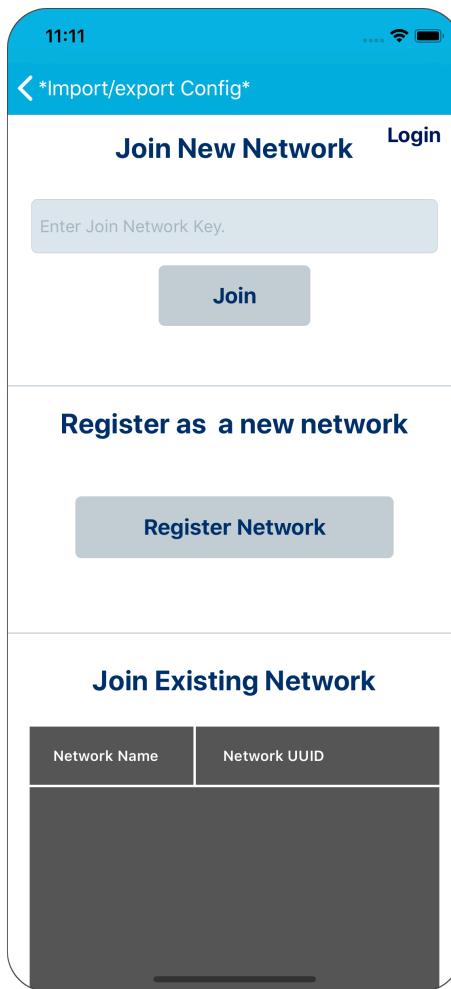
Figure 29. Log in

Once registration is complete, you can login to the account.

Figure 30. Network registration

There are three scenarios when working with cloud-based network sharing:

1. **Register New Network**: allows registering the network as a new network. Other users can be invited to join it.
2. **Join Network**: allows joining an existing network using an invitation code shared by the network creator.
3. **Join Existing Network**: allows re-joining an existing network created earlier. It is used as a backup option, useful when the app is re-installed or you change smartphone.

5 Communication security

All communication between BlueNRG-Mesh App and the mesh network is secured by encryption and authentication. The underlying standards of secured communication are compliant with the official BLE mesh specifications.

Revision history

Table 1. Document revision history

Date	Version	Changes
06-Feb-2018	1	Initial release.
20-Sep-2018	2	Updated Figure 1. ST BlueNRG-Mesh scenario, Figure 2. BlueNRG-Mesh iOS App, Figure 3. First launch, Section 2.1 Introduction to the app controls, Section 3.1 Provisioning a node, Section 3.2 Using network view, Section 3.3 Using groups view and Section 4 Network configuration sharing. Added Section 3.4 Side menu and Section 4.1 Sharing via cloud.

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Glossary

Mesh Address Each node in the network has (at-least) one unique unicast address. Mesh addresses are represented by an unsigned short number (2 bytes).

Mesh Element Some nodes have multiple, constituents parts. Each of them can be independently controlled. A switch board can have multiple sockets. In mesh terminology, an element is the smallest addressable unit in a mesh network.

Mesh Node A device that is a member of a mesh network is called node.

provisioner A provisioner is a node in the mesh network that provisions and configures device nodes There can be more than one provisioner in the mesh network.

provisioning The process of including an unprovisioned device as a node in a mesh network.

proxy node To allow a smartphone that cannot receive/transmit BLE Mesh messages to interact with a mesh network, the network assumes the role of Proxy node.

publication address A publication address is the default address targeted by the node when it sends a message. A publication address may be a unicast of group addresses.

subscription The assignment of a node to one or more groups.

universally unique identifier A 128-bit number used to uniquely identify some object or entity on a network.

Unprovisioned device A device that is not part of a mesh network.

IMPORTANT NOTICE – PLEASE READ CAREFULLY