Talaria TWO™ (INP2045)

Ultra-Low Power Multi-Protocol Wireless Platform SoC

IEEE 802.11 b/g/n, BLE 5.0

Application Note

Alexa Ready Application with AWS IoT Embedded C Device SDK

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Revision History

Version	Date	Comments
1.0	18-11-2020	First release.
2.0	02-02-2022	Updated for SDK 2.4 release. Updated application note with details regarding the option to provision AP using mobile application.
3.0	11-11-2022	Updated to include the updated BLE provisioning mobile application.

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Terms & Definitions

API	Application Programming Interface
AWS	Amazon Web Services
ELF	Executable and Linkable Format
EVB	Evaluation Board
GPIO	General Purpose Input/Output
HTTP	Hypertext Transfer Protocol
LWA	Login With Amazon

Introduction

Alexa Ready application on Talaria TWO uses AWS IoT Embedded C Device SDK available on Talaria TWO to interact with the Device Shadow Service on AWS IoT Core.

Device makers can have their own Alexa Skill implementation hosted on their cloud to bridge the Alexa Voice Service (AVS) and device maker's AWS IoT Core Cloud Service. Post this, AWS IoT Embedded C Device SDK available on Talaria TWO can be used to make their smart home device endpoints which can be controlled using Alexa.

This Application Note describes the APIs used to achieve this on Talaria TWO and guides the reader to a demo of Alexa Ready application using InnoPhase Smart Home Demo Alexa Skill to control a device endpoint running on Talaria TWO EVB and behaving as an Alexa Smart Home Switch.

This is achieved by Alexa Voice Service (AVS) Cloud interacting with the Alexa Skill hosted at InnoPhase Inc.'s AWS Cloud which eventually controls the Talaria TWO EVB represented as an IoT device endpoint in InnoPhase Inc.'s AWS IoT Core Cloud.

AWS IoT Device Shadow Service

Device Shadow is the always-available device state in the AWS cloud. A device's shadow is a JSON document that is used to store and retrieve current state information for a device. The AWS IoT Device Shadow service adds and maintains shadows to AWS IoT Thing objects. It is also known as Thing Shadow.

Shadows can make a device's state available to apps and other cloud services whether the device is connected to AWS IoT or not.

To get and set the state of a device from AWS IoT Core, the Device Shadow service can be used over MQTT and HTTP. Applications and web services generally use HTTP to interact with Device Shadow and Embedded devices often use MQTT to interact with Device Shadow.

Common use cases for Device Shadow include backing up device state, or sending commands to devices and as a reliable data store for devices, applications, and other cloud services to share data. While devices, applications, and other cloud services are connected to AWS IoT Core, they can access and control the current state of a device through its shadows. Device Shadow Service enables devices, applications, and other cloud services to connect and disconnect without losing a device's state.

AWS IoT Embedded C Device SDK 3.0.1 Features

AWS IoT Embedded C Device SDK version 3.0.1 is available with Talaria TWO SDK which allows embedded applications to securely connect to the AWS IoT Core platform. It simplifies access to the PUB/SUB functionality of the AWS IoT Core broker via MQTT and provides convenient APIs for handling MQTT topics reserved for Device Shadow Service to interact with Thing Shadows.

AWS IoT Embedded C Device SDK was specifically designed for resource constrained devices (running on micro-controllers and RTOS), and follows a layered architecture as shown in Figure 1.

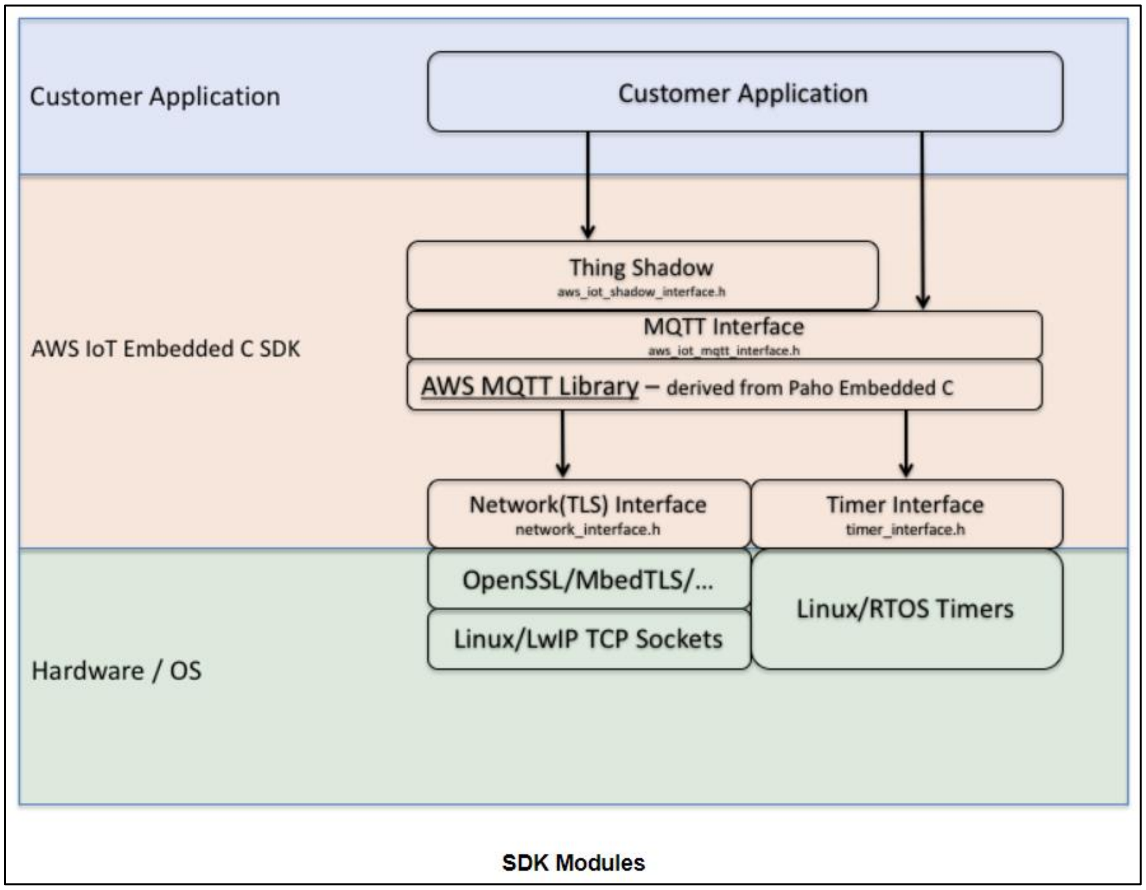


Figure 1: SDK architecture & modules

MQTT Connection

AWS IoT Embedded C Device SDK provides functionality to create and maintain a mutually authenticated TLS connection over which it runs MQTT. This connection is used for any further publish operations and allow for subscribing to MQTT topics which will call a configurable callback function when these topics are received.

Thing Shadow

AWS IoT Embedded C Device SDK implements the specific protocol for Thing Shadows to retrieve, update and delete Thing Shadows. This protocol is implemented to ensure correct versioning and support for client tokens.

AWS IoT Core Device Shadow Service Protocol

This section describes device communications with Shadows using Shadow Service Protocol.

It internally uses MQTT messages which is the preferred method for embedded devices to communicate with the AWS IoT Device Shadow service.

It abstracts the necessary MQTT topic subscriptions by automatically subscribing to and unsubscribing from the reserved topics for Device Shadow Service as needed for each API call. Inbound state change requests are automatically signaled via a configurable call back.

Shadow communications emulate a request/response model using the publish/subscribe communication of MQTT. As MQTT is used, the shadow needs to connect and disconnect.

There are three actions a device can perform on the shadow - Get, Update and Delete. Every shadow action consists of a request topic, a successful response topic (accepted), and an error response topic (rejected). On performing any action, the acknowledgment will be received in either accepted topic or rejected topic.

On performing any action, the acknowledgment will be received in either accepted or rejected.

For Example: If there is a need to perform a GET on a Thing Shadow the following messages will be sent and received:

1. A MQTT Publish on the topic - `$aws/things/{thingName}/shadow/get`
2. Subscribe to MQTT topics - `$aws/things/{thingName}/shadow/get/accepted` and `$aws/things/{thingName}/shadow/get/rejected`.

If the request was successful, the things json document is received in the accepted topic.

Similarly, for another example, when an Update is performed to a Thing Shadow, one of the two things can happen and can be acknowledged.

The update action could be accepted by the Thing Shadow and the version of the JSON document will be updated. The update request could also be rejected.

This can be known by subscribing to the two topics:
`$aws/things/{thingName}/shadow/update/accepted` and
`$aws/things/{thingName}/shadow/update/rejected`.

Initialization of the device on first connection to AWS IoT Core

After a device registers with AWS IoT, it subscribes to these MQTT messages for the shadows that it supports. The ShadowTopicPrefix can refer to either a named or an unnamed shadow, as described in Table 1.

Shadows can be named or unnamed (classic). The topics used by each differ only in the topic prefix. Table 1 shows the topic prefix used by each shadow type.

ShadowTopicPrefix value	Shadow type
$aws/things/thingName/shadow	Unnamed (classic) shadow
$aws/things/thingName/shadow/name/shadowName	Named shadow

Table 1: Topic prefix used by each shadow type

Topic	Meaning	Action a device should take when this topic is received
ShadowTopicPrefix/delete/accepted	The delete request was accepted and AWS IoT deleted the shadow.	The actions necessary to accommodate the deleted shadow, such as stop publishing updates.
ShadowTopicPrefix/delete/rejected	The delete request was rejected by AWS IoT and the shadow was not deleted. The message body contains the error information.	Respond to the error message in the message body.
ShadowTopicPrefix/get/accepted	The get request was accepted by AWS IoT, and the message body contains the current shadow document.	The actions necessary to process the state document in the message body.
ShadowTopicPrefix/get/rejected	The get request was rejected by AWS IoT, and the message body contains the error information.	Respond to the error message in the message body.
ShadowTopicPrefix/update/accepted	The update request was accepted by AWS IoT, and the message body contains the current shadow document.	Confirm the updated data in the message body matches the device state.
ShadowTopicPrefix/update/rejected	The update request was rejected by AWS IoT, and the message body contains the error information.	Respond to the error message in the message body.
ShadowTopicPrefix/update/delta	The shadow document was updated by a request to AWS IoT, and the message body contains the changes requested.	Update the device's state to match the desired state in the message body.

ShadowTopicPrefix/update/documents	An update to the shadow was recently completed, and the message body contains the current shadow document.	Confirm the updated state in the message body matches the device's state.

Table 2: ShadowTopicPrefix

After subscribing to the messages in the preceding table for each shadow, the device tests to see if the shadows that it supports have already been created by publishing a /get topic to each shadow. If a /get/accepted message is received, the message body contains the shadow document, which the device uses to initialize its state. If a /get/rejected message is received, the shadow is created by publishing an /update message with the current device state.

Processing messages while the device is connected to AWS IoT Core

There are three key value pairs of device states in shadow JSON document which a device needs to be concerned about.

1. Reported
2. Desired
3. Delta

All these keys are under the `state`.

If the device state is changed using a physical interaction, then Publishing an /update message with a desired message body that has the device’s physically changed state is needed. When it is done, other entities connected with Device Shadow Service get a delta callback notifying them with the change.

The device always receives a delta message if there is any difference between the desired and the reported section of the device and if the device has subscribed for the delta topic using the API `aws_iot_shadow_register_delta()`.

While a device is connected to AWS IoT, it can receive /update/delta messages if the desired state is changed by another party, and should keep the device state matched to the changes in its shadows by:

1. Reading all /update/delta messages received and synchronizing the device state to match.
2. Publishing an /update message with a reported message body that has the device’s current state, whenever the device's state changes.

While a device is connected, it publishes these messages when indicated.

Indication	**Topic**	**Payload**
The device's state has changed.	ShadowTopicPrefix/update	A shadow document with the reported property.
The device's desired state has changed (physical interaction).	ShadowTopicPrefix/update	A shadow document with the desired property.

The device might not be synchronized with the shadow.	ShadowTopicPrefix/get	(empty)
An action on the device indicates that a shadow will no longer be supported by the device, such as when the device is being remove or replaced	ShadowTopicPrefix/delete	(empty)

Table 3: Indication

Processing messages when the device is reconnected to AWS IoT Core

When a device with one or more shadows connects to AWS IoT, it should synchronize its state with that of all the shadows that it supports by:

1. Reading all /update/delta messages received and synchronizing the device state to match.
2. Publishing an /update message with a reported message body that has the device's current state.

AWS IoT Embedded C Device SDK - Shadow Service APIs and Structures

APIs available in Talaria TWO AWS IoT Device SDK to effectively use the AWS IoT Device Shadow Service are as follows:

aws_iot_shadow_init()

This API takes care of initializing the IoT client and the internal book-keeping data structures of Thing Shadow before use.

Parameter pClient is a new MQTT Client to be used as the protocol layer. Will be initialized with pParams.

Returns an IoT Error Type defining successful/failed Initialization.

```
IoT_Error_t aws_iot_shadow_init(AWS_IoT_Client *pClient, ShadowInitParameters_t

*pParams);
```

aws_iot_shadow_connect()

This API does the TLSv1.2 handshake and establishes the MQTT connection to connect to the AWS IoT Thing Shadow service over MQTT.

Parameter pClient is MQTT Client used as the protocol layer, pParams holds Shadow Connection parameters.

Returns an IoT Error Type defining successful/failed Connection.

```
IoT_Error_t aws_iot_shadow_connect(AWS_IoT_Client *pClient, ShadowConnectParameters_t

*pParams);
```

aws_iot_shadow_yield()

This API is called to yield the current thread to the underlying MQTT client and Shadow. It ensures the expired requests of Shadow actions are cleared and Timeout callback is executed.

It also ensures that the MQTT client gets the time to manage PING requests to monitor the health of the TCP connection as well as periodically check the socket receive buffer for subscribe messages.

This function could be used in a separate thread waiting for the incoming messages, ensuring the connection is kept alive with the AWS Service.

All callbacks used in the SDK will be executed in the context of this function.

Parameter pClient is MQTT Client used as the protocol layer, timeout is the maximum time in milliseconds the yield function will wait for a message and/or read the messages from the TLS buffer.

Returns an IoT Error Type defining successful/failed Yield.

```
IoT_Error_t aws_iot_shadow_yield(AWS_IoT_Client *pClient, uint32_t timeout);
```

(*fpActionCallback_t)()

This is a Function Pointer typedef used as the callback for the actions Update, Get and Delete.

This function will be called from the context of thread which called `aws_iot_shadow_yield()`.

Parameter `pThingName` is Thing Name of the response received, action tells that the response is of which action (Update, Get or Delete), status informs if the action was Accepted/Rejected or Timed out, `pReceivedJsonDocument` is received JSON document when Accepted, `pContextData` is the `void*` data passed in during the action call (Update, Get or Delete).

```
typedef void (*fpActionCallback_t)(const char *pThingName, ShadowActions_t action,

Shadow_Ack_Status_t status, const char *pReceivedJsonDocument, void *pContextData);
```

```
/**

 * @brief Thing Shadow Acknowledgment enum

*/

typedef enum {

      SHADOW_ACK_TIMEOUT, SHADOW_ACK_REJECTED, SHADOW_ACK_ACCEPTED

} Shadow_Ack_Status_t;


/**

 * @brief Thing Shadow Action type enum

*/

typedef enum {

      SHADOW_GET, SHADOW_UPDATE, SHADOW_DELETE

} ShadowActions_t;
```

aws_iot_shadow_update()

This API is the used to perform an Update action to a Thing Name's Shadow.

Update is one of the most frequently used functionalities by a device. In most cases the device may be just reporting few params to update the thing shadow in the cloud.

If no callback or if the JSON document does not have a client token, then the Update Action will just publish the update and not track it.

The following steps are performed on using this function:

1. Subscribe to Shadow topics - `$aws/things/{thingName}/shadow/update/accepted` and `$aws/things/{thingName}/shadow/update/rejected`
2. Wait for two seconds for the subscription to take effect
3. Publish on the update topic - `$aws/things/{thingName}/shadow/update`
4. The response will be handled in the `aws_iot_shadow_yield()` function. In case of timeout or if no response is received, the subscription to shadow response topics is un-subscribed.

On the contrary, if the persistent subscription is set to TRUE then the un-subscribe will not be done. The topics will always be listened to.

Parameter `pClient` is MQTT Client used as the protocol layer, `pThingName` is the Thing Name of the shadow that needs to be Updated, `pJsonString` contains a JSON document which update action expects. The JSON String should be a null terminated string. This JSON document should adhere to the AWS IoT Thing Shadow specification. To help in the process of creating this JSON document- SDK provides JSON handling APIs explained later in this app note.

Parameter callback is the callback that will be used to inform the caller of the response from the AWS IoT Shadow service. Callback could be set to NULL if response is not important.

Parameter `pContextData` is an extra parameter that could be passed along with the callback. Should be set to NULL if not used.

Parameter `timeout_seconds` is the time the SDK will wait for the response on either accepted or rejected topic before declaring timeout on the action.

Parameter `isPersistentSubscribe` should be set to true to avoid repeated subscription and un-subscription if every time a device updates the same shadow, as mentioned above. If the update action on the Thing Name is a one-off update, then `isPersistentSubscribe` should be set to false.

Returns an IoT Error Type defining successful/failed Update action.

```
IoT_Error_t aws_iot_shadow_update(AWS_IoT_Client *pClient, const char *pThingName, char

*pJsonString, fpActionCallback_t callback, void *pContextData, uint8_t timeout_seconds,

bool isPersistentSubscribe);
```

aws_iot_shadow_get()

This API is the used to perform a Get action to a Thing Name's Shadow.

This is usually used to get the config of a device at boot up. It is like the Update API internally, except it does not take a JSON document as the input. In case of success, JSON document is received over the accepted topic.

All the other parameters are same as explained in API `aws_iot_shadow_update()`.

Returns an IoT Error Type defining successful/failed Get action.

```
IoT_Error_t aws_iot_shadow_get(AWS_IoT_Client *pClient, const char *pThingName,

fpActionCallback_t callback, void *pContextData, uint8_t timeout_seconds, bool

isPersistentSubscribe);
```

aws_iot_shadow_delete()

This API is the used to perform a Delete action to a Thing Name's Shadow.

It is generally the responsibility of the accompanying web service / app to do the delete so it is not a very common use case for the device.

It is like the Update function internally, except it does not take a JSON document as the input. The Thing Shadow referred by the Thing Name will be deleted.

All the other parameters are same as explained in API `aws_iot_shadow_update()`.

Returns an IoT Error Type defining successful/failed Delete action.

```
IoT_Error_t  aws_iot_shadow_delete(AWS_IoT_Client  *pClient,  const  char  *pThingName,

fpActionCallback_t  callback,  void  *pContextData,  uint8_t  timeout_seconds,  bool

isPersistentSubscriptions);
```

aws_iot_shadow_register_delta()

This API is the used to listen on the delta topic of #AWS_IOT_MY_THING_NAME mentioned in the `aws_iot_config.h` file. Any time a delta is published, the JSON document will be delivered to the `pStruct->cb`. If the parsing done by the SDK is not needed, then use the `jsonStruct_t` key set to "state".

Parameter `pClient` is MQTT Client used as the protocol layer and `pStruct` is the struct used to parse JSON value. To help in the process of parsing this JSON document- SDK provides JSON handling APIs explained later in this app note.

Returns an IoT Error Type defining successful/failed delta registration.

```
IoT_Error_t aws_iot_shadow_register_delta(AWS_IoT_Client *pClient, jsonStruct_t

*pStruct);
```

aws_iot_shadow_reset_last_received_version()

This API is the used Reset the last received version number to zero and is useful when the Thing Shadow is deleted and the local version needs to be rest.

```
void aws_iot_shadow_reset_last_received_version(void);
```

aws_iot_shadow_get_last_received_version()

This API is the used get the last received version number for a JSON document.

Version of a document is received with every accepted/rejected and the SDK keeps track of the last received version of the JSON document of #AWS_IOT_MY_THING_NAME shadow.

One exception to this version tracking is that the SDK ignores the version from update/accepted topic. Rest of the responses will be scanned to update the version number.

Reason behind this is, accepting version change for update/accepted may cause version conflicts for delta message if the update message is received before the delta.

Returns version number of the last received response.

```
uint32_t aws_iot_shadow_get_last_received_version(void);
```

aws_iot_shadow_enable_discard_old_delta_msgs()

This API enables the ignoring of delta messages with old version number.

As the MQTT is as protocol layer, there could be more than 1 of the same messages if we use QoS 0. To avoid getting called for the same message, this functionality should be enabled. If enabled, all the old messages will be ignored.

```
void aws_iot_shadow_enable_discard_old_delta_msgs(void);
```

aws_iot_shadow_disable_discard_old_delta_msgs()

This API disables the ignoring of delta messages with old version number.

```
void aws_iot_shadow_disable_discard_old_delta_msgs(void);
```

aws_iot_shadow_set_autoreconnect_status()

This API is the used to enable or disable `autoreconnect` feature. Any time a disconnect happens the underlying MQTT client attempts to reconnect if this is set to true.

Parameter `pClient` is MQTT Client used as the protocol layer, `newStatus` holds the value to set the `autoreconnect` option to.

Returns an IoT Error Type defining successful/failed operation.

```
IoT_Error_t aws_iot_shadow_set_autoreconnect_status(AWS_IoT_Client *pClient, bool

newStatus);
```

aws_iot_shadow_disconnect()

This API is used to disconnect from the AWS IoT Thing Shadow service over MQTT. This closes the underlying TCP connection.

Parameter `pClient` is MQTT Client used as the protocol layer.

Returns an IoT Error Type defining successful/failed disconnect status.

```
IoT_Error_t aws_iot_shadow_disconnect(AWS_IoT_Client *pClient);
```

aws_iot_shadow_free()

This API is used to clean shadow client and free up memory that was dynamically allocated for the client.

Parameter `pClient` is MQTT Client that was previously created by calling `aws_iot_shadow_init()`.

Returns an IoT Error Type defining successful/failed freeing.

```
IoT_Error_t aws_iot_shadow_disconnect(AWS_IoT_Client *pClient);
```

aws_iot_shadow_init_json_document()

This API initializes the JSON document with Shadow expected name/value and fills the JSON Buffer with a null terminated string. This function should always be used First, before using `iot_shadow_add_reported()` and/or `iot_shadow_add_desired()`, and finally `iot_finalize_json_document()` is called.

The caller of the API needs to ensure the size of the buffer is enough to hold the entire JSON document.

Parameter `pJsonDocument` is the JSON document filled in this char buffer, `maxSizeOfJsonDocument` is maximum size of the `pJsonDocument` that can be used to fill the JSON document.

Returns an IoT Error Type defining if the buffer was null or the entire string was not filled up.

Note: The JSON library used for this SDK is JSMN which does not use any dynamic memory allocation.

```
IoT_Error_t aws_iot_shadow_init_json_document(char *pJsonDocument, size_t

maxSizeOfJsonDocument);
```

structure jsonStruct_t

After the initialization of the JSON document, APIs `iot_shadow_add_reported()` and/or `iot_shadow_add_desired()`, are used to fill the JSON document's reported or desired section with the values we want to report/desire. The relevant structure is as follows:

```
/**

 * @brief This is the struct form of a JSON Key value pair

 */

struct jsonStruct {

      const char *pKey; ///< JSON key

      void *pData; ///< pointer to the data (JSON value)

      size_t dataLength; ///< Length (in bytes) of pData

      JsonPrimitiveType type; ///< type of JSON

      jsonStructCallback_t cb; ///< callback to be executed on receiving the Key value

pair

};



/**

 * @brief All the JSON object types enum
 *
 * JSON number types need to be split into proper integer / floating point data types and
sizes on embedded platforms.
 */
typedef enum {
	SHADOW_JSON_INT32,
	SHADOW_JSON_INT16,
	SHADOW_JSON_INT8,
	SHADOW_JSON_UINT32,
	SHADOW_JSON_UINT16,
	SHADOW_JSON_UINT8,
	SHADOW_JSON_FLOAT,
	SHADOW_JSON_DOUBLE,
	SHADOW_JSON_BOOL,
	SHADOW_JSON_STRING,
	SHADOW_JSON_OBJECT
} JsonPrimitiveType;
```

aws_iot_shadow_add_reported()

This API is used to Add the reported section of the JSON document of `jsonStruct_t`.

It API takes variable number of arguments; count is the number of `jsonStruct_t` types that you would like to add in the reported section.

It adds "reported":{<all the values that needs to be added>} to the JSON document.

The caller of the API needs to ensure the size of the buffer is enough to hold the reported section + the `init` section. The JSON document buffer needs to be initialized using `iot_shadow_init_json_document()` before calling this API.

Parameter `pJsonDocument` is the JSON document filled in this char buffer, `maxSizeOfJsonDocument` is maximum size of the `pJsonDocument` that can be used to fill the JSON document.

Parameter count is total number of arguments (`jsonStruct_t` object) passed in the arguments.

Returns an IoT Error Type defining if the buffer was null or the entire string was not filled up.

```
IoT_Error_t aws_iot_shadow_add_reported(char *pJsonDocument, size_t

maxSizeOfJsonDocument, uint8_t count, ...);
```

aws_iot_shadow_add_desired()

This API is used to Add the desired section of the JSON document of `jsonStruct_t`.

It API takes variable number of arguments; count is the number of `jsonStruct_t` types that you would like to add in the desired section.

It adds " desired “: {<all the values that needs to be added>} to the JSON document.

The caller of the API needs to ensure the size of the buffer is enough to hold the desired section + the `init` section. The JSON document buffer needs to be initialized using `iot_shadow_init_json_document()` before calling this API.

Parameter `pJsonDocument` is the JSON document filled in this char buffer, `maxSizeOfJsonDocument` is maximum size of the `pJsonDocument` that can be used to fill the JSON document.

Parameter count is total number of arguments (`jsonStruct_t` object) passed in the arguments.

Returns an IoT Error Type defining if the buffer was null or the entire string was not filled up.

Note: Both ‘desired’ and ‘reported’ section are not mandatory. Most devices might just use the reported section.

```
IoT_Error_t aws_iot_shadow_add_desired(char *pJsonDocument, size_t

maxSizeOfJsonDocument, uint8_t count, ...);
```

aws_iot_finalize_json_document()

This API is used to finalize the JSON document with Shadow expected client Token and increments the client token every time this API is called.

The caller of the API needs to ensure the size of the buffer is enough to hold the entire JSON document.

This API is to be called after using `iot_shadow_add_reported()` and/or `iot_shadow_add_desired()`, otherwise the JSON document after ADD operation will not be valid.

Parameter `pJsonDocument` is the JSON document filled in this char buffer, `maxSizeOfJsonDocument` is maximum size of the `pJsonDocument` that can be used to fill the JSON document.

Returns an IoT Error Type defining if the buffer was null or the entire string was not filled up.

```
IoT_Error_t aws_iot_finalize_json_document(char *pJsonDocument, size_t

maxSizeOfJsonDocument);
```

When action Update is called after finalize, there could a situation of multiple other services trying to update the same shadow. To differentiate the services / device in such situation, a client token string is included to the request.

`AWS_IOT_MQTT_CLIENT_ID` with a sequence number to differentiate between our own previous update requests is used as a client token. It is of the form: "clientToken": "UniqueClientID+Seq". This is also taken care by `aws_iot_finalize_json_document()` APIs.

aws_iot_fill_with_client_token()

This API fills the given buffer with client token for tracking the Response.

It adds the `AWS_IOT_MQTT_CLIENT_ID` with a sequence number. Every time this function is used the sequence number gets incremented.

Parameter `pBufferToBeUpdatedWithClientToken` is the buffer to be updated with the client token string, `maxSizeOfJsonDocument` is maximum size of the `pJsonDocument` that can be used to fill the JSON document.

Returns an IoT Error Type defining if the buffer was null or the entire string was not filled up.

```
IoT_Error_t aws_iot_fill_with_client_token(char *pBufferToBeUpdatedWithClientToken,

size_t maxSizeOfJsonDocument);
```

Auto Reconnect Feature

If Auto Reconnect feature is enabled using API: `aws_iot_shadow_set_autoreconnect_status()`, an attempt to reconnect is made as part of the next yield call at any time, a disconnect happens. On reconnecting the MQTT connection, all the topics will be re-subscribed.

The auto-reconnect feature could be enabled at any point of time after the `aws_iot_shadow_connect()` is a success. It should not be enabled before `aws_iot_shadow_connect()`. To verify if this feature is enabled or disabled, an underlying MQTT API `aws_iot_is_autoreconnect_enabled()` is used.

Exponential back-off is used to decide the time between two reconnect attempts.

There are two configuration parameters associated with exponential back-off:

1. AWS_IOT_MQTT_MIN_RECONNECT_WAIT_INTERVAL
2. AWS_IOT_MQTT_MAX_RECONNECT_WAIT_INTERVAL

Interval before every next try is multiplied by 2, starting with `AWS_IOT_MQTT_MIN_RECONNECT_WAIT_INTERVAL`.

After all the reconnect attempts fail based on the maximum back-off time, an attempt will be made every `AWS_IOT_MQTT_MAX_RECONNECT_WAIT_INTERVAL`.

In the following cases a network disconnect is detected:

1. As part of MQTT Keepalive functionality, if the Ping Response is not received back, then a disconnect is initiated and `iot_disconnect_handler()` is called.
2. If we are unable to send the Ping in the first place, then it is flagged as a disconnect.

Any time a disconnect is detected because of the keep alive logic then this disconnect handler is invoked. The `iot_disconnect_handler()` is invoked even if the auto-reconnect feature is enabled. It is invoked only once before the beginning of the reconnection attempt.

When auto-reconnect is attempted, API `iot_tls_is_connected()` is called to check if the Physical Network is up and whether the TLS layer is connected or not. Every time before performing a TLS handshake, the return value of this function will be checked.

Yield return values could be one of these while using the reconnect feature:

1. NETWORK_RECONNECTED
2. NETWORK_ATTEMPTING_RECONNECT
3. NETWORK_RECONNECT_TIMED_OUT
4. NETWORK_DISCONNECTED

Note: If the AWS IoT Embedded C Device SDK library is built with configuration network reconnect timeout enabled (#define `AWS_IOT_MQTT_DISABLE_NETWORK_RECONNECT_TIME_OUT 0)`, then auto reconnect behavior changes as detailed below.

After all reconnect attempt failure based on the maximum back-off time, `NETWORK_RECONNECT_TIMED_OUT` is returned by `aws_iot_mqtt_yield()`. There will be no longer reconnect attempts. If a reconnect is needed after this based on some external conditions then use `aws_iot_mqtt_attempt_reconnect()` API to reconnect and re-subscribe. This API could be manually used without turning on the auto-reconnect feature. It will attempt to reconnect only once. `aws_iot_mqtt_attempt_reconnect()` is a blocking call.

About Alexa Smart Home Skill

'Alexa Skills Kit' can be used by the Customer to develop various Alexa controlled devices with different use cases.

In this application note demo, Alexa Smart Home Skill is used where voice interaction model is prebuilt and Smart Home Devices can be discovered and controlled using Amazon Alexa Smartphone App user interface.

https://developer.amazon.com/en-US/docs/alexa/smarthome/understand-the-smart-home-skill-api.html

Smart Home Skill also provide various APIs with predefined protocols as interface for different types of Smart Home Devices, For example: thermostat, temperature sensor, color controller and so on.

Similarly, there is Smart Home Security Skills with predefined voice interaction models and predefined protocols covering doorbell and lock control etc., use cases.

https://developer.amazon.com/en-US/docs/alexa/device-apis/overview-smart-home-security.html

There are around 25 predefined interfaces in Smart Home category, for which this sample code can be easily extended.

This application note demo skill uses `PowerController` interface and `PowerState` in the device shadow is updated based on Alexa commands from Alexa Voice Service.

https://developer.amazon.com/en-US/docs/alexa/device-apis/alexa-powercontroller.html

This is achieved by Alexa Smart Home Skill bridging between Alexa Voice Service (AVS) and AWS IoT Core service where the device endpoint resides. This shadow is replicated by the Talaria TWO running the example code with this application note.

To achieve this, customers will need to develop and deploy their own Alexa Skill.

A demo of this can be seen in action using 'InnoPhase Smart Home Demo' Alexa Skill and a device endpoint 'InnoSwitch' residing at InnoPhase AWS Endpoint Cloud. Talaria TWO EVB is used to connect to this device endpoint 'InnoSwitch' and be controlled by Alexa commands or Amazon Alexa Smartphone App. Next section describes how to setup this demo.

Custom Alexa Skills with customer's own voice interaction models can also be built with your own protocol over AWS IoT Core Device Shadow Service.

Setting up a Talaria TWO InnoSwitch Demo

The following section describes the steps needed to successfully setup the Alexa Ready Talaria TWO App with InnoPhase Smart Home Demo Alexa Skill.

Following steps are a one-time process for the individual using the skill to link the account and receive unique device name, device cert and device key or Talaria TWO ELF binary.

Prerequisite

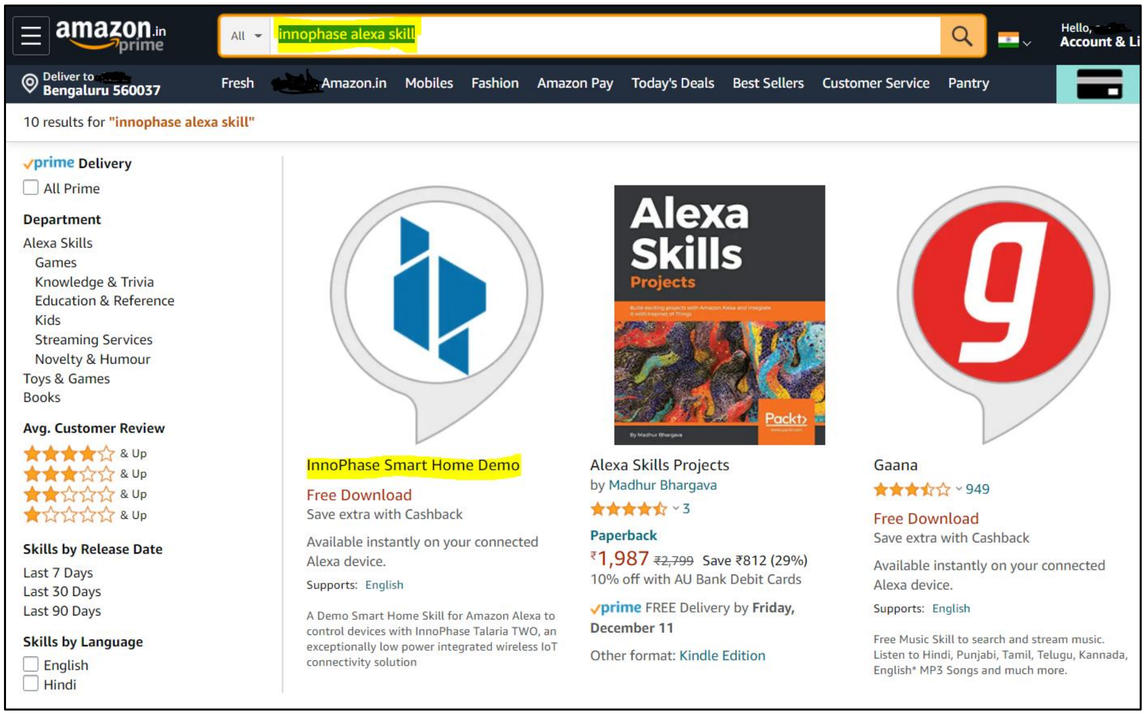
The User should already have an active Amazon account and an Alexa Application in User's Smart Phone. Optionally, an Alexa enabled speaker like Echo can be used for voice interaction. Talaria TWO EVB and Talaria TWO Download Tool will be needed to program the board.

Enable InnoPhase Smart Home Demo Alexa Skill

LWA (Login with Amazon) service from Amazon is used for securely linking the Alexa account to the Skill. There are two methods to enable Skill for your amazon account which are as follows:

Method 1 - Enabling Via Browser

Login to amazon.com with the amazon account you want to link with the skill, and search for `innophase alexa skill` as shown in Figure 2.



10 results for "innophase alexa skill"

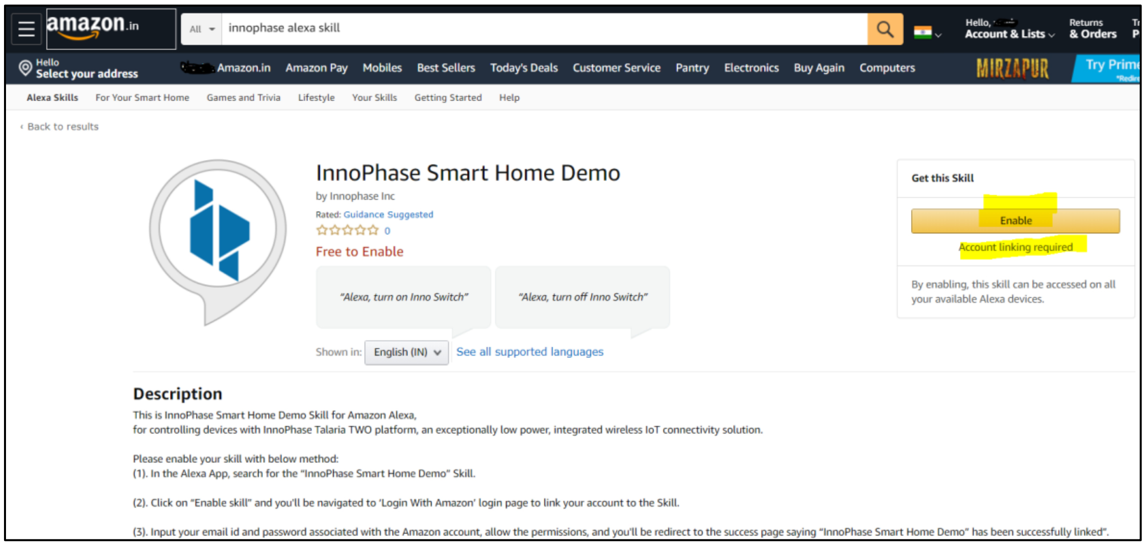
InnoPhase Smart Home Demo
Free Download
Save extra with Cashback
Available instantly on your connected Alexa device.
Supports: English
A Demo Smart Home Skill for Amazon Alexa to control devices with InnoPhase Talaria TWO, an exceptionally low power integrated wireless IoT connectivity solution

Alexa Skills Projects
by Madhur Bhargava
3
Paperback
₹1,987 ~~₹2,799~~ Save ₹812 (29%)
10% off with AU Bank Debit Cards
prime FREE Delivery by Friday, December 11
Other format: Kindle Edition

Gaana
949
Free Download
Save extra with Cashback
Available instantly on your connected Alexa device.
Supports: English
Free Music Skill to search and stream music. Listen to Hindi, Punjabi, Tamil, Telugu, Kannada, English* MP3 Songs and much more.

Figure 2: Locating and enabling skill via amazon.com in browser -- 1

Click the link of the skill and look for `Enable`. Once enabled from here, this skill will show up in Alexa App logged in to same account as well.



InnoPhase Smart Home Demo

by Innophase Inc

Rated: Guidance Suggested

☆☆☆☆☆ 0

Free to Enable

"Alexa, turn on Inno Switch"

"Alexa, turn off Inno Switch"

Shown in: English (IN) See all supported languages

Get this Skill

Enable

Account linking required

By enabling, this skill can be accessed on all your available Alexa devices.

Description

This is InnoPhase Smart Home Demo Skill for Amazon Alexa,
for controlling devices with InnoPhase Talaria TWO platform, an exceptionally low power, integrated wireless IoT connectivity solution.

Please enable your skill with below method:
(1). In the Alexa App, search for the "InnoPhase Smart Home Demo" Skill.

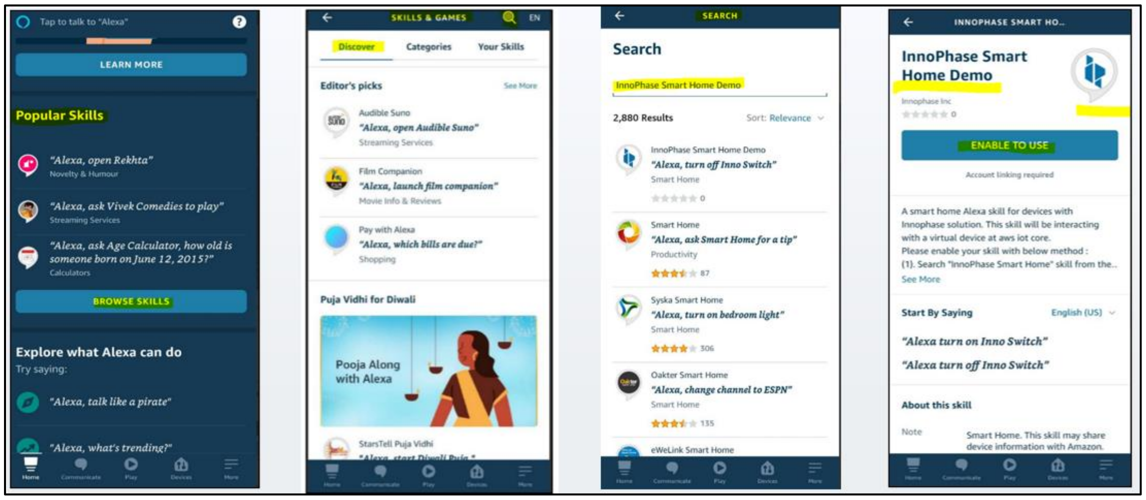
(2). Click on "Enable skill" and you'll be navigated to 'Login With Amazon' login page to link your account to the Skill.

(3). Input your email id and password associated with the Amazon account, allow the permissions, and you'll be redirect to the success page saying "InnoPhase Smart Home Demo" has been successfully linked".

Figure 3: Locating and enabling skill via amazon.com in browser -- 2

Method 2 - Enabling Via Amazon Alexa App

Search for InnoPhase Smart Home Demo from Alexa App `Skill Section -> Browse Skills -> Search`, locate the skill and tap `Enable To Use`, as shown in Figure 4.



"Alexa, open Rekhta"
Novelty & Humour

"Alexa, ask Vivek Comedies to play"
Streaming Services

"Alexa, ask Age Calculator, how old is someone born on June 12, 2015?"
Calculators

"Alexa, talk like a pirate"

"Alexa, what's trending?"

Audible Suno
"Alexa, open Audible Suno"
Streaming Services

Film Companion
"Alexa, launch film companion"
Movie Info & Reviews

Pay with Alexa
"Alexa, which bills are due?"
Shopping

StarsTell Puja Vidhi
"Alexa, start Diwali Puja."

InnoPhase Smart Home Demo

2,880 Results

InnoPhase Smart Home Demo
"Alexa, turn off Inno Switch"
Smart Home
☆☆☆☆☆ 0

Smart Home
"Alexa, ask Smart Home for a tip"
Productivity
★★★★☆ 87

Syska Smart Home
"Alexa, turn on bedroom light"
Smart Home
★★★★☆ 306

Oakter Smart Home
"Alexa, change channel to ESPN"
Smart Home
★★★★☆ 135

eWeLink Smart Home

InnoPhase Smart Home Demo
Innophase Inc
☆☆☆☆☆ 0

Account linking required

A smart home Alexa skill for devices with Innophase solution. This skill will be interacting with a virtual device at aws iot core.
Please enable your skill with below method :
(1). Search "InnoPhase Smart Home" skill from the...
See More

"Alexa turn on Inno Switch"
"Alexa turn off Inno Switch"

Note Smart Home. This skill may share device information with Amazon.

Figure 4: Locating and enabling skill via Alexa phone app

Linking the Alexa account to the Skill

Follow the login instructions that appears on subsequent screens and allow the permissions as required as described below.

Clicking enable in previous steps will open a new page (or redirect to next screen) where it asks for an Amazon account, as shown in Figure 5.

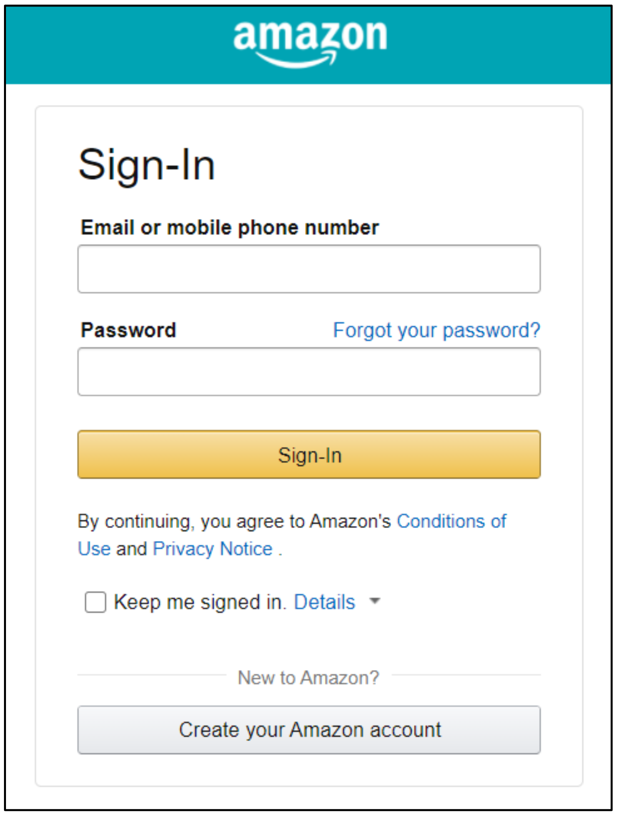
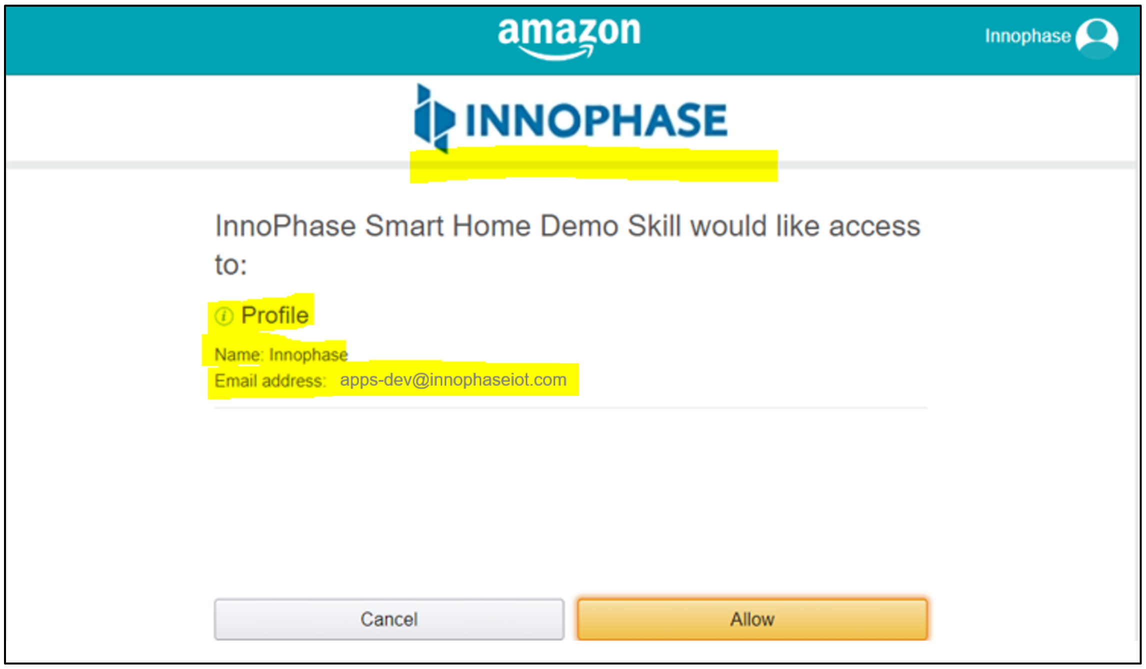

amazon
Sign-In
Email or mobile phone number
Password
Forgot your password?
Sign-In
By continuing, you agree to Amazon's Conditions of Use and Privacy Notice .
Keep me signed in. Details
New to Amazon?
Create your Amazon account

Figure 5: Amazon account – credentials asked for account linking

Ensure you use the same account you have used for Alexa app to login.

Note: If the User has already logged in to the Amazon account in the same browser but in a different tab, then the step in Figure 5 might be skipped and you will directly see a prompt as shown in Figure 6.

Provide permission for accessing email address and name by the Skill.



InnoPhase Smart Home Demo Skill would like access to:

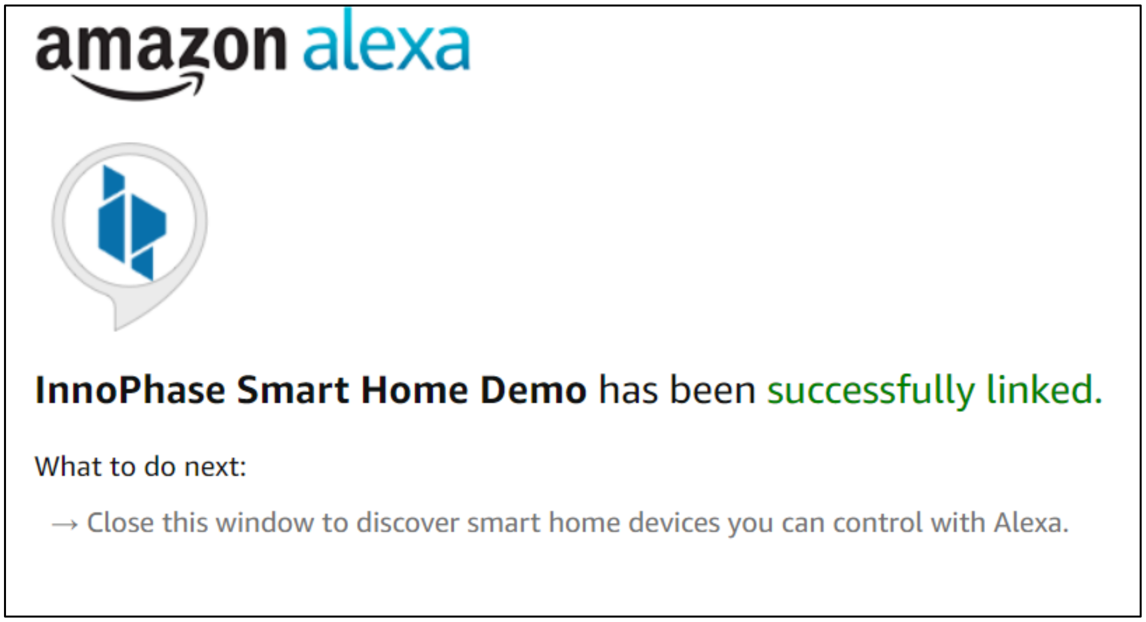
Profile

Name: Innophase
Email address: apps-dev@innophaseiot.com

Figure 6: Permissions asked to access profile for Account Linking

Note: This permission is asked only for the first time of account linking. Disabling the Skill and enabling it again with account linking later might not pop-up a prompt looking exactly as shown in this figure. Instead, the user might see a variant of this prompt or this prompt might be skipped altogether.

This will lead to successfully linking your Amazon Account to InnoPhase Smart Home Demo Skill and a confirmation screen like Figure 7 would appear. This completes the Alexa skill setup in your Amazon account.



InnoPhase Smart Home Demo has been successfully linked.

What to do next:

→ Close this window to discover smart home devices you can control with Alexa.

Figure 7: Amazon Alexa Account Successfully linked to the InnoPhase Smart Home Demo Alexa Skill

Request for AWS IoT Thing creation & Certs created for the Thing

Please communicate the email-id associated with your Amazon Account to cloud-dev@innophaseinc.com with the subject line -- ‘`Request for T2 Alexa End Point`’.

In response, an email with the certificates, keys created for the thing and a ‘Thing Name’ similar to ‘INNO_ENDPOINT_ABCD1234’ will be provided. The certificates, keys and ‘Thing Name’ are unique to your account.

There are two ways in which the ELF is made available:

1. As part of SDK package in the `<sdk_directory>/binaries/ eval/Alexa_ready/bin` path
2. In case you do not have the SDK package, the ELF can be sent along with certs and Thing in response to the request email for Alexa Ready App.

Note: Make sure you can login to Alexa Smart Phone App with your Amazon Account.

Programming Applications

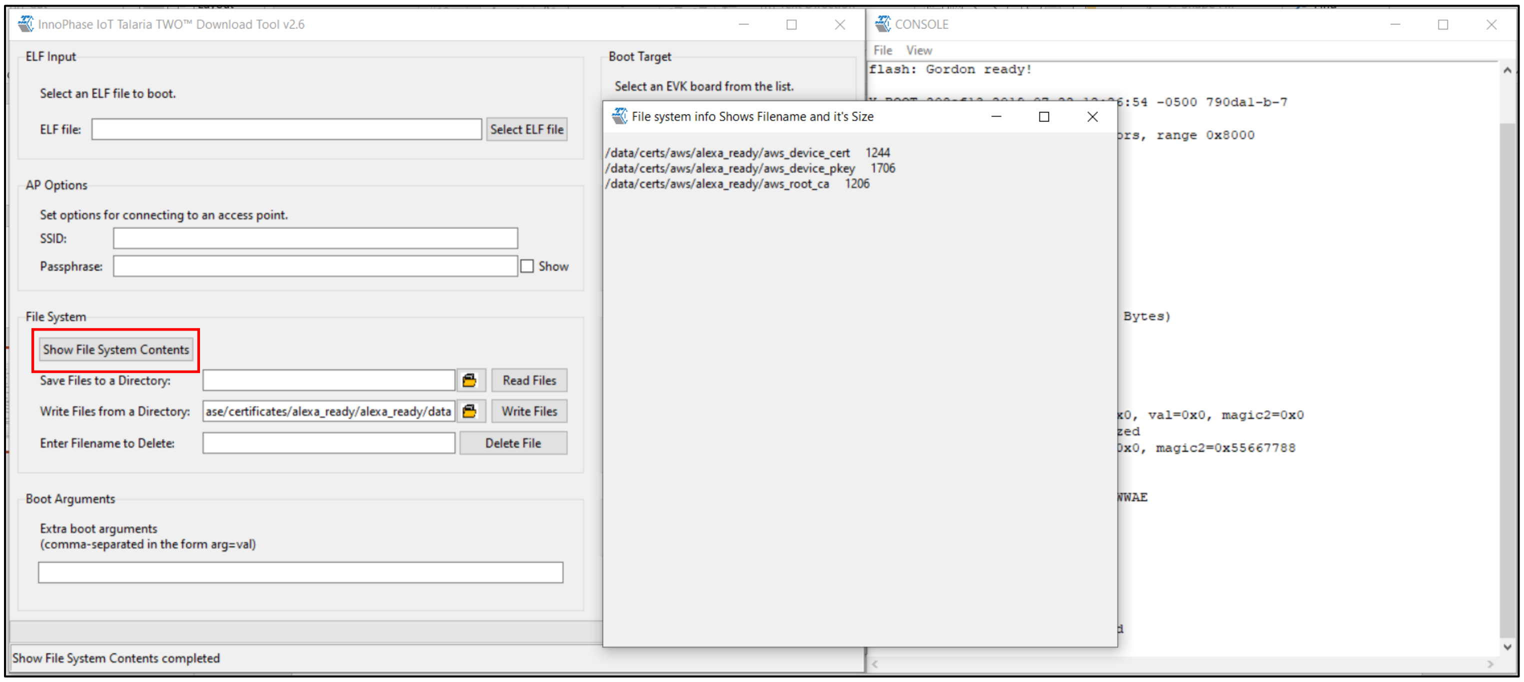
Programming Talaria TWO board with certificates

Program the ELFs, certificate and key onto Talaria TWO using the Download tool.

Launch the Download tool provided with InnoPhase Talaria TWO SDK: (*sdk_2.4\pc_tools\Download_Tool\bin*).

Show File System Contents

Click on `Show File System Contents` to see the current available files in the file system.


InnoPhase IoT Talaria TWO™ Download Tool v2.6
ELF Input
Select an ELF file to boot.
ELF file:
Select ELF file
AP Options
Set options for connecting to an access point.
SSID:
Passphrase:
Show
File System
Show File System Contents
Save Files to a Directory:
Read Files
Write Files
Enter Filename to Delete:
Delete File
Boot Arguments
Extra boot arguments
(comma-separated in the form arg=val)
Boot Target
Select an EVK board from the list.
File system info Shows Filename and it's Size
CONSOLE
File
View

Write Files from a Directory: ase/certificates/alexa_ready/alexa_ready/data

```
/data/certs/aws/alexa_ready/aws_device_cert    1244
/data/certs/aws/alexa_ready/aws_device_pkey    1706
/data/certs/aws/alexa_ready/aws_root_ca    1206
```

Show File System Contents completed

```
flash: Gordon ready!

6:54 -0500 790dal-b-7

rs, range 0x8000

Bytes)

x0, val=0x0, magic2=0x0
zed
0x0, magic2=0x55667788

WWAE

d
```

Figure 8: Download Tool - Show File System Contents

Writing Files into File System

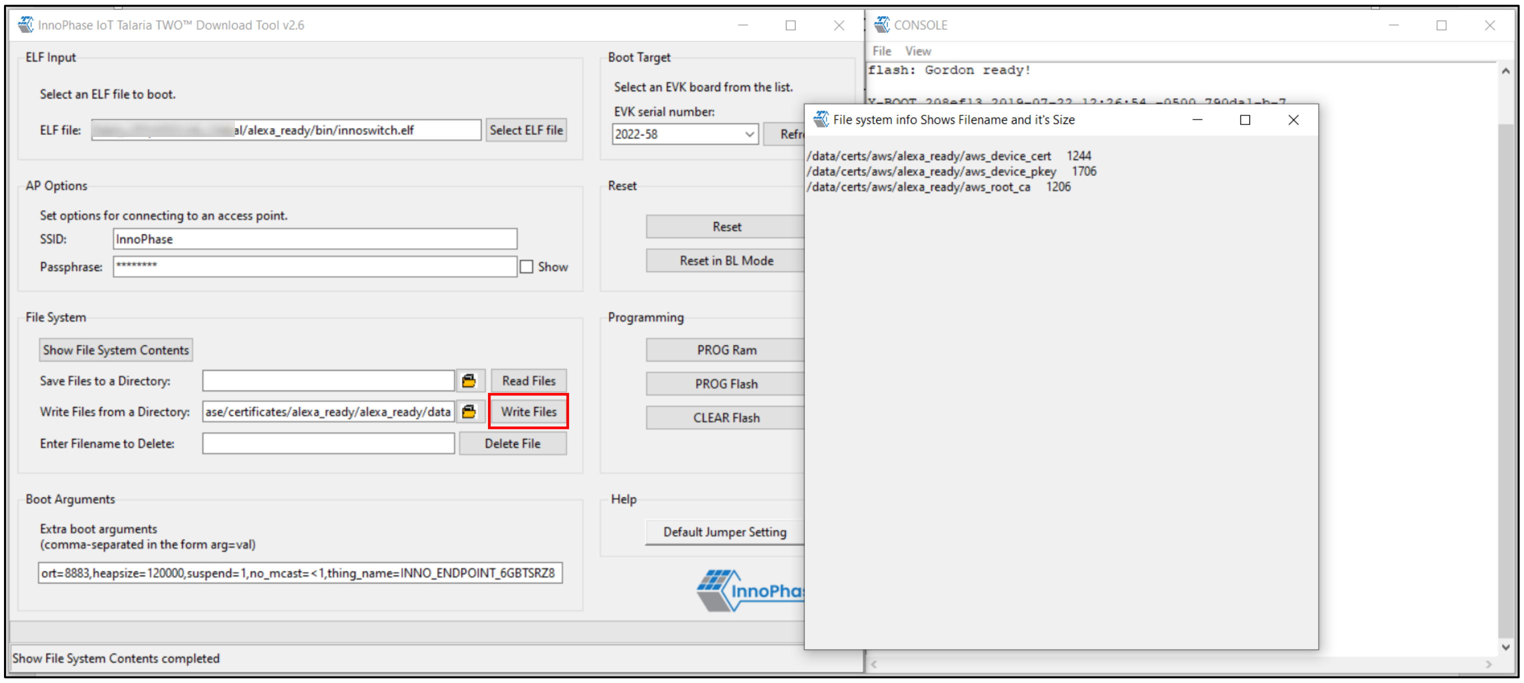
The user needs to add three files in file system:

1. aws_device_cert
2. aws_root_ca
3. aws_device_pkey

User should rename certificates and key received in the mail with the above provided name.

For example: `5497cf0b16-private.pem.key` must be renamed to `aws_device_pkey`.

To write files into Talaria TWO, user must create a folder with the name `data` and must create a sub folder (`/data/certs/aws/alexa_ready`) which is the default sub-folder used and place all certificates, keys into it. Using the Download tool, files must be written to file system.


InnoPhase IoT Talaria TWO™ Download Tool v2.6
ELF Input
Select an ELF file to boot.
Select ELF file
Boot Target
Select an EVK board from the list.
Refr
AP Options
Set options for connecting to an access point.
Show
Reset
Reset
Reset in BL Mode
File System
Show File System Contents
Read Files
Write Files
Delete File
Programming
PROG Ram
PROG Flash
CLEAR Flash
Boot Arguments
Extra boot arguments
(comma-separated in the form arg=val)
Help
Default Jumper Setting
CONSOLE
File View
File system info Shows Filename and it's Size

ELF file: [redacted]al/alexa_ready/bin/innoswitch.elf

EVK serial number: 2022-58

SSID: InnoPhase

Passphrase: ********

Save Files to a Directory:

Write Files from a Directory: ase/certificates/alexa_ready/alexa_ready/data

Enter Filename to Delete:

ort=8883,heapsize=120000,suspend=1,no_mcast=<1,thing_name=INNO_ENDPOINT_6GBTSRZ8

Show File System Contents completed

```
flash: Gordon ready!

Y-BOOT 208ef13 2019-07-22 12:26:54 -0500 790da1-b-7
```

```
/data/certs/aws/alexa_ready/aws_device_cert    1244
/data/certs/aws/alexa_ready/aws_device_pkey    1706
/data/certs/aws/alexa_ready/aws_root_ca    1206
```

Figure 9: Write certificates to Talaria TWO

Programming Talaria TWO board with ELF

There are two Talaria TWO applications available in the following location of the SDK release package: `sdk_x.y\binaries\eval\alexa_ready\bin`.

1. `innoswitch.elf`
2. `innoswitch_ble_provisionig.elf`

Note: x and y in sdk_x.y refer to the SDK release version. For example: *sdk_2.4\binaries\eval\alexa_ready\bin*.

The difference amongst the two is, while using `innoswitch_ble_provisioning.elf` , the AP details (SSID, Passphrase) can be provisioned to the Talaria TWO application from a mobile application instead of passing it from Download Tool.

Programming Talaria TWO board with innoswitch.elf

Program `innoswitch.elf` (*sdk_x.y\examples\watchdog_timer\bin*) using the Download tool:

1. Launch the Download tool provided with InnoPhase Talaria TWO SDK.
2. In the GUI window:
    a. Boot Target: Select the appropriate EVK from the drop-down.
    b. ELF Input: Load the `innoswitch.elf` by clicking on `Select ELF File`.
    c. AP Options: Provide the appropriate SSID and Passphrase to connect to an Access Point.
    d. Boot Arguments: Pass the following boot arguments:

```
aws_host=a3t0o11ohwlo2h-ats.iot.us-east-1.amazonaws.com,

aws_port=8883,suspend=1,no_mcast=< 1 or 0,thing_name=INNO_ENDPOINT_xxxxxxxx
```

Note: Replace the xxxxxx with the appropriate details.
Ensure correct boot parameters are supplied to your Wi-Fi network and the information from the device/thing created previously on AWS.

    a. `aws_host` is the custom AWS location.
    b. `thing_name` unique Thing name you received.

    e. Programming: Prog RAM or Prog Flash as per requirement.

For more details on using the Download tool, refer to the document: `UG_Download_Tool.pdf` (path: *sdk_x.y\pc_tools\Download_Tool\doc*).

Console log after programming:

```
Y-BOOT 208ef13 2019-07-22 12:26:54 -0500 790da1-b-7

ROM yoda-h0-rom-16-0-gd5a8e586

FLASH:PNWWWWWAEBuild $Id: git-b664be2af $

aws_host=a3t0o11ohwlo2h-ats.iot.us-east-1.amazonaws.com aws_port=8883 suspend=1

no_mcast=< 1 thing_name=INNO_ENDPOINT_6GBTSRZ8 np_conf_path=/sys/nprofile.json

ssid=InnoPhase passphrase=43083191

$App:git-38ca4ab7

SDK Ver: SDK_2.4

Innoswitch Demo App

Mounting file system

read_certs() success

addr e0:69:3a:00:2c:3e

added network profile successfully, will try connecting..

[2.769,774] CONNECT:d2:01:2a:d2:4a:2d Channel:11 rssi:-24 dBm

wcm_notify_cb to App Layer - WCM_NOTIFY_MSG_LINK_UP

wcm_notify_cb to App Layer - WCM_NOTIFY_MSG_ADDRESS

[4.805,318] MYIP 192.168.224.237

[4.805,402] IPv6 [fe80::e269:3aff:fe00:2c3e]-link

wcm_notify_cb to App Layer - WCM_NOTIFY_MSG_CONNECTED

Shadow Connect


 Root Done[0]Loading the client cert. and key. size TLSDataParams:2080


 Loading the client cert done.... ret[0]

 Client pkey loaded[0]

   . Connecting to a3t0o11ohwlo2h-ats.iot.us-east-1.amazonaws.com/8883... ok

   . Setting up the SSL/TLS structure...  This certificate has no flags
```

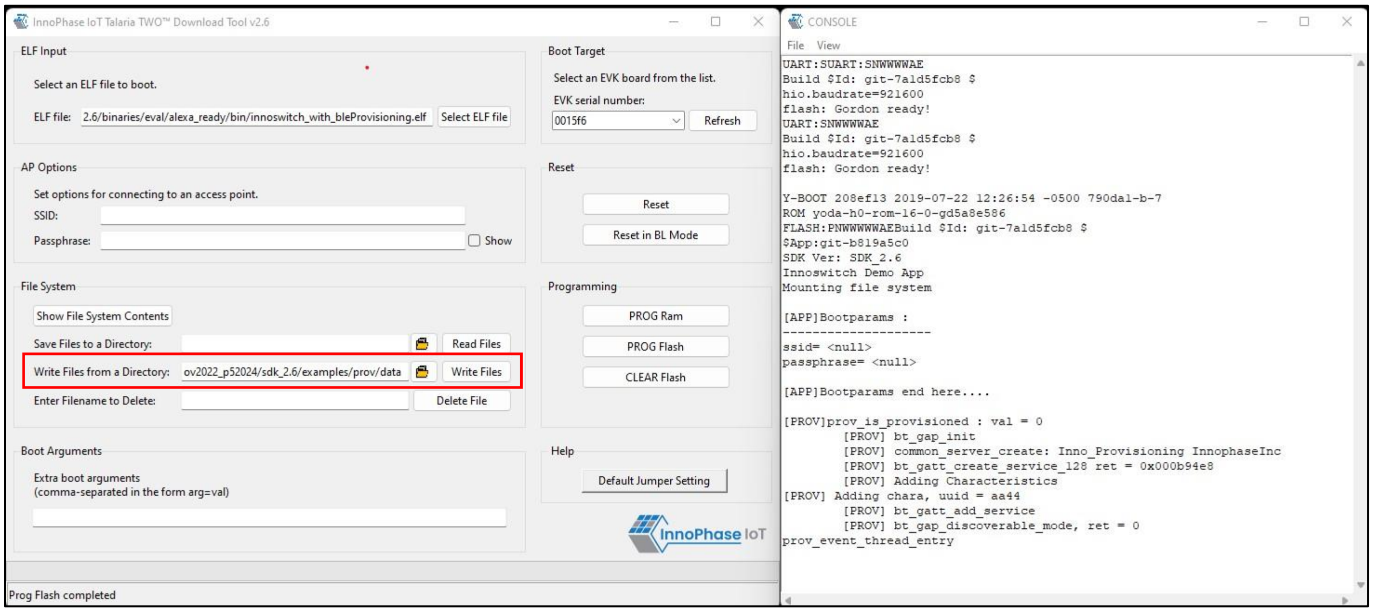
```
  This certificate has no flags

  This certificate has no flags

SSL/TLS handshake. DONE ..ret:0

 ok

    [ Protocol is TLSv1.2 ]

    [ Ciphersuite is TLS-ECDHE-RSA-WITH-AES-128-GCM-SHA256 ]

    [ Record expansion is 29 ]

. Verifying peer X.509 certificate...

 ok

Shadow Connected

init_and_connect_aws_iot. ret:0

LED Off

Update Shadow: {"state":{"reported":{"powerState":"OFF"}},

"clientToken":"INNO_ENDPOINT_6GBTSRZ8-0"}

Delta - Switch state changed to ON

LED On

Update Shadow: {"state":{"reported":{"powerState":"ON"}},

"clientToken":"INNO_ENDPOINT_6GBTSRZ8-1"}

Update Accepted !!

Update Accepted !!

Delta - Switch state changed to OFF

LED Off

Update Shadow: {"state":{"reported":{"powerState":"OFF"}},

"clientToken":"INNO_ENDPOINT_6GBTSRZ8-2"}

Update Accepted !!

Delta - Switch state changed to ON

LED On
```

```
Update Shadow: {"state":{"reported":{"powerState":"ON"}},

"clientToken":"INNO_ENDPOINT_6GBTSRZ8-3"}

Update Accepted !!

Delta - Switch state changed to OFF

LED Off

Update Shadow: {"state":{"reported":{"powerState":"OFF"}},

"clientToken":"INNO_ENDPOINT_6GBTSRZ8-4"}

Update Accepted !!

Delta - Switch state changed to ON

LED On

Update Shadow: {"state":{"reported":{"powerState":"ON"}},

"clientToken":"INNO_ENDPOINT_6GBTSRZ8-5"}

Update Accepted !!

Delta - Switch state changed to OFF

LED Off

Update Shadow: {"state":{"reported":{"powerState":"OFF"}},

"clientToken":"INNO_ENDPOINT_6GBTSRZ8-6"}

Update Accepted !!

Delta - Switch state changed to ON

LED On

Update Shadow: {"state":{"reported":{"powerState":"ON"}},

"clientToken":"INNO_ENDPOINT_6GBTSRZ8-7"}

Update Accepted !!

Delta - Switch state changed to OFF

LED Off

Update Shadow: {"state":{"reported":{"powerState":"OFF"}},

"clientToken":"INNO_ENDPOINT_6GBTSRZ8-8"}
```

```
Update Accepted !!

Delta - Switch state changed to ON

LED On

Update Shadow: {"state":{"reported":{"powerState":"ON"}},

"clientToken":"INNO_ENDPOINT_6GBTSRZ8-9"}

Update Accepted !!

Delta - Switch state changed to OFF

LED Off

Update Shadow: {"state":{"reported":{"powerState":"OFF"}},

"clientToken":"INNO_ENDPOINT_6GBTSRZ8-10"}

Update Accepted !!
```

Programming Talaria TWO board with innoswitch_ble_provisioning.elf

Write the `part.json` file to the `data` folder using `Write Files` in the Download Tool. Once done, program `innoswitch_with_bleProvisioning.elf` (refer steps from section: *Programming Talaria TWO board with innoswitch.elf* to program the ELF onto Talaria TWO).


InnoPhase IoT Talaria TWO™ Download Tool v2.6

ELF Input

Select an ELF file to boot.

ELF file: 2.6/binaries/eval/alexa_ready/bin/innoswitch_with_bleProvisioning.elf

Boot Target

Select an EVK board from the list.

EVK serial number: 0015f6

AP Options

Set options for connecting to an access point.

SSID:

Passphrase:

File System

Save Files to a Directory:

Write Files from a Directory: ov2022_p52024/sdk_2.6/examples/prov/data

Enter Filename to Delete:

Boot Arguments

Extra boot arguments
(comma-separated in the form arg=val)

Prog Flash completed

CONSOLE

```
UART:SUART:SNWWWWAE
Build $Id: git-7a1d5fcb8 $
hio.baudrate=921600
flash: Gordon ready!
UART:SNWWWWAE
Build $Id: git-7a1d5fcb8 $
hio.baudrate=921600
flash: Gordon ready!

Y-BOOT 208ef13 2019-07-22 12:26:54 -0500 790da1-b-7
ROM yoda-h0-rom-16-0-gd5a8e586
FLASH:PNWWWWWAEBuild $Id: git-7a1d5fcb8 $
$App:git-b819a5c0
SDK Ver: SDK_2.6
Innoswitch Demo App
Mounting file system

[APP]Bootparams :
--------------------
ssid= <null>
passphrase= <null>

[APP]Bootparams end here....

[PROV]prov_is_provisioned : val = 0
        [PROV] bt_gap_init
        [PROV] common_server_create: Inno_Provisioning InnophaseInc
        [PROV] bt_gatt_create_service_128 ret = 0x000b94e8
        [PROV] Adding Characteristics
[PROV] Adding chara, uuid = aa44
        [PROV] bt_gatt_add_service
        [PROV] bt_gap_discoverable_mode, ret = 0
prov_event_thread_entry
```

Figure 10: Writing part.json

Note:

1. To reprovision the Talaria TWO module, write the `part.json` file onto Talaria TWO filesystem using Write Files.
2. For connecting the Talaria TWO to an AP, the SSID and Passphrase are provisioned to Talaria TWO through BLE from a mobile application as mentioned in the following section (section: *Using InnoPhase Talaria TWO Smart Home Application*). Ensure to keep the SSID and Passphrase fields in the Download Tool empty.

Using InnoPhase Talaria TWO Smart Home Application

To test this sample application (`innoswitch_ble_provisionig.elf`), the companion `Innophase T2 Smart Home Android` application can be used from either an Android or iOS device.

1. To install, open the provided `.apk` file (*sdk_x.y\apps\ble_provisioning\mobile_app*) from the phone (Android or iOS).
   Note: x and y in sdk_x.y refer to the SDK release version.
2. To connect to the Talaria TWO BLE Server, wait for the application to complete the scanning and look for `Inno_Ble_WiFiProvisioning` and click on it.

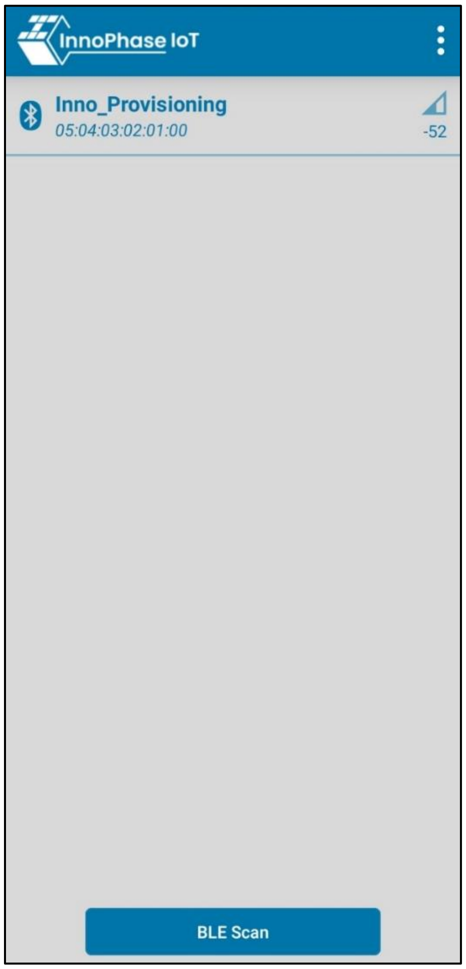
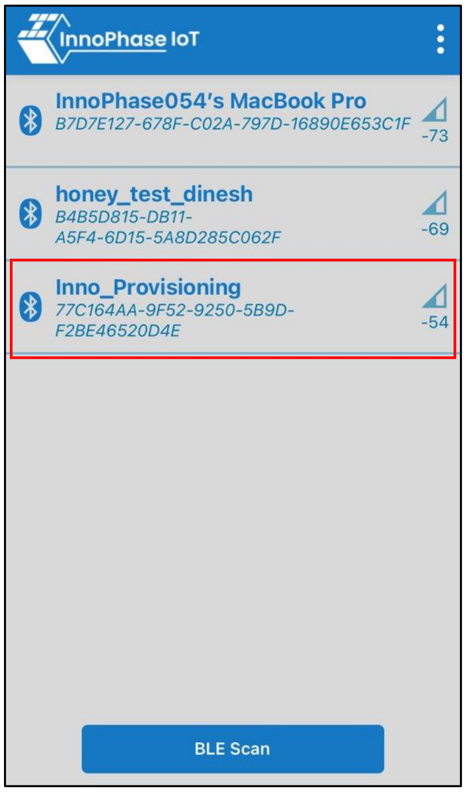


Figure 11: Android - Scanning for Talaria TWO BLE Server for Wi-Fi Provisioning



InnoPhase IoT

InnoPhase054's MacBook Pro
B7D7E127-678F-C02A-797D-16890E653C1F
-73

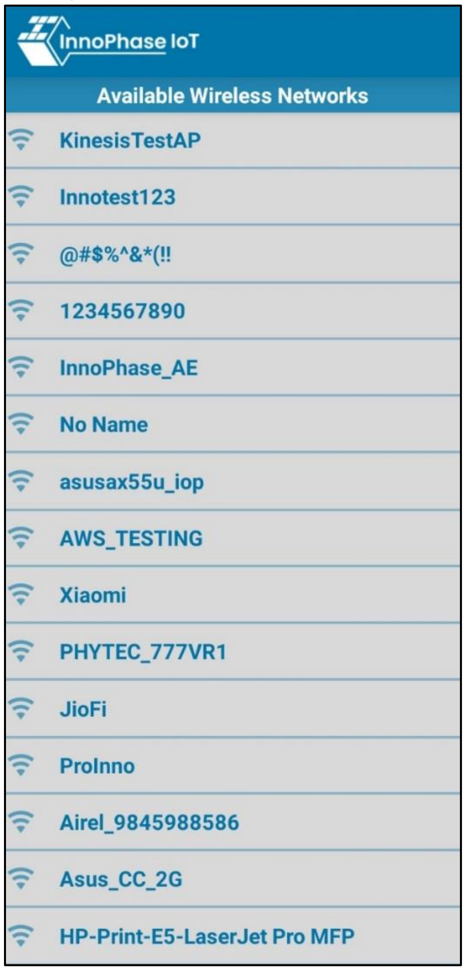
honey_test_dinesh
B4B5D815-DB11-A5F4-6D15-5A8D285C062F
-69

Inno_Provisioning
77C164AA-9F52-9250-5B9D-F2BE46520D4E
-54

Figure 12: iOS - Scanning for Talaria TWO BLE Server for Wi-Fi Provisioning

Android phone connects as a BLE Client to Talaria TWO device at this stage.

3. Android application scans for the nearby available Wi-Fi networks and displays them in a list view.



InnoPhase IoT

Available Wireless Networks

KinesisTestAP

Innotest123

@#$%^&*(!!

1234567890

InnoPhase_AE

No Name

asusax55u_iop

AWS_TESTING

Xiaomi

PHYTEC_777VR1

JioFi

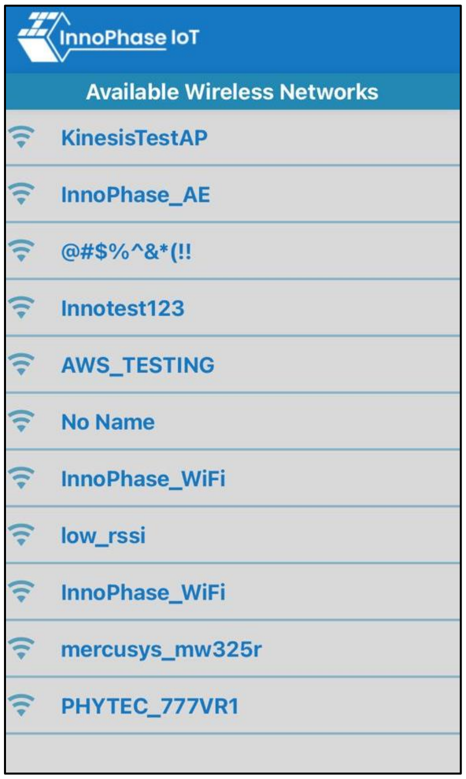
ProInno

Airel_9845988586

Asus_CC_2G

HP-Print-E5-LaserJet Pro MFP

Figure 13: Android - Available Wi-Fi networks as scanned by Android Phone



Available Wireless Networks

- KinesisTestAP
- InnoPhase_AE
- @#$%^&*(!!
- Innotest123
- AWS_TESTING
- No Name
- InnoPhase_WiFi
- low_rssi
- InnoPhase_WiFi
- mercusys_mw325r
- PHYTEC_777VR1

Figure 14: iOS - Available Wi-Fi networks as scanned by Android Phone

4. Select the SSID of the AP you want to connect to. A passphrase needs to be provided for the SSID.

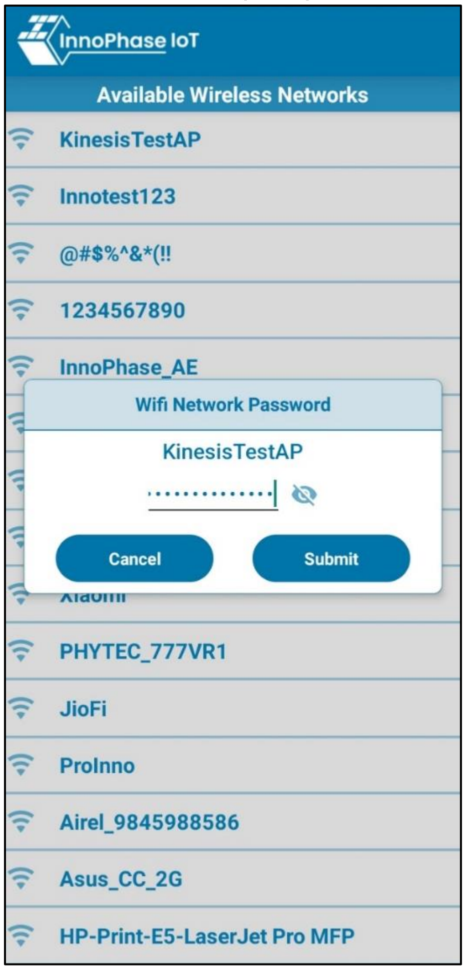


Figure 15: Android - Providing the passphrase

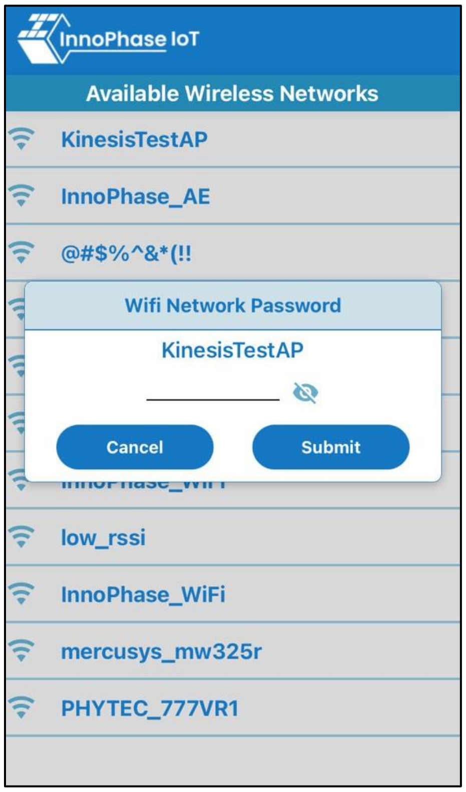
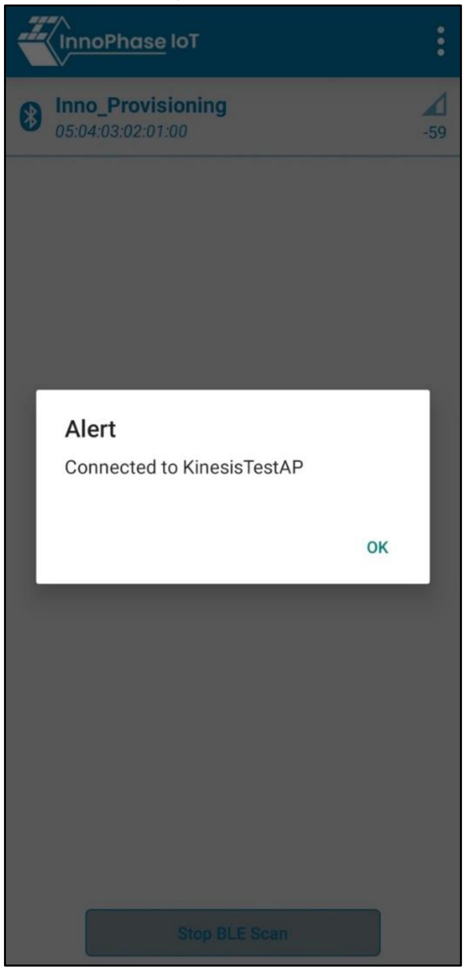


Figure 16: iOS - Providing the passphrase

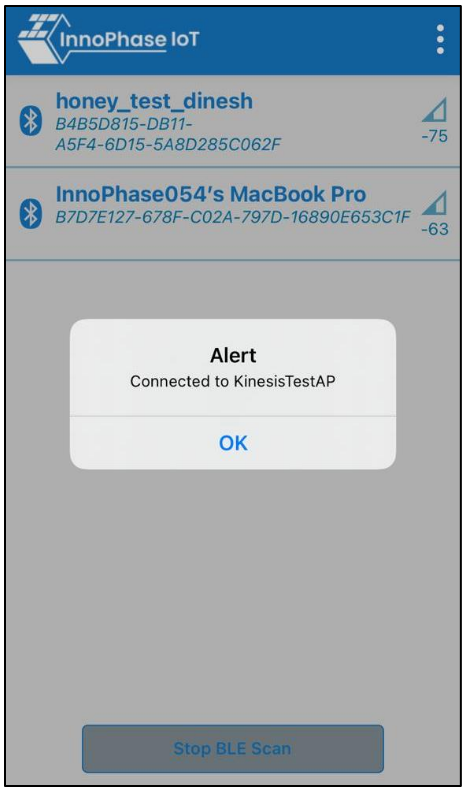
5. Once the passphrase is entered, click on Done. If the provided passphrase is correct, connection is established successfully. If not, an error message is shown.



Alert

Connected to KinesisTestAP

Figure 17: Android - Connecting successful

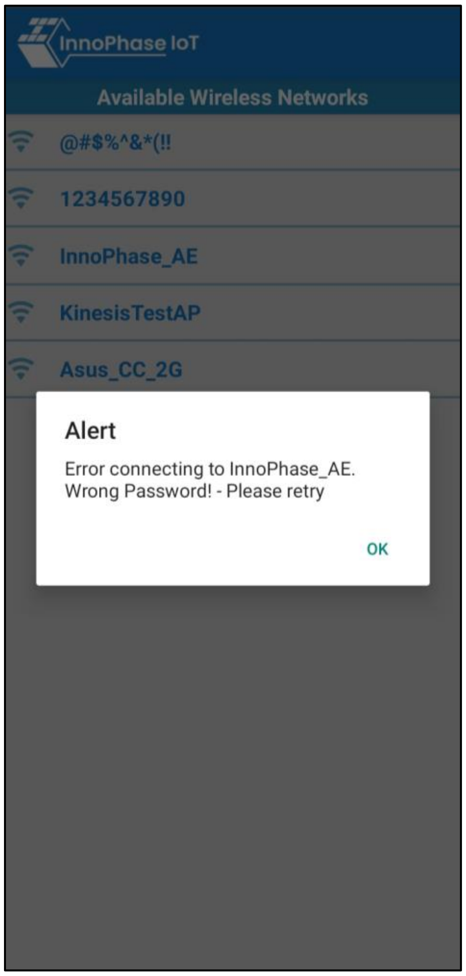

InnoPhase IoT
honey_test_dinesh
B4B5D815-DB11-A5F4-6D15-5A8D285C062F
-75
InnoPhase054's MacBook Pro
B7D7E127-678F-C02A-797D-16890E653C1F
-63
Stop BLE Scan

Alert

Connected to KinesisTestAP

OK

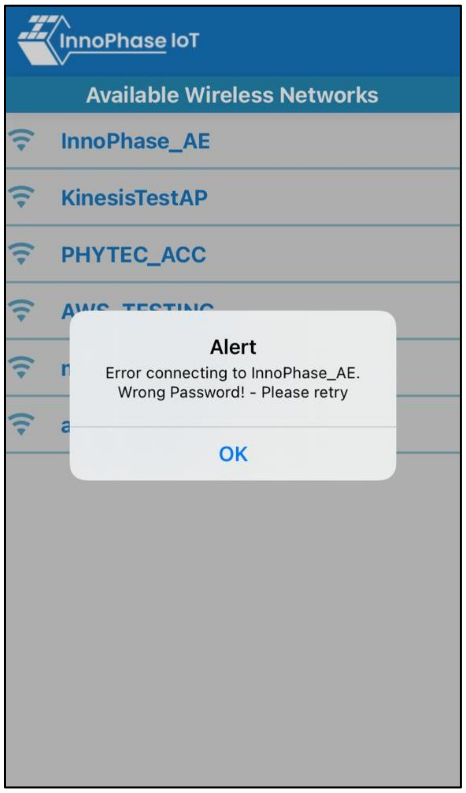
Figure 18: iOS - Connecting successful



Alert

Error connecting to InnoPhase_AE.
Wrong Password! - Please retry

Figure 19: Android - Error in connection



Alert

Error connecting to InnoPhase_AE. Wrong Password! - Please retry

Figure 20: iOS - Error in connection

6. On establishing the connection successfully, the android application should transfer the Wi-Fi credentials using custom GATT Service and Characteristics we created.

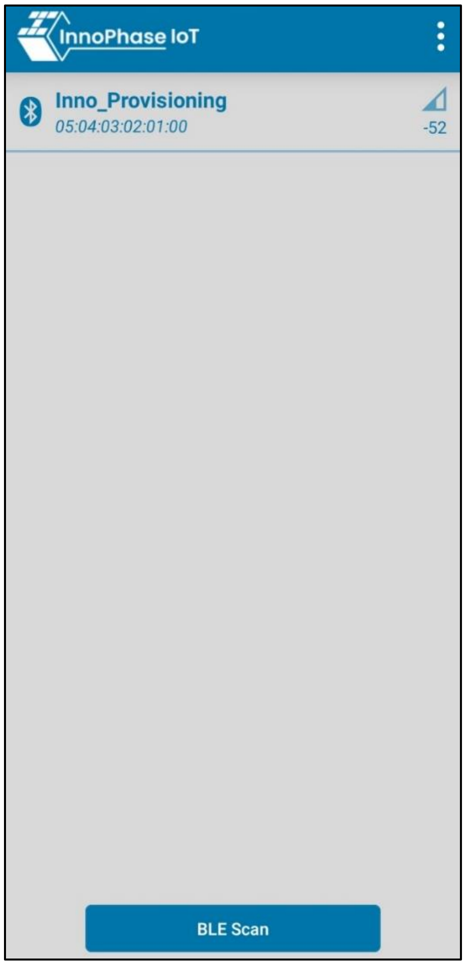


Figure 21: Android - Connection successful

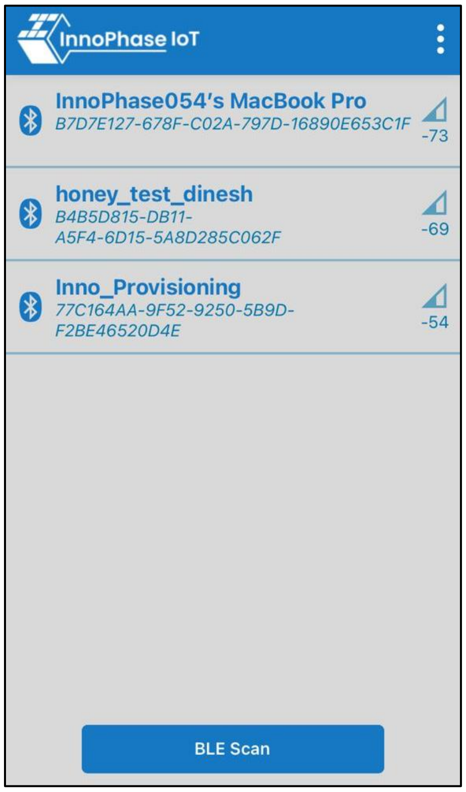

InnoPhase IoT
InnoPhase054's MacBook Pro
B7D7E127-678F-C02A-797D-16890E653C1F
-73
honey_test_dinesh
B4B5D815-DB11-A5F4-6D15-5A8D285C062F
-69
Inno_Provisioning
77C164AA-9F52-9250-5B9D-F2BE46520D4E
-54
BLE Scan

Figure 22: iOS - Connection successful

Talaria TWO will try to connect to the provisioned network and provide the following console output:

```
UART:SNWWWWWAEBuild $Id: git-65f6c1f46 $

aws_host=a3t0o11ohwlo2h-ats.iot.us-east-1.amazonaws.com aws_port=8883 suspend=1

no_mcast=< 1 thing_name=INNO_ENDPOINT_6GBTSRZ8

Inno_Ble_WiFiProvisioning started

[63.146,804] BT connect[0]: ia:60:4d:89:ec:f3:51 aa:05:04:03:02:01:00 phy2:0/0 phyC:00

Client connected

client reading status:waiting




WiFi Details  SSID: InnoPhase, PASSWORD: 43083191



addr e0:69:3a:00:13:90
```

```
client reading status:waiting

client reading status:waiting

Connecting to WiFi...

added network successfully, will try connecting..

connecting to network status: 0


 connection attempt timer started. current timein microseconds:[66337388]

[66.879,059] CONNECT:00:5f:67:cd:c5:a6 Channel:6 rssi:-32 dBm

wcm_notify_cb to App Layer - WCM_NOTIFY_MSG_LINK_UP

client reading status:waiting

wcm_notify_cb to App Layer - WCM_NOTIFY_MSG_ADDRESS

[67.638,187] MYIP 192.168.0.104

[67.638,466] IPv6 [fe80::e269:3aff:fe00:1390]-link

wcm_notify_cb to App Layer - WCM_NOTIFY_MSG_CONNECTED


 Cancelling the connection timeout timer. current timein microseconds:[67639064]

client reading status : success

status sent to phone app, now calling common_server_destroy and bt_gap_destroy

$App:git-cd11dc34

SDK Ver: SDK_2.4

Innoswitch Demo App

Mounting file system

read_certs() success

Shadow Connect


 Root Done[0]Loading the client cert. and key. size TLSDataParams:2080
 Loading the client cert done.... ret[0]

 Client pkey loaded[0]

  . Connecting to a3t0o11ohwlo2h-ats.iot.us-east-1.amazonaws.com/8883... ok

  . Setting up the SSL/TLS structure...  This certificate has no flags

  This certificate has no flags

  This certificate has no flags

SSL/TLS handshake. DONE ..ret:0

 ok

    [ Protocol is TLSv1.2 ]

    [ Ciphersuite is TLS-ECDHE-RSA-WITH-AES-128-GCM-SHA256 ]

    [ Record expansion is 29 ]

. Verifying peer X.509 certificate...

 ok

Shadow Connected

init_and_connect_aws_iot. ret:0

LED Off

Update Shadow: {"state":{"reported":{"powerState":"OFF"}},

"clientToken":"INNO_ENDPOINT_6GBTSRZ8-0"}

Delta - Switch state changed to ON

LED On

Update Shadow: {"state":{"reported":{"powerState":"ON"}},

"clientToken":"INNO_ENDPOINT_6GBTSRZ8-1"}

Update Accepted !!

Update Accepted !!
```

Jumper Setting in Talaria TWO EVB

This example uses GPIO 14 to toggle the LED D1. Ensure jumper J3 is installed which connects GPIO14 and LED.

Interacting the Talaria TWO EVB with Alexa

Inno Switch can be controlled either using Amazon's Alexa App installed in Android Phone or iOS Phone, or using the Alexa Voice Interactions with the Alexa speaker which is linked with User's Alexa account.

For testing with a Phone, go to the `Devices` -> `Switches` and refresh the page if the Inno Switch is not found here.

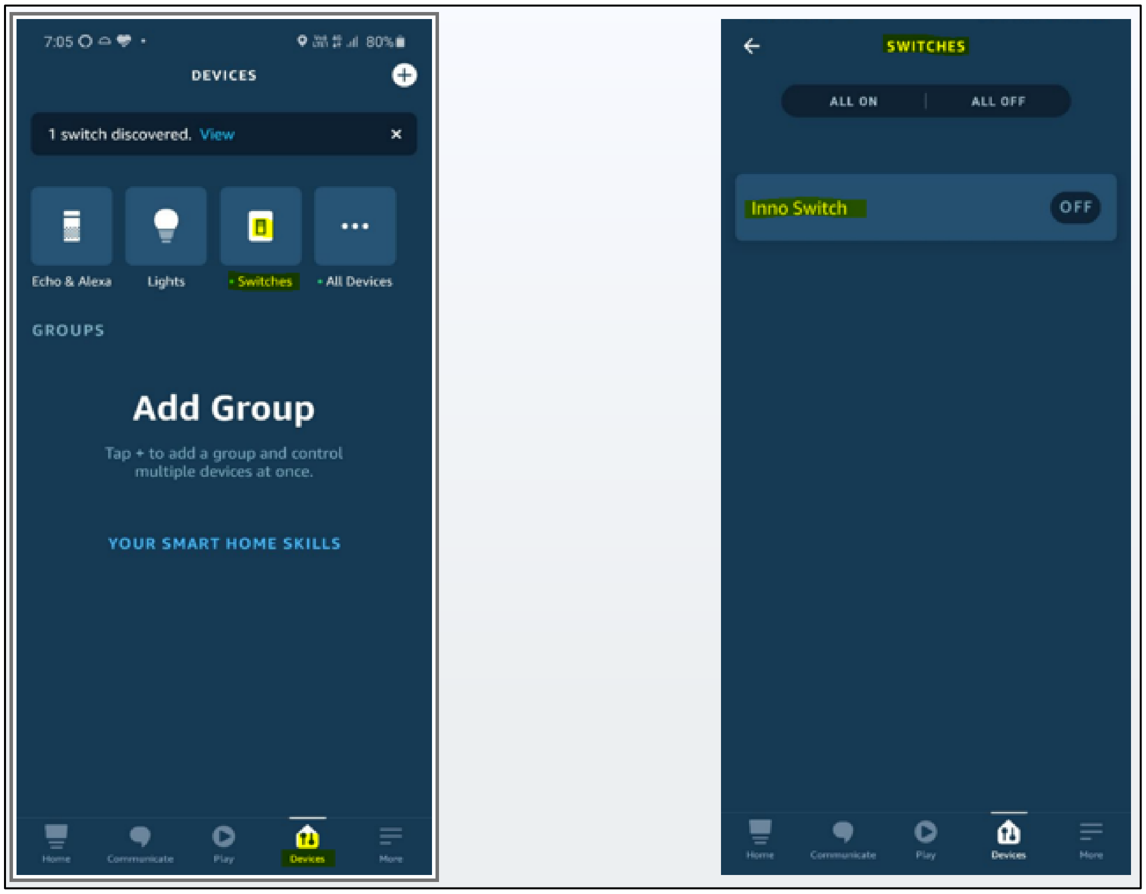


Figure 23: Devices – Switches -- InnoSwitch

Tap on `Inno Switch` to find power on/off control. The switch can be controlled from here by tapping on the Power Button, and the results will be reflected in LED status and Console of Talaria TWO EVB.

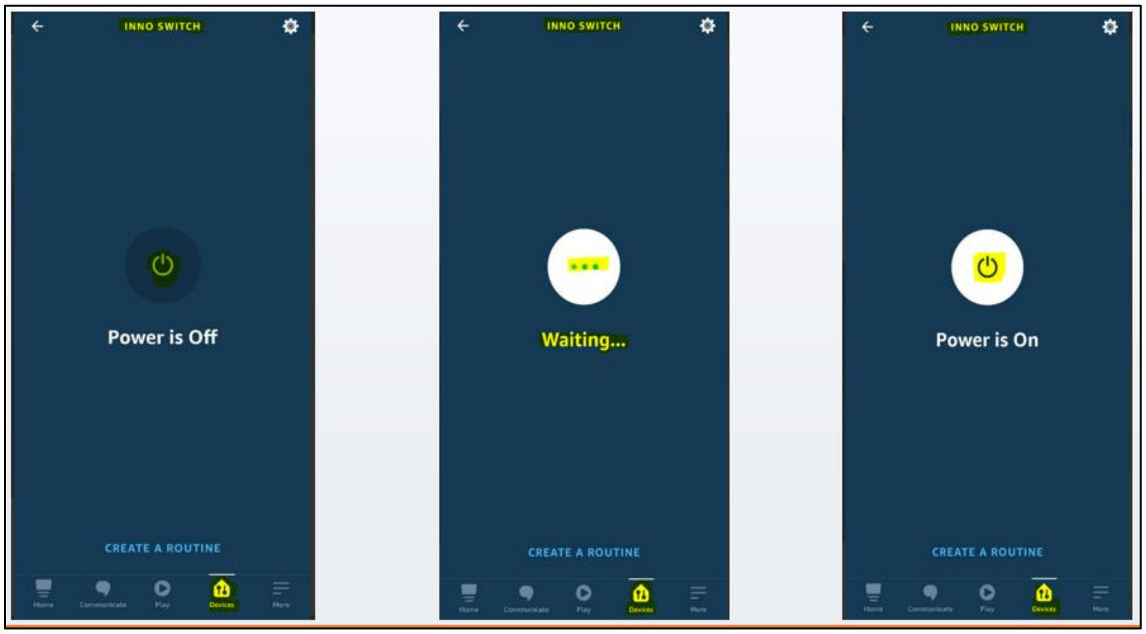


Figure 24: InnoSwitch power on-off control

Optionally, for controlling the device with Voice Interaction, you will need an Alexa enabled speaker (e.g., Amazon Echo) logged in with same Amazon Account.

Following voice commands are used to control the switch operation:

```
1. Alexa, turn on the Inno Switch
2. Alexa, turn off the Inno Switch
```

Console log while interacting with the device is as follows:

```
Y-BOOT 208ef13 2019-07-22 12:26:54 -0500 790da1-b-7

ROM yoda-h0-rom-16-0-gd5a8e586

FLASH:PNWWWWWAEBuild $Id: git-b664be2af $

aws_host=a3t0o11ohwlo2h-ats.iot.us-east-1.amazonaws.com aws_port=8883 suspend=1

no_mcast=< 1 thing_name=INNO_ENDPOINT_6GBTSRZ8

Inno_Ble_WiFiProvisioning started

[22.113,536] BT connect[0]: ia:7c:36:ff:b4:67:18 aa:05:04:03:02:01:00 phy2:0/0 phyC:00

Client connected

client reading status:waiting



WiFi Details  SSID:InnoPhase, PASSWORD: 43083191


addr e0:69:3a:00:2c:3e

client reading status:waiting

client reading status:waiting

Connecting to WiFi...

added network successfully, will try connecting..

connecting to network status: 0


 connection attempt timer started. current timein microseconds:[25293138]

[25.832,396] CONNECT:e8:48:b8:fb:35:70 Channel:6 rssi:-71 dBm

wcm_notify_cb to App Layer - WCM_NOTIFY_MSG_LINK_UP

client reading status:waiting

wcm_notify_cb to App Layer - WCM_NOTIFY_MSG_ADDRESS

[26.705,681] MYIP 192.168.0.116

[26.705,845] IPv6 [fe80::e269:3aff:fe00:2c3e]-link
```

```
wcm_notify_cb to App Layer - WCM_NOTIFY_MSG_CONNECTED


 Cancelling the connection timeout timer. current timein microseconds:[26706029]

client reading status : success

status sent to phone app, now calling common_server_destroy and bt_gap_destroy

$App:git-38ca4ab7

SDK Ver: SDK_2.4

Innoswitch Demo App

Mounting file system

read_certs() success

Shadow Connect


 Root Done[0]Loading the client cert. and key. size TLSDataParams:2080


 Loading the client cert done.... ret[0]

 Client pkey loaded[0]

   . Connecting to a3t0o11ohwlo2h-ats.iot.us-east-1.amazonaws.com/8883... ok

   . Setting up the SSL/TLS structure...  This certificate has no flags

  This certificate has no flags

  This certificate has no flags

SSL/TLS handshake. DONE ..ret:0

 ok

    [ Protocol is TLSv1.2 ]

    [ Ciphersuite is TLS-ECDHE-RSA-WITH-AES-128-GCM-SHA256 ]

    [ Record expansion is 29 ]

. Verifying peer X.509 certificate...

 ok
```

```
Shadow Connected

init_and_connect_aws_iot. ret:0

LED Off

Update Shadow: {"state":{"reported":{"powerState":"OFF"}},

"clientToken":"INNO_ENDPOINT_6GBTSRZ8-0"}

Update Accepted !!

Delta - Switch state changed to ON

LED On

Update Shadow: {"state":{"reported":{"powerState":"ON"}},

"clientToken":"INNO_ENDPOINT_6GBTSRZ8-1"}

Update Accepted !!

Delta - Switch state changed to OFF

LED Off

Update Shadow: {"state":{"reported":{"powerState":"OFF"}},

"clientToken":"INNO_ENDPOINT_6GBTSRZ8-2"}

Update Accepted !!

Delta - Switch state changed to ON

LED On

Update Shadow: {"state":{"reported":{"powerState":"ON"}},

"clientToken":"INNO_ENDPOINT_6GBTSRZ8-3"}

Update Accepted !!

Delta - Switch state changed to OFF

LED Off

Update Shadow: {"state":{"reported":{"powerState":"OFF"}},

"clientToken":"INNO_ENDPOINT_6GBTSRZ8-4"}

Update Accepted !!
```

Support

1. Sales Support: Contact an InnoPhase sales representative via email – sales@innophaseiot.com
2. Technical Support:
    a. Visit: https://innophaseiot.com/contact/
    b. Also Visit: https://innophaseiot.com/talaria-two-modules/
    c. Contact: support@innophaseiot.com

InnoPhase is working diligently to provide customers outstanding support to all customers.

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