Using This Guide

Conventions used in this Guide

This icon indicates a step that has a potential to be troublesome. Further information regarding items marked with this symbol can be found in troubleshooting (Appendix A).

This icon indicates a hint, or concept that is learned.

This icon indicates that a goal of the kit has been completed.

This icon indicates a warning of the potential for confusion or danger

Contact Information

Please always check the product specific section on the Digi support website for the most current version of this document: http://www.digi.com/support/

For more information about your Digi products, or for customer service and technical support, contact Digi International.

To Contact Digi International by	Use
FoMail	Digi International World Headquarters 11001 Bren Road East Minnetonka, MN 55343
Internet	http://www.digi.com/support
Telephone (US)	(952) 912-3444 or (877) 912-3444

Telephone (other locations)	+1(952) 912-3444 or (877)912-3444
Forum	http://forums.digi.com/support/forum/index
Knowledge Base	http://www.digi.com/support/kbase/

Introduction

Thank you for purchasing a Digi Smart Energy Kit. The purpose of this kit is to demonstrate the value of Digi's gateways and iDigi cloud-based software, teach you about Digi's ZigBee Smart Energy Framework and iDigi development tools, and make it easy for a developer to use those tools to create custom smart energy applications. You will refer to two documents as you use this kit:

Quick Start Guide (the printed guide that came with the kit): Guides you through the initial kit setup.

Getting Started Guide: (this document) A longer document available online that teaches you more about the underlying technology. The Getting Started Guide also includes an in-depth troubleshooting section.

Refer to [URL TBD] for more in-depth information about software development and commercialization with this technology.

Goals of this Kit

As you go through this kit, you will:

1. Understand how to set up an iDigi account and add a gateway.
2. Learn the basics of a ZigBee Smart Energy network and how to set one up using iDigi.
3. Understand ZigBee Cluster Library attributes and how to read/write attributes using iDigi.
4. Understand how to use iDigi's restful APIs to read/write attributes.
5. Understand how to create and deploy an app using the iDigi APIs.

Types of Kits

Digi offers 3 kinds of Smart Energy Kits for three different kinds of users:

Kit Type	What's in the box	Intended User
Smart Energy AMI Kit	- ConnectPort X2e in Router configuration - Smart plug	A person with access to a smart meter "talking" ZigBee Smart Energy.
Smart Energy AMR+ Kit	- ERT ZigBee SE Bridge - ConnectPort X2e in Coordinator configuration - Smart plug	A person with access to an ERT-based water, gas, or electric meter.
Smart Energy Developer Kit	- ConnectPort X2e in Coordinator configuration - Smart plug	A software developer or technical evaluator without access to a ZigBee SE or ERT meter.

Requirements for this Kit

System Requirements

- For PC users it is recommended that you have a Windows XP or newer. Any version older than Windows XP could be slow running the iDigi page.

Additional Requirements

- For testing your network, it is recommended that you have a smartphone (Android or iPhone), and that you install the Smartlee application on your smartphone. Smartleek can be found at the iTunes app store or at Google Play.

- A secure internet connection is also required in order to connect to the iDigi network. In this guide, it is assumed that you are on a network with only one ZigBee coordinator, which has been provided for you.

Goal 1: Set up an iDigi Account and Add a Gateway

Break Up Smartlee Network

1. If you followed the steps in the Quick Start Guide, you created a ZigBee Smart

Energy network. To accomplish Goal 1, we will disassemble, (or break up) this network and reasseble it using iDigi.

2. Go to www.livesmartlee.com and log into your account.
3. Click on "My Devices."

Gateway Name			Gateway ID		
ConnectPort X2			00409D 45EBB4		

Name	Type	Status	Total Consumption	Price
Electric Meter	Metering (Electric)	06/08/2012 03:18 PM	1441326	N/A
ERT/Smart Energy Bridge		Not Metered	N/A	
Device		Not Metered	N/A	

My Devices   My Account   My Apps   My Reports   My Data

4. Select all of the boxes next to your devices and click "Delete."

Select	Name	Type	Status	Unique Identifier
☐	Electric Meter	Metering (Electric)	06/08/2012 03:18 PM	00:13:A2:00:40:6B:8E:95-1
☐	ERT/Smart Energy Bridge		Not Metered	00:13:A2:00:40:6B:8E:95-94
☐	Device		Not Metered	00:24:46:00:00:06:71:1C-999

Add   Edit   Delete

5. This will take apart your Smartlee network so that you can re-build it in iDigi.

Create an Account

1. Go to https://developer.idigi.com/login.do.
2. If you have an account already, login. If not, click the green button on the right that says "Are you a new user?"

LOG IN TO iDIGI

User Name: [   ]

Password: [   ]

LOGIN

ARE YOU A NEW USER?

Forgot your user name or password?

3. Complete required fields and create an account

iDigi Registration

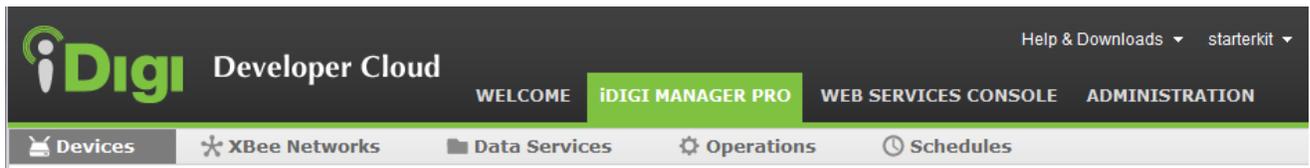|				
Company:	[ ] ⚠ *	Address:	[ ]	
First Name:	[ ] *			
Last Name:	[ ] *	City:	[ ]	
Email:	[ ] *	State:	[ ]	
Job Title:	[ ]	Postal Code:	[ ]	
Phone:	[ ]	Country:	United States ▼	

* Asterisk indicates required field.

Your privacy is important to us! We do not share your contact information with third parties. Privacy Policy

[Previous] [Next] [Cancel]

Adding a Gateway

1. Once you have completed creating your account, you will be taken to the iDigi Developer Cloud. On the navigation bar at the top of the page, select the "iDigi Manager Pro" tab.

iDigi Developer Cloud

Help & Downloads ▼   starterkit ▼

WELCOME   **iDIGI MANAGER PRO**   WEB SERVICES CONSOLE   ADMINISTRATION

🖥 Devices   ✳ XBee Networks   📁 Data Services   ⚙ Operations   🕐 Schedules

2. On the gray navigation bar below the main navigation bar, click on "Devices" on the far left side. (See picture above).
3. To add a device, click on the small blue plus sign that is above the MAC address field.

| MAC Address	Device ID	IP Address
00409D:521223	00409DFF-FF521223	10.8.16.11

4. To have iDigi find any local devices on your network, click the "Discover" button

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on the right side of the window. If this method fails to find your device, click on the "Add Manually >>" button at the bottom right-hand corner.

a. You can find the device using the MAC Address, the IMEI number, or the device ID, whatever your device has available.

b. If this doesn't work, make sure your device is connected to the internet and check to make sure your internet is working properly. *Note: If there are lights flashing by the Ethernet port, then the device is connected to the internet.*
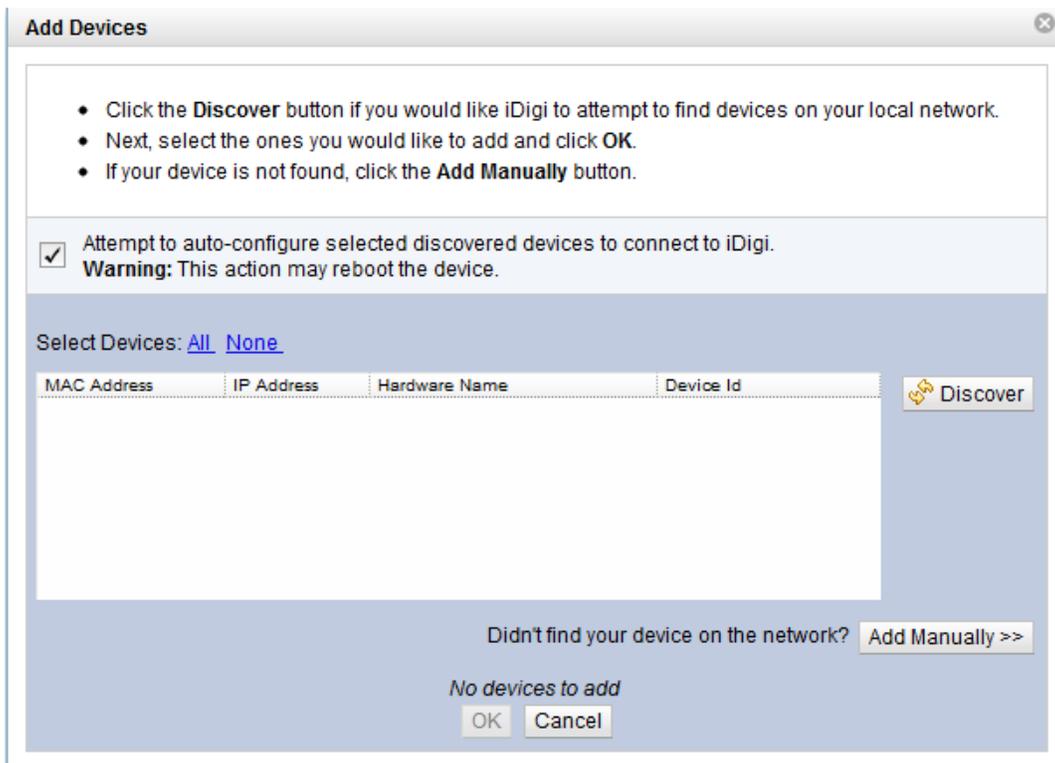
5. Once you find your device, click on it. A green message will appear at the top of the web page to let you know the device was added successfully.

Quick Overview of the iDigi Cloud Page

1. On the gray navigation bar, we have "Devices," "XBee Networks," "Data Services," "Operations," and "Schedules,"

| MAC Address	Device ID	IP Address	Device Type	Description	Status	Firmware Level	User Meta Data
00409D:458861	00409DFF-FF458861	10.8.16.106	ConnectPort X2		Connected	2.14.0.3	
00409D:485911	00409DFF-FF485911	10.8.16.108	ERT/Ethernet Gateway		Disconnected	2.13.0.10	
00409D:441BA4	00409DFF-FF441BA4	10.8.127.44	ConnectPort X4	...	Disconnected	...	
00409D:508716	00409DFF-FF508716	10.86.65.205	ConnectPort X4		Disconnected	2.13.0.12	

a. Devices allows you to add and manage devices

b. XBee Networks allows you to look at and manage the available XBee devices on your network (ex. Routers, Coordinators, etc.).

c. Data Services allows for device-specific storage

d. Operations shows the operations that are currently running, have been completed, or failed. You can also view details about the operations.

e. Schedules allows you to schedule tasks to happen automatically at a desired time

2. Next to the iDigi Manager Pro, there is the Web Services Console
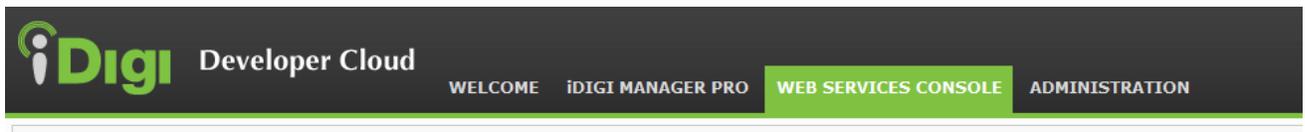
a. This allows you to run commands on your devices. You can perform any iDigi Web Service request and view the response data.

b. For more information about using the Web Services Console, click "Help & Downloads" at the top right corner of the page and select "Documentation." On the page that comes up, click "iDigi Web Services Programming Guide."

3. Next to the Web Services Console, there is the Administration tab
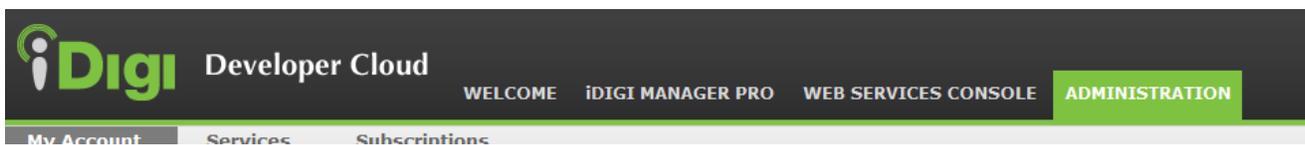
a. Allows you to change your account information, password, and register for a new vendor id in the "My Account" section.

b. "Services" shows a history of your transactions, devices, and messages.

c. "Subscriptions" shows what type of services you are subscribed to and when you will have to pay for them (if applicable).

Congratulations, you've accomplished Goal #1 : Set up an iDigi account and add a gateway"

Goal 2: Learn the Basics of a ZigBee Smart Energy Network

For full details on the ZigBee Smart Energy Network, refer to the AMI Profile Specification. Note: This specification is provided by the ZigBee Alliance and requires registration to access.

The ZigBee Network

The ZigBee Smart Energy Network has a mesh network setup. This setup allows any part of the network to talk to any other part without having to use the Coordinator as a switchboard. Each device not only handles it own data, but also acts as a router through which other devices can talk. Basically, a mesh network creates a direct link between each device on a network, or a link through another device if a device is too far away for a direct connection to be established.

ZigBee Coordinators

The ZigBee Coordinators **(also called "gateways" by Smartlee)** are the central piece of the Smart Energy Network. They coordinate all of the devices on the network to work within the same time, they set up and enforce the security standards for the network, and they act as the starting point to get to any device on the network. Smart meters are usually set up as the coordinator of the ZigBee SE network.

ZigBee Routers

The ZigBee Routers can be used to extend the reach of the network run by the ZigBee Coordinator. They are useful for an implementation of the Smart Energy network with a large number of devices and networks with devices that are spread out.

Devices

Devices controlled by ZigBee have three different components, which are unique depending on the device. To illustrate how a ZigBee device is laid out, let's use the

example of the SafePlug, which is included in this kit.

Endpoint

A device can have a single or multiple endpoints. In the case of the SafePlug, there are two endpoints, one endpoint for each outlet. Although these two outlets are a part of the same device, they each have their own operations that are independent from each other.

Cluster

A cluster is essentially a collection of functionality. An endpoint can have single or multiple clusters. There are often two common clusters in our network layout, a server cluster and a client cluster. The server cluster controls the endpoint and sends data to the client cluster, while the client cluster sends commands to the server cluster to get data. To put it simply, a client cluster sends commands and a server cluster receives and performs those commands.

- For our SafePlug, we can have a server cluster that controls the plug with commands like On/Off. Our SafePlug can also sends information, such as how much energy is being consumed by an endpoint at a certain time, using the server cluster.
- In the network setup with our SafePlug, the ConnectPort X2e would have a client cluster that sends commands to the server cluster on the SafePlug.

For more information about using ZigBee clusters and common clusters, refer to the ZigBee Cluster Library Specification (Note: This specification is provided by the ZigBee Alliance and requires registration to access.)
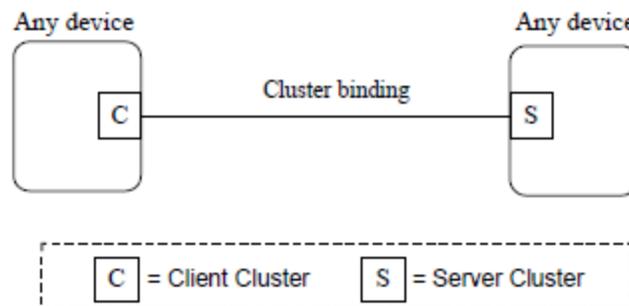
Attributes

These are individual data points inside the clusters. Clusters can have one or many different attributes. For our SafePlug, an attribute could be an On/Off

attribute. These attributes would exist in a server cluster. We could also have attributes for reading data or sending data to the user, which would exist in the client cluster. In our example, we could have attributes for current or voltage going through the plug.

Setting up a network

The ZigBee Coordinator must be connected to the iDigi cloud in order for the wireless network to be set up. The iDigi Cloud allows the user to communicate with the devices on their network. The cloud can send commands to the ZigBee network coordinator which in turn sends commands to the devices. The user can also get data from the devices through the cloud. A device can also send the data and store it on the cloud, which the user can then access and use in a variety of applications.

If you have an AMI Quick Start Kit, then it is assumed that you have a Smart Meter that can speak to the ZigBee Smart Energy Network. This will be the coordinator for your network. If you have trouble adding your ConnectPort X2e router to your existing Smart Energy network, refer to documentation for your Smart Meter or contact the company that created your Smart Meter for more information.

Joining a network

When the ZigBee Coordinator is set in open join mode, any device can be marked as a discovered device and can attempt to join the network. Once a device has been added to the network, it can rejoin the network at any time.

Setting Up a Smart Energy Network Using iDigi

1. Before beginning the process of establishing the Smart Energy network, you should write down both the installation code and the device ID (or MAC address) of the devices that you are trying to add to the network.
2. Go to www.idigi.com and sign into your account. If you have not added a gateway to your account yet, go back to goal 1.
3. Go to the "Web Services Console" on the top navigation bar.
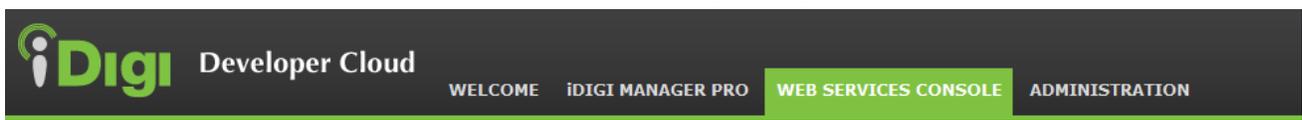
4. Make sure the Path field, located at the top of the page on the left, says "/ws/sci". For the HTTP method, click "Post".

Path:
/ws/sci

HTTP Method: ○ GET ● POST ○ PUT ○ DELETE ○ HEAD

5. To add a device, you will use "add_device." Type in the following code, replacing the blue highlighted text with your Gateway's ID (which you can get on the iDigi Manager Pro page), the orange highlighted text with your device ID type, the green highlighted text with your device ID (make sure to put colons after every two numbers), and the yellow highlighted text with your installation code.

```
<sci_request version="1.0" >
  <send_message cache="false" >
    <targets>
      <device id="00000000-00000000-00409DFF-FF012345" />
    </targets>
    <rci_request version="1.1" >
      <do_command target="RPC_request" >
        <add_device synchronous="true" >
          <device_address type="MAC" >
                    00:00:00:00:00:00:00:00
          </device_address>
          <join_time>
                    0x100
          </join_time>
          <installation_code type="string" >
                    ABC123ABC123ABC1
          </installation_code>
        </add_device>
      </do_command>
    </rci_request>
  </send_message>
</sci_request>
```

6. Click the "Send" button at the top of the page.

SCI Targets   Examples ▾   Export ▾   ▶ Send   ✖ Clear

7. If done correctly, you will get a response back.

```
<sci_reply version="1.0" >
  <send_message>
    <device id="00000000-00000000-00409DFF-FF012345" >
      <rci_reply version="1.1" >
        <do_command target="RPC_request" >
          <responses
            remaining="1"
            timestamp="1339686141.33" >
            <add_device_response timestamp="1339686141" >
              <device_address type="MAC" >
                  00:00:00:00:00:00:00:00
              </device_address>
              <join_time type="int" >
                  0x100
              </join_time>
            </add_device_response>
          </responses>
        </do_command>
      </rci_reply>
    </device>
  </send_message>
</sci_reply>
```
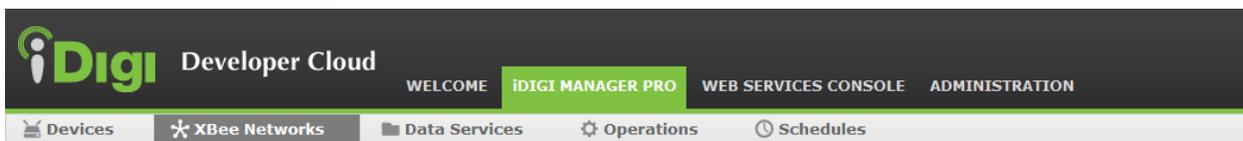
8. To check that your device was successfully added, click on "iDigi Manager Pro" and select "XBee Networks". If your device was added to your network, you will see it on this page.

9. If the device is not added to the network, make sure that your device is not a member of any other network, including the Smartlee network that you created in the Quick Start Guide.

10. If you have a device on your network that you would like to remove, you will call remove_device. As with add_device, you will go to the Web Services console, confirm that the Path field is "/ws/sci" and make the HTTP method "Post". Then, you will modify this code.

```
<sci_request version="1.0" >
  <send_message cache="false" >
```

```
    <targets>
      <device id="00000000-00000000-00409DFF-FF012345" />
    </targets>
    <rci_request version="1.1" >
      <do_command target="RPC_request" >
        <remove_device synchronous="true" >
          <device_address type="MAC" >
                    00:00:00:00:00:00:00:00
          </device_address>
        </remove_device>
      </do_command>
    </rci_request>
  </send_message>
</sci_request>
```

As before, the blue text will be replaced with your Gateway's ID, the orange text with

your device address type, and the green text with your device's address.

11. If the command is executed properly, you will get a reply back.

```
<sci_reply version="1.0" >
  <send_message>
    <device id="00000000-00000000-00409DFF-FF012345" >
      <rci_reply version="1.1" >
        <do_command target="RPC_request" >
          <responses
            remaining="1"
            timestamp="1339686141.53" >
            <remove_device_response timestamp="1339686141" >
              <device_address type="MAC" >
                    00:00:00:00:00:00:00:00
              </device_address>
              <join_time type="int" >
                    0x100
              </join_time>
            </remove_device_response>
          </responses>
        </do_command>
      </rci_reply>
    </device>
  </send_message>
```

```
</sci_reply>
```

12. If you go to "iDigi Manager Pro" and click "XBee Networks," the device that you removed will not appear and is no longer on the network.
Note: All code used above is XML.

Adding An ERT Meter

1. If you have the AMR+ Starter Kit, then you have an ERT Meter. To add your ERT/Smart Energy Bridge to your network, follow the steps in the "Setting Up a ZigBee Network Using iDigi" section above.
2. To add an ERT meter (which is recognized as an endpoint to your ERT/Smart Energy Bridge), first navigate to www.idigi.com and go to the "Web Services Console" tab.
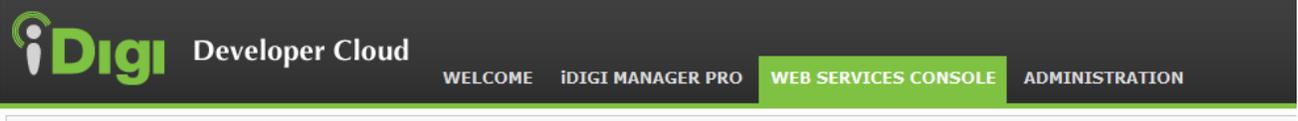
3. Make sure the Path field, located at the top of the page on the left, says "/ws/sci". For the HTTP method, click "Post".

4. To add an ERT Meter, you will use "configure_ert_meter". Replace the blue text with your Gateway's device ID, the green text with your ERT/Smart Energy Bridge MAC address, the pink text with your ERT meter's type (the first two digits of the number on your ERT meter, consult your Quick Start Guide for more details), and the yellow text with your ERT meter's ID.

```
<sci_request version="1.0" >
  <send_message cache="false" >
    <targets>
      <device id="00000000-00000000-00409DFF-FF012345" />
    </targets>
    <rci_request version="1.1" >
      <do_command target="RPC_request" >
        <configure_ert_meter synchronous="true" >
          <destination_address type="MAC" >
            00:00:00:00:00:00:00:00
```

```
                </destination_address>
                <source_endpoint_id>
                        0x5E
                </source_endpoint_id>
                <destination_endpoint_id>
                        0x5E
                </destination_endpoint_id>
                <record type="ERTConfigurationRecord" >
                  <ert_type type="int" >
                        07
                  </ert_type>
                  <ert_id type="int" >
                        12345678
                  </ert_id>
                  <unit_of_measure type="int" >
                        0x2
                  </unit_of_measure>
                  <divisor type="int" >
                        0x1
                  </divisor>
                  <summation_formatting type="int" >
                        0xB
                  </summation_formatting>
                  <multiplier type="int" >
                        0x2
                  </multiplier>
                  <metering_device_type type="int" >
                        0x1
                  </metering_device_type>
                </record>
              </configure_ert_meter>
            </do_command>
         </rci_request>
      </send_message>
   </sci_request>
```

5. Click the "Send" button at the top of the page.

> SCI Targets 📄 Examples ▾ 🗐 Export ▾ ▶ Send ✖ Clear

6. You should get a response like this:

```
<sci_reply version="1.0" >
  <send_message>
    <device id="00000000-00000000-00409DFF-FF012345" >
      <rci_reply version="1.1" >
        <do_command target="RPC_request" >
```

```xml
            <responses
              remaining="0"
              timestamp="1340127646.01" >
              <configure_ert_meter_response timestamp="1340127645" >
                <source_endpoint_id type="int" >
                        0x5E
                </source_endpoint_id>
                <destination_endpoint_id type="int" >
                        0x5E
                </destination_endpoint_id>
                <source_address type="MAC" >
                        00:00:00:00:00:00:00:00
                </source_address>
                <verify_status type="int" >
                        0x0
                </verify_status>
                <record type="ERTEndpointResponseRecord" >
                  <ert_id type="int" >
                        0x11B7302
                  </ert_id>
                  <ert_type type="int" >
                        0x7
                  </ert_type>
                  <endpoint_id type="int" >
                        0x1
                  </endpoint_id>
                </record>
              </configure_ert_meter_response>
            </responses>
          </do_command>
        </rci_reply>
      </device>
    </send_message>
</sci_reply>
```
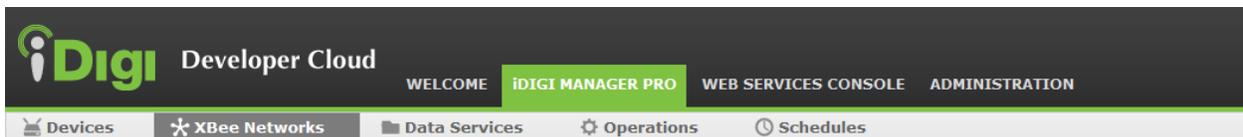
7. To check that your device was successfully added, click on "iDigi Manager Pro" and select "XBee Networks".

8. Find your ERT/Smart Energy Bridge on this page and double click on it. You should see in the left panel different endpoints. If you have a "Metering Device" as an endpoint, then you have successfully added your ERT Meter to your network.

Endpoint 0x1 - Metering Device
Endpoint 0x2 - Metering Device
Endpoint 0x5E - Range Extender
Endpoint 0xE8 - Unknown Device ID

9. If you have an ERT Meter on your network that you would like to remove, you will call "remove_ert_meter". As with configure_ert_meter, you will go to the Web Services console, confirm that the Path field is "/ws/sci" and make the HTTP method "Post". Then, you will modify this code.

```
<sci_request version="1.0" >
  <send_message cache="false" >
    <targets>
      <device id="00000000-00000000-00409DFF-FF012345" />
    </targets>
    <rci_request version="1.1" >
      <do_command target="RPC_request" >
        <remove_ert_meter synchronous="true" >
          <destination_address type="MAC" >
                  00:00:00:00:00:00:00:00
          </destination_address>
          <source_endpoint_id>
                  0x5E
          </source_endpoint_id>
          <destination_endpoint_id>
                  0x5E
          </destination_endpoint_id>
          <record type="RemoveERTMeterRequestRecord" >
            <ert_type type="int" >
                  07
            </ert_type>
            <ert_id type="int" >
                  12345678
            </ert_id>
          </record>
        </remove_ert_meter>
      </do_command>
    </rci_request>
  </send_message>
</sci_request>
```

Once again, the blue text is the Gateway's device ID, the green is the ERT/Smart Energy Bridge's MAC address, the pink is the ERT Meter type and the yellow is the

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ERT Meter ID.

10. You will get a response like this.

```
<sci_reply version="1.0" >
  <send_message>
    <device id="00000000-00000000-00409DFF-FF012345" >
      <rci_reply version="1.1" >
        <do_command target="RPC_request" >
          <responses
            remaining="0"
            timestamp="1340128706.47" >
            <remove_ert_meter_response timestamp="1340128706" >
              <source_endpoint_id type="int" >
                    0x5E
              </source_endpoint_id>
              <destination_endpoint_id type="int" >
                    0x5E
              </destination_endpoint_id>
              <source_address type="MAC" >
                    00:00:00:00:00:00:00:00
              </source_address>
              <verify_status type="int" >
                    0x0
              </verify_status>
              <record type="RemoveERTMeterRequestRecord" >
                <ert_id type="int" >
                    0x11B7302
                </ert_id>
                <ert_type type="int" >
                    0x7
                </ert_type>
              </record>
            </remove_ert_meter_response>
          </responses>
        </do_command>
      </rci_reply>
    </device>
  </send_message>
</sci_reply>
```

11. If you go to "iDigi Manager Pro," click "XBee Networks," and double click on your ERT/Smart Energy Bridge, your ERT meter will no longer appear as an endpoint.

Congratulations, you've accomplished Goal 2: Learning

the basics of a ZigBee Smart Energy network and how to set one up using iDigi.

# Goal 3: Understanding the ZigBee Cluster Library and Reading/Writing Attributes

The ZigBee cluster library (or ZCL) is a library of clusters and corresponding commands to manipulate them. The ZCL is an abstraction which gives users the ability to easily work with ZigBee clusters on their devices. It further allows ZigBee profiles to be developed with more of an object-oriented style approach. The iDigi commands often incorporate the ZCL in them relieving the user of having to dive down into the ZCL layer. In this section we will show how to manipulate ZigBee attributes using raw ZCL commands by directly talking to the device.

Manipulating Attributes Using the ZCL

Generally, when working within iDigi, you should use iDigi's restful APIs (see Goal 4) because they are faster,easier and provide error checking for you. However, in developing an application, you may want to use the ZigBee Cluster Library. In order for you to get a basic understanding of the ZigBee Cluster Library, we will go through the example of toggling the safeplug meter on and off using a raw ZCL command.

1. Go to www.idigi.com and sign in to your account.
2. Go to the "Web Services Console."
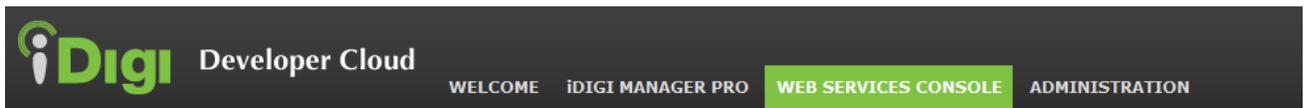
3. Make sure your "Path" is wsi/sci and select "Post" for your HTTP command.

4. Enter the following XML code, modifying the blue highlighted part with your

Gateway's ID, the green part with your SafePlug's MAC address, the yellow part with your gateway's endpoint id, and the pink highlighted part with the destination endpoint id of the SafePlug outlet that you want to toggle (normally, this is 0xB or 0xC).

```xml
<sci_request version="1.0">
 <send_message>
  <targets>
   <device id="00000000-00000000-00409DFF-FF012345"/>
  </targets>
  <rci_request version="1.1">
   <do_command target="RPC_request">
    <send_ZCL synchronous="true">
     <destination_address type="MAC">00:00:00:00:00:00:00:00</destination_address>
     <source_endpoint_id>0x5E</source_endpoint_id>
     <destination_endpoint_id>0xB</destination_endpoint_id>
     <cluster_id>0x6</cluster_id>
         <server_or_client>0</server_or_client>
     <disable_default_response type="bool">false</disable_default_response>
     <command_identifier>0x02</command_identifier>
     <command_type>1</command_type>
     <payload type="base16">1E00</payload>
    </send_ZCL>
   </do_command>
  </rci_request>
 </send_message>
</sci_request>
```

5. Click the send button.

    SCI Targets   Examples ▾   Export ▾   ▶ Send   ✘ Clear

6. Your SafePlug outlet should turn on or off, depending on if it was initially off or on. If this happens, then you have successfully used a command in the ZCL.

Lets look at the different parts of this code:

First we supply the Gateway_ID and the MAC address of the SafePlug. We then specify that we are going to do an RPC_request with a ZCL command. We further specify the Energy Endpoint of the gateway with <source_endpoint_id> and the SafePlug specific meter's endpoint with <destination_endpoint_id>. Within the specified endpoint we locate the On/Off cluster, in our case 0x6. And we execute the ZCL Toggle command, 0x02, with <command_identifier>. This command will be sent to the device and let it know that it should execute a toggle request.

To get more information about the ZigBee Cluster Library and to gain access to the ZigBee

Cluster Library documentation, register for the ZigBee Alliance at http://www.zigbee.org/. The main documents you will be interested in are the Zigbee Cluster Library (ZCL) Specification and the Zigbee Smart Energy Profile Specification.

 Congratulations, you've accomplished Goal 3: Understanding the ZigBee Cluster Library and Reading/Writing Attributes

# Goal 4: Understanding How to Use iDigi's Restful APIs to Read Attributes

iDigi has implemented many of the common ZCL calls to provide you with an easy way of working with your ZigBee devices. Digi recommends using iDigi calls as they are easier to write, understand, are faster, and do much of the error handling for you.

Reading Attributes

1. Navigate to the 'XBee Networks' view, and locate the device you wish to read the attributes of, in this case a SafePlug.
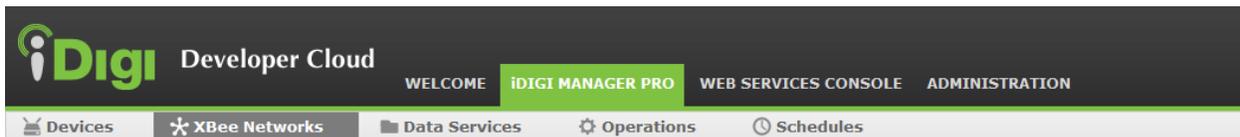
2. In the other window, navigate to the Web Services Console.
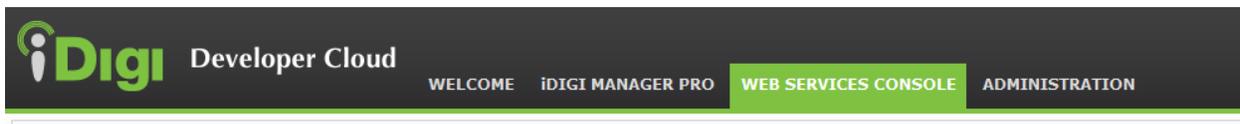
3. This time, we will be using Smart Energy calls instead of ZCL requests. Under examples, go to Smart Energy -> XbeeAttributeDataCore -> List Attribute Data. You will notice that this time, instead of "/ws/sci", the path reads "/ws/XbeeAttributeDataCore"
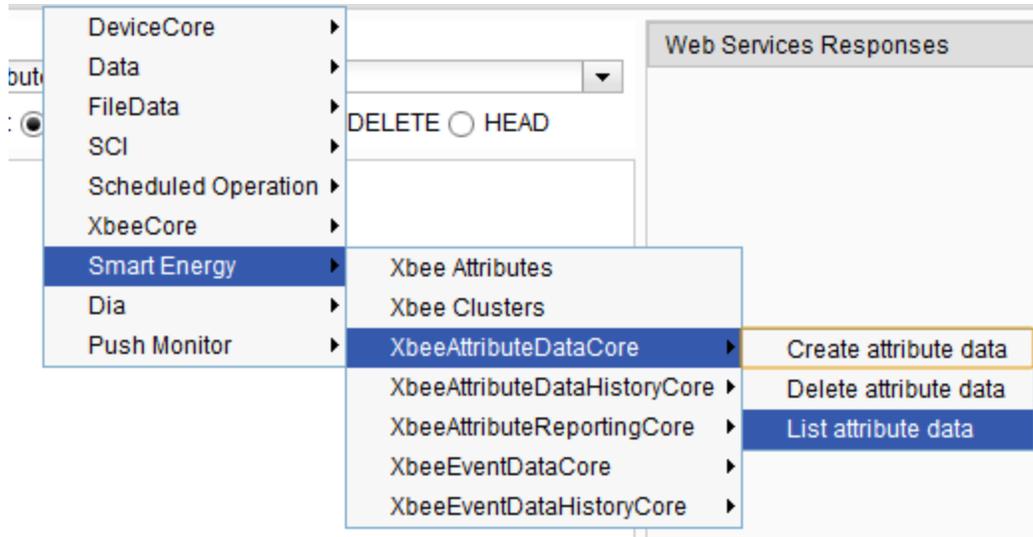
4. Right now, if you send this 'GET' request, it will respond with all of the attributes for all of your devices. However, to filter the attributes of the SafePlug we specify restrictions (found on the bottom right corner) in the format below:

```
/ws/XbeeAttributeDataCore?condition= identifier = value and identifier = value and....
and identifier = value
```
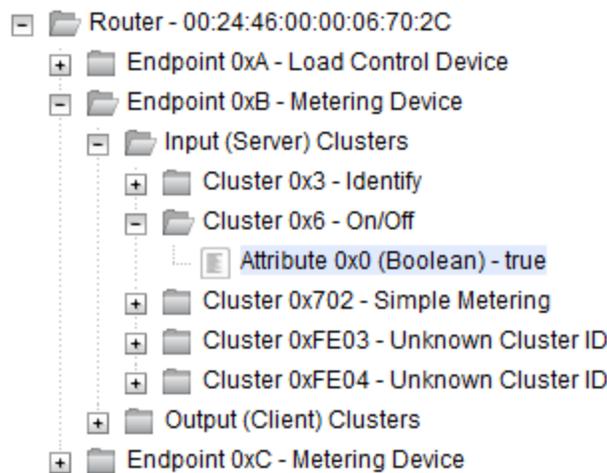
5. Let's narrow the request down to just your SafePlug. Locate its extended address in your first window under XBee Networks. Use the 'xpExtAddr' keyword to add the external address identifier. Your path should now look something like this:

```
/ws/XbeeAttributeDataCore?condition=xpExtAddr='00:00:00:00:00:00:00:00'
```

6. Try sending the request. You will see that the response is still an overwhelming amount of data, but all of the <xpExtAddr> fields in the response match your device. You have now successfully read the attributes of your SafePlug.
7. Now we will narrow it down further into something more useable: the on/off status of one of the sockets.The first step is to find the identifiers related to the cluster we want to examine. Return to your XBee Networks window, and double click on the SafePlug. You will be brought to a navigation view of that device. In this view, you will see a few endpoints, two of which are labelled as 'Metering Devices,' one for each socket of the safeplug. Expand one of these 'Metering Devices'.

	Devices	⚹ XBee Networks	📁 Data Services	⚙ Operations	🕐 Schedules

Extended Address	Gateway Device ID	Module Type	Product Type	Type	Role
((ᵖ)) 00:13:A2:00:40:6B:8A:FF	00409DFF-FF5212A6	Smart Energy			Unknown
⟜ 00:13:A2:00:40:6B:93:81	00409DFF-FF5212A6	Smart Energy		0xa001a	Coordinator
((ᵖ)) 00:13:A2:00:40:6B:8B:00	00409DFF-FF5212A6	Smart Energy			Router
((ᵖ)) 00:24:46:00:00:06:71:1C	00409DFF-FF5212A6	Smart Energy			Router

8. At this point you should see two more folders - input and output clusters. Open up the input clusters, then find and open the cluster labelled 'On/Off. Select the boolean attribute there.

> Router - 00:24:46:00:00:06:70:2C
> > ⊞ Endpoint 0xA - Load Control Device
> > ⊟ Endpoint 0xB - Metering Device
> > > ⊟ Input (Server) Clusters
> > > > ⊞ Cluster 0x3 - Identify
> > > > ⊟ Cluster 0x6 - On/Off
> > > > > Attribute 0x0 (Boolean) - true
> > > > ⊞ Cluster 0x702 - Simple Metering
> > > > ⊞ Cluster 0xFE03 - Unknown Cluster ID
> > > > ⊞ Cluster 0xFE04 - Unknown Cluster ID
> > > ⊞ Output (Client) Clusters
> > ⊞ Endpoint 0xC - Metering Device

9. The attribute you just found, as you probably deduced, is the on/off attribute for one of the sockets on your SafePlug. At the bottom, the 'attribute value' lets you know the current state of the plug.

Endpoint 0xB - Metering Device

Profile ID: 0x109
Device ID: 0x501 (Metering Device)
Device Version: 0x0

Cluster 0x6 - On/Off

Cluster ID: 0x6 (On/Off)
Cluster Type: Server

Attribute 0x0 (Boolean) - true

Attribute ID: 0x0
Attribute Type: 0x10 (Boolean)
Attribute Value: true

[Read Attribute]
[Write Attribute]

10. Go back to the Web Services Console and add more constraints to your request.

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At the end of this, your path should have an external address, an endpoint ID, a cluster ID, and an attribute ID added to it. Your final path will look similar to this:

```
/ws/XbeeAttributeDataCore?condition=xpExtAddr = '00:24:46:00:00:06:70:2C' and
xeEndpointId = 11 and xcClusterId = 6 and xaAttributeId = 0
```

11. Send the GET request. The output should be much more manageable than the previous requests, as we are now only looking at one attribute instead of all of them. You can examine the <xadAttributeIntegerValue> and <xadAttributeIntegerValue> to see the value of the On/Off SafePlug attribute.

SCI Targets   Examples ▾   Export ▾   ▶ Send   ✖ Clear

```
<result>
 <resultTotalRows>1</resultTotalRows>
 <requestedStartRow>0</requestedStartRow>
 <resultSize>1</resultSize>
 <requestedSize>1000</requestedSize>
 <remainingSize>0</remainingSize>
 <XbeeAttributeDataCore>
  <id>
   <xpExtAddr>00:00:00:00:00:00:00:00</xpExtAddr>
   <xeEndpointId>11</xeEndpointId>
   <xcClusterType>0</xcClusterType>
   <xcClusterId>6</xcClusterId>
   <xaAttributeId>0</xaAttributeId>
  </id>
  <cstId>2</cstId>
  <devConnectwareId>00000000-00000000-00409DFF-FF012345</devConnectwareId>
  <xeProfileId>265</xeProfileId>
  <xeDeviceId>1281</xeDeviceId>
  <xeDeviceVersion>0</xeDeviceVersion>
  <xaAttributeType>16</xaAttributeType>
  <xadAttributeStringValue>1</xadAttributeStringValue>
  <xadAttributeIntegerValue>1</xadAttributeIntegerValue>
  <xadUpdateTime>2012-06-19T23:25:59.000Z</xadUpdateTime>
 </XbeeAttributeDataCore>
</result>
```

12. Now that you know how to modify and read the device state, you may want to try reading attributes of some other clusters, such as the simple metering cluster.

These attributes can all be read in a similar manner to those in the on/off cluster we just examined, but will require a bit more interpretation. Navigate to the simple metering cluster in your device manager and take a look at the attributes there.
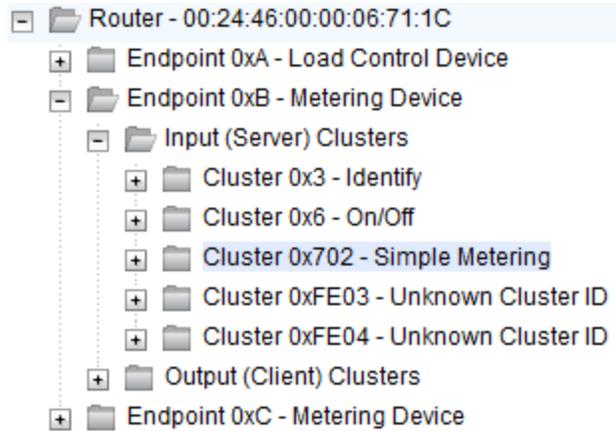
13. In this cluster, the attributes are a bit harder to identify than they were in the on/off cluster. To interpret them, you have to look them up in the documentation found at http://www.zigbee.org/, in this case the info can be found in the Zigbee Smart Energy Profile Specification in the section on simple metering clusters. To keep things moving, here is a quick breakdown of the attributes you see and their values:
   - 0x0 - Reading Information set
     - 0x000 - Current summation delivered
   - 0x2 - Meter Status
     - 0x200 - Status (8bit warning indicator)
   - 0x3 - Formatting
     - 0x300 - Unit of Measure
     - 0x301 - Multiplier
     - 0x302 - Divisor
     - 0x303 - Summation Formatting
     - 0x304 - Demand Formatting
     - 0x306 - Metering Device Type
   - 0x4 - ESP Historical Consumption
     - 0x400 - Instantaneous Demand

14. Each of these attributes can be examined in the same way you examined the on/off cluster's attribute earlier. After reading them, They can be interpreted according to the Zigbee Smart Energy Profile Specification to generate readable results.

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EXAMPLE - Interpreting Instantaneous Demand

Attribute ID	Description	Value
0x400	Instantaneous Demand	0x27 (Decimal 39)
0x300	Unit of Measure	0x0 (Translates to kW)
0x301	Multiplier	0x1 (Decimal 1)
0x302	Divisor	0x3E8 (Decimal 1000)
0x304	Demand Formatting	0x3B (Binary 0011 1011)

39 * 1 / 1000 = .039

Unit = 0x0 = kW

Demand Formatting = 0x3B = 0011 1011
      -> [0]   do not suppress leading zeros
      -> [0111]   7 Digits to the left of the decimal
      -> [011]   3 Digits to the right of the decimal

Final Value: .039kW

Congratulations, you've accomplished Goal 4: Understanding How to Use iDigi's Restful APIs to Read

Goal 5: Build Your Own App

Go to [URL] to download a simple application that demonstrates how the four previous goals can be used to make an application. You can also use the source code for this application at [URL] as an example to follow when making your own applications.

This example application is written in python. However, when developing your own application, feel free to use any language that you are comfortable with.

When you run the sample application, make sure you put the install code and MAC address for your Safe Plug into the application correctly. The install code should be entered with no spaces (ex. ABC123ABC123ABC1), while the MAC address should have a colon between every two numbers (ex. 00:00:00:00:00:00:00).

To get this application to run, make sure you have python installed and in your build path. Also, make sure you have Requests installed. Go http://docs.python-requests.org to download Requests and to get download instructions.

HINT: Having PIP installed on your system makes downloading Requests very easy. Using Easy_Install is a good way to get PIP. In general, PIP and Requests are both very helpful tools to have on your system for developing applications with iDigi.

Once you have all of this done, you should download our sample app into your User folder. Then, open a command prompt and simply type "python sample_app.py".

This will start the application, which can add devices, remove devices, toggle your SafePlug, and read your SafePlug's metering information.

Congratulations, you have accomplished Goal 5: create and deploy a sample application using iDigi APIs. You are now ready to start developing your own applications using the iDigi Smart Energy Network. Happy Developing!

APPENDIX A: Troubleshooting

The Smartlee website does not recognize my gateway

Ensure that the ConnectPort X2e Coordinator is plugged in and connected, see steps below.

Ensure that the gateway is connected to your iDigi account.

I can't see my SafePlug in my Smartlee account

Ensure that the SafePlug is not out of range of gateway.
SafePlug may be paired with another device. Unpair the SafePlug through the Smartlee interface or by swiping the correct magnetic key over the SafePlug.

Installation for iPhone/Android application is failing

Please refer to your manufacturer's website for help.

I can't control my SafePlug with my Smartlee account

Check to see if the status LEDs are operating properly on your Devices:

ConnectPort X2e:

Power

Status	Description	Next Step
Off	No power	Unplug the ConnectPort X2 and plug it back in to an outlet. If LED is not blinking call Digi technical support.
Solid green	Device is powered	No further action required

ZigBee

Status	Description	Next Step
Off	Radio disabled	

Blinking green (slow)	*Searching of other ZigBee devices on the network*	
Blinking green (fast)	*Establishing a Smart Energy network*	
Solid green	*Connected to a Smart Energy network*	

Network

Status	Description	Next Step
Off	*Powered OFF*	
Blinking yellow (slow)	*Powered ON, no Ethernet/WIFI link*	
Blinking yellow (fast)	*Ethernet/WIFI link, no IP address*	
Solid yellow	*IP address assigned*	
Blinking green (slow)	*Attempting a connection to the iDigi server*	
Blinking green (fast)	*iDigi server found, authenticating*	
Solid green	*Connected to iDigi server*	

Note: The button on the ConnectPort X2e is intended for advanced configuration or as directed in the online setup.

ERT/Smart Energy Bridge:

ERT	LED Status Update	Next Step
OFF	*No ERT meter configured*	*Go through the steps to add an ERT meter on Smartlee (however, it doesn't exist right now)*
ON	*All ERT meters successfully read in the last 30 minutes*	*No further action required*

Fast Blink (2x second period)	*At least one ERT meter has not been read in the last 30 minutes.*	*1. Verify that the ERT Smart Energy bridge is close enough to the meter.* *2. If blinking persists, call Digi Technology support or look at the support website and support forum.*
Slow Blink (once every 2 seconds)	*Initial 30 minute setup blink, at least one meter has not been read*	*Wait one minute. If after one minute the LED is not solid, follow "Next step" for "Fast Blink" above.*
Association		
OFF	*Not functioning correctly*	*1.Verify that the power supply is connected to the device and outlet.* *2. If still not operating, call Digi Technology support or look at the support website and support forum.*
ON	*OK, however, online installation is not complete*	*Go through the steps to add an ERT meter on Smartlee (however, it doesn't exist right now). If you ERT meter shows up on your device list, delete it and re-add it*
Blink	*OK*	*No further action required*
Power		
OFF	*No power*	*1.Verify that the power supply is connected to the device and outlet.* *2. If still not operating, call Digi Technology support or look at the support website and support forum.*
ON	*OK*	*No further action required*

SafePlug:

Outlet/Receptacle Status Indicators

Outlet Status	Receptacle Status	Description	Next Step
Off	Off	No power	Check circuit breaker/fuse
Flashing Green	Off	Power quality fault, or outlet is recovering from a power failure/fault.	If this lasts longer than 30 seconds you may be experiencing failure in your building's electrical system
Flashing Green	Flashing Red	Power quality fault, or outlet is recovering from a power failure/fault AND an overload has been detected at the affected receptacle.	Remove the encoded plug, or remove the non-encoded plug and use 1622 Reset Fault key to clear the fault.
Green	Off	Power is OK, receptacle is "normally off", or a demand response event is active, or Zigbee "off" command was sent (encoded plug is not inserted).	Use a 1623 Power Key or send a remote "on" command.
Green	Green	Power is OK, receptacle is on.	No action required
Green	Flashing Green	Power is OK, encoded plug inserted, receptacle is off due to a demand response event or ZIgbee "off" command.	Remove and reinsert the plug or send a Zigbee "on" command to turn power back on.
Green	Flashing	An overload has been	Remove the encoded plug, or

	Red	detected at the affected receptacle.	remove the non-encoded plug and use 1622 Reset Fault key, to clear the fault. Have the load device inspected for faults and repaired or replaced.
Green	Red	SafePlug encoding error or invalid key.	Replace the plug encoding tag. Use only the valid keys.
Green	Double Flash Red/Green	Identify Mode activated	Normal receptacle operation. Identify mode terminates automatically after the interval expires.
Off	Both Flashing Red	Self-test Failure	Replace the SafePlug.

(Note: this table was copied from SafePlug Model 1202 Electrical Outlet Installation Code Guide (option 9915) last page.)

Zigbee Status Indicator:

Zigbee Status	Meaning
Off	Outlet has not been previously joined to a Zigbee network and is scanning for a network to join.
1 flash/ 2sec. Amber	Outlet has been previously joined to a network and is attempting to rejoin.
Amber	Outlet is currently joined to a network.
2 flash/ sec. Amber	Outlet has been previously joined to a network and attempted rejoin failed. Outlet continues to try to rejoin.

APPENDIX B: Extending Your Network Using Smartlee

Adding Your ERT Bridge and ERT Meter

1. Make sure your ERT/Smart Energy Bridge is connected to a power supply.
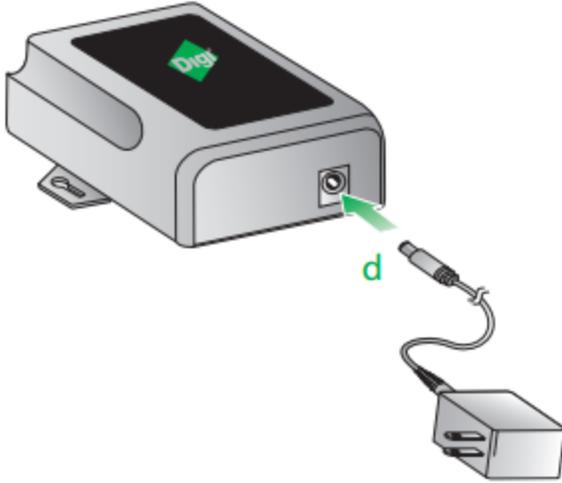
2. Go to www.livesmartlee.com to start the online process for building your network.
3. If you already have a Smartlee account, login. If not, refer to the "Connecting To Smartlee" part of this guide.
4. Once you have logged in, you will be taken to the homepage. Click on "My Devices" at the bottom left corner of your window.

Gateway Name		Gateway ID		
ConnectPort X2		00409D 45EBB4		

Name	Type	Status	Total Consumption	Price
Electric Meter	Metering (Electric)	06/08/2012 03:18 PM	1441326	N/A
ERT/Smart Energy Bridge		Not Metered	N/A	
Device		Not Metered	N/A	

| My Devices | My Account | My Apps | My Reports | My Data |

5. Click on the "Add" button at the bottom left corner of this page to start the process of adding a new device.

Select	Name	Type	Status	Unique Identifier
☐	Electric Meter	Metering (Electric)	06/08/2012 03:18 PM	00:13:A2:00:40:6B:8E:95-1
☐	ERT/Smart Energy Bridge		Not Metered	00:13:A2:00:40:6B:8E:95-94
☐	Device		Not Metered	00:24:46:00:00:06:71:1C-999

| Add | Edit | Delete |

6. Select your device from the list.

Total devices found: 4	Gateway ID	00409D 45EBB4		
Select	**Device**		**State**	**Notes**
	00:24:46:00:00:06:71:1C		Inactive	
	00:13:A2:00:40:5C:0F:F9		Active	
	00:13:A2:00:40:6B:8E:95		Inactive	
☐	00:13:A2:00:40:6B:93:69		Discovered	

[Previous] [Next]

7. On the Select Wireless Devices page, enter the install code that you recorded earlier into the "Install Code" field and click next.

8. You will be taken to a page that will allow you to connect your ERT device. To do this, simply find the ID number on your ERT device and put it into the appropriate fields.

Identify Meter

Enter the following information located on your meter. See picture to the right for an example of where to find this information.

Meter Type: *   Choose One ▼

ERT Type: *

ERT ID: *

Device Name: *   Meter

* = Required Information

[Previous] [Next]

ERT Type

12 54348622 100G

ERT ID

9. Make sure to fill out the other fields with information from your ERT device and click "Next".

Meter Format

Choose the unit of measure and multiplier for the meter. These settings configure Smartlee to display your meter readings correctly. Your provider should supply you with the proper settings or accept the default values below.

Unit of Measure: * `kWh ▼`

Multiplier: * `1`

Digits left of decimal point: * `15`

Digits right of decimal point: * `0`

◀ **Previous** **Next** ▶

Adding a Second ERT Device

1. Go to http://www.livesmartlee.com and log into your account. This should take you to the homepage.

2. On this page, click on "My Devices" at the bottom left corner of your window.

Gateway Name		Gateway ID		
ConnectPort X2		00409D 45EBB4		

Name	Type	Status	Total Consumption	Price
Electric Meter	Metering (Electric)	06/08/2012 03:18 PM	1441326	N/A
ERT/Smart Energy Bridge		Not Metered	N/A	
Device		Not Metered	N/A	

My Devices   **My Account**   **My Apps**   **My Reports**   **My Data**

3. Click on the "Add" button at the bottom left corner of this page to start the process of adding your second ERT Device.

Select	Name	Type	Status	Unique Identifier
☐	Electric Meter	Metering (Electric)	06/08/2012 03:18 PM	00:13:A2:00:40:6B:8E:95-1
☐	ERT/Smart Energy Bridge		Not Metered	00:13:A2:00:40:6B:8E:95-94
☐	Device		Not Metered	00:24:46:00:00:06:71:1C-999

Add   **Edit**   **Delete**

4. Smartlee will take you to a page to add a device that is not an ERT meter. So, simply select "Next" without doing anything else.

Gateway ID	00409D 45EBB4			
Select	**Device**		**State**	**Notes**
	00:24:46:00:00:06:71:1C		Inactive	
	00:13:A2:00:40:5C:0F:F9		Active	
	00:13:A2:00:40:6B:8E:95		Inactive	
☐	00:13:A2:00:40:6B:93:69		Discovered	

Total devices found: 4

[Previous]   [Next]

5. On the "Select Wireless Devices Page," click "Next" again. This will take you to the "Add Meter Page".

Select	**Device**	**Install Code**	**State**	**Notes**
No devices found				

[Manually Add Device]

[Previous]   [Next]

6. Find the ERT ID and ERT Type on your device and put it into the appropriate fields. Once you have filled out all of the field, click "Next".

Identify Meter

Enter the following information located on your meter. See picture to the right for an example of where to find this information.

Meter Type: * [Choose One ▾]

ERT Type: * [|]

ERT ID: * [   ]

Device Name: * [Meter   ]

* = Required Information

[Previous]   [Next]

Meter Format

Choose the unit of measure and multiplier for the meter. These settings configure Smartlee to display your meter readings correctly. Your provider should supply you with the proper settings or accept the default values below.

Unit of Measure: *   kWh ▾

Multiplier: *   1

Digits left of decimal point: *   15

Digits right of decimal point: *   0

◀ **Previous**   **Next** ▶

7. Once you have completed this step, you will be able to access your second ERT device through your smartphone.

Adding Other Smart Energy Devices

Now that you have set up your network using the Quick Start guide, you can add more devices onto your network.

1. Make sure your Smart Energy Device is connected to a power source.

1. When you log on to your Smartlee account at http://www.livesmartlee.com, you will be taken to your homepage.
2. On this page, click on "My Devices" at the bottom left corner of your window.

Gateway Name		Gateway ID		
ConnectPort X2		00409D 45EBB4		

Name	Type	Status	Total Consumption	Price
Electric Meter	Metering (Electric)	06/08/2012 03:18 PM	1441326	N/A
ERT/Smart Energy Bridge		Not Metered	N/A	
Device		Not Metered	N/A	

My Devices　**My Account**　**My Apps**　**My Reports**　**My Data**

3. Click on the "Add" button at the bottom left corner of this page to start the process of adding a new device.

Select	Name	Type	Status	Unique Identifier
☐	Electric Meter	Metering (Electric)	06/08/2012 03:18 PM	00:13:A2:00:40:6B:8E:95-1
☐	ERT/Smart Energy Bridge		Not Metered	00:13:A2:00:40:6B:8E:95-94
☐	Device		Not Metered	00:24:46:00:00:06:71:1C-999

Add　**Edit**　**Delete**

4. Select your device from the list.

Gateway ID　**00409D 45EBB4**

Total devices found: 4

Select	Device	State	Notes
	00:24:46:00:00:06:71:1C	Inactive	
	00:13:A2:00:40:5C:0F:F9	Active	
	00:13:A2:00:40:6B:8E:95	Inactive	
☐	00:13:A2:00:40:6B:93:69	Discovered	

◀ Previous　**Next ▶**

5. Get the install code off of your device and put it in the "Install Code" field and click next.

Gateway ID　**00409D 45EBB4**

Devices to install: 1

Select	Device	Install Code	State	Notes
☑	00:13:A2:00:40:6B:93:69		Discovered	