



Abstract:

This document explains how to get Crimson® 3.1 devices to talk to Amazon Web Services (AWS) using the MQTT Connector. It assumes a basic knowledge of Crimson and its operation, and the ability to read and manipulate JSON. For more details on the Crimson Cloud Connectors, please consult the Crimson User Manual.

Products:

CR3000 HMIs / Graphite® HMI / Graphite Controllers

Use Case: AWS Connector

Transferring tag data to Amazon Web Services.

Required Software:

Crimson 3.1

Required Firmware:

Build 3106.000 or higher

Step 1 - Creating an Account

If you do not have an AWS account, visit <http://aws.amazon.com/free> to create a free tier account. The free tier provides more than sufficient capacity for testing and may even be sufficient for limited deployments. If you move to a paid tier, be careful not to leave test devices configured in a manner that will run up your bill.

Step 2 - Accessing the IoT Core

Logon to AWS and select the *IoT Core* service. Refer to the dashboard in Figure 1.

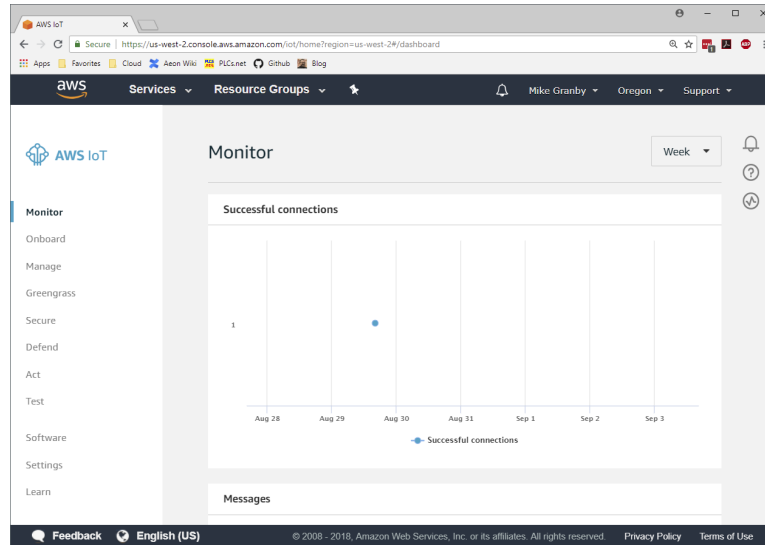


Figure 1.

Step 3 - Creating a Policy

AWS uses Policies to control access to its IoT services. We must therefore create a policy that allows our Crimson devices to submit data to the cloud. To do this, select the *Secure* option in the left-hand menu and select the *Policies* option under that. A window will appear saying that you do not have any policies. Press the button labelled *Create a Policy* to create our new policy.

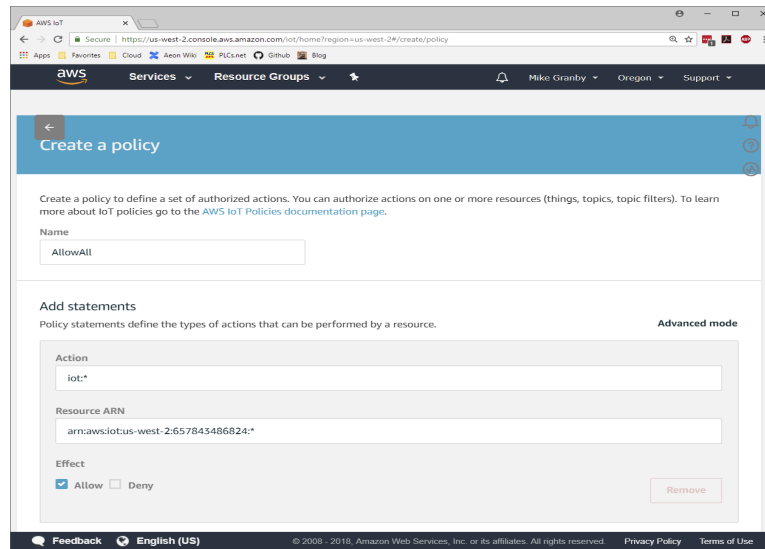


Figure 2.

Referring to Figure 2, perform the following actions:

1. In the Name box, enter **AllowAll**
2. In the Action box, enter **iot:***
3. The Resource ARN box will update to show a resource identifier.
4. Replace **topic/replaceWithATopic** at the end of the ARN with *****
5. Under the Effects heading, check the Allow box.
6. Press the *Create* button to commit the change.

This policy allows anyone using a certificate to which it is assigned to perform any supported action on any resource in your IoT account. As you learn more about AWS, you might want to create more sophisticated policies to implement finer-grained control of access to your resources.

Step 4 - Creating a Type

AWS uses Types to group devices into categories. While not strictly necessary, we shall be creating a type to hold all our Crimson-based devices. To do this, select the *Manage* option in the left-hand menu and select the *Types* option under that. A window will appear saying that you do not have any types. Press the button labelled *Create a Thing Type* to create our new type.

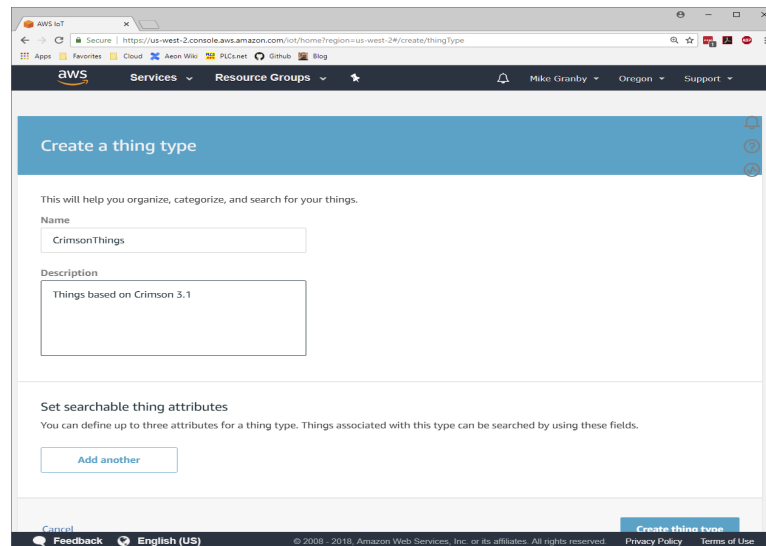


Figure 3.

Referring to Figure 3, perform the following actions:

1. In the Name box, enter ***CrimsonThing***
2. In the Description box, enter any suitable description.
3. Press the *Create Thing Type* button to commit the change.

As you learn more about AWS, you might want to create different types to provide finer-grained grouping of your devices. This will make it easier to search for and manage the devices associated with, for example, a particular site or a particular project.

Step 5 - Creating a Thing

AWS uses Things to represent devices. Each thing corresponds to a device that is pushing data to the cloud, and we shall be creating a Thing to hold the data submitted by our Crimson device. To do this, select the *Manage* option in the left-hand menu and select the *Things* option under that. A window will appear saying that you do not have any things. Press the button labelled *Register a Thing* to create our new thing.

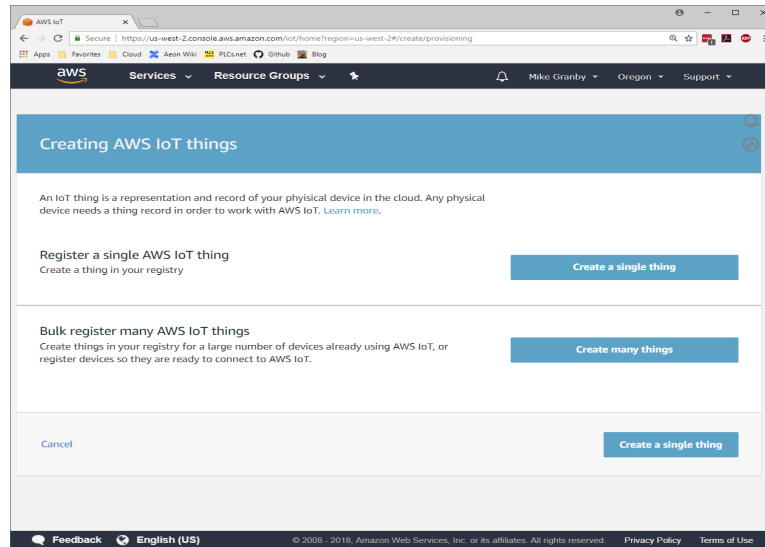


Figure 4.

Referring to Figure 4, select the *Create a single thing* option...

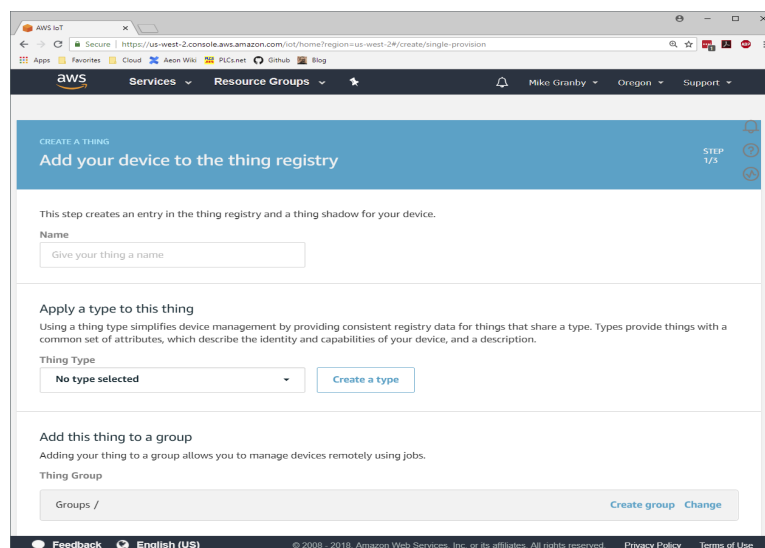


Figure 5.

Referring to Figure 5, perform the following actions...

1. In the Name box, enter ***Thing01***
2. From the Thing Type dropdown, select ***CrimsonThings***
3. Skip the rest of the options and press the ***Next*** button.

A window will be displayed to allow you to configure the thing's security settings...

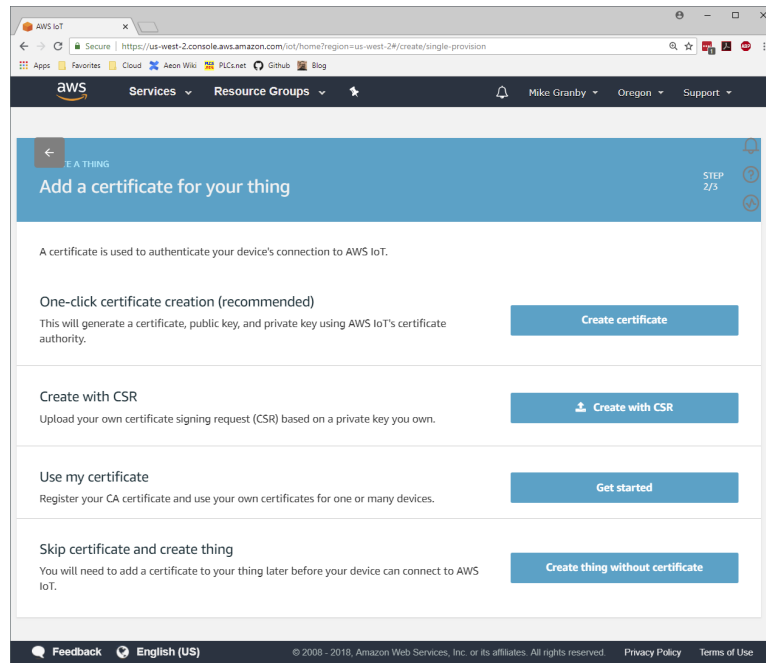


Figure 6.

Referring to Figure 6, select the *Create Certificate* button...

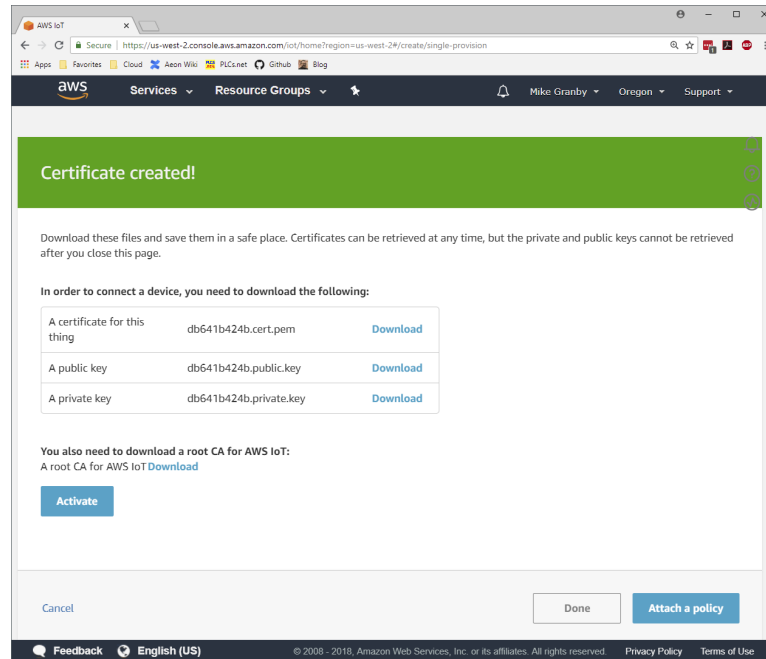


Figure 7.

Referring to Figure 7, perform the following actions...

1. Click on the *Download* link next to the certificate and allow your browser to save the file.
2. Click on the *Download* link next to the private key and allow your browser to save the file.
3. Press the *Activate* button to activate the certificate.

When performing this step, **take very careful note of where the certificate and key files are saved.** If you lose them, you will have to create and attach a new certificate or delete this thing and start again. Your browser will typically save them to its Downloads folder, but you may want to move them to a more secure location.

You may now click on the *Attach a Policy* button to move to the next step...

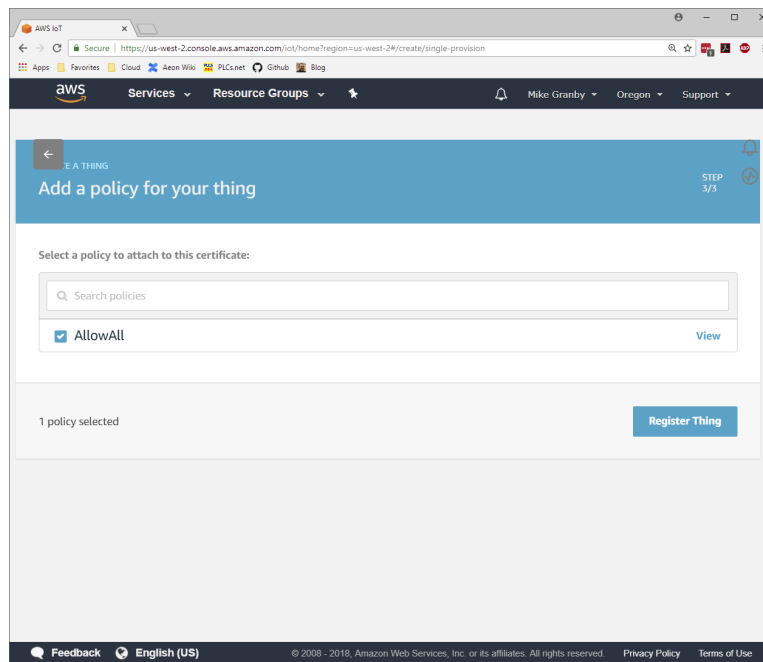


Figure 8.

Referring to Figure 8, perform the following steps...

1. From the list of policies, check the box next to the **AllowAll** policy we created earlier.
2. Press the *Register Thing* button to complete the process.

We have now created a thing called **Thing01** to which we shall be pushing data. The thing has a certificate and a private key to identify it, and we have downloaded the associated files for import into Crimson. The thing's certificate has been assigned a policy that allows it to perform any operations. We have also downloaded a root certificate that will authenticate the Amazon server to our device.

Step 6 - Finding the Server Host Name

In order for our device to interact with AWS, we need to find the name of the server to which our MQTT requests will be sent. To find the host name, first ensure that you have **Thing01** selected. This will already be the case if you have just completed the previous step, but if you have navigated away, you will have to return to the appropriate location by selecting the *Manage* option in the left-hand menu, selecting the *Things* option under that and then selecting *Thing01*. With **Thing01** selected, select the *Interact* option from the left-hand menu.

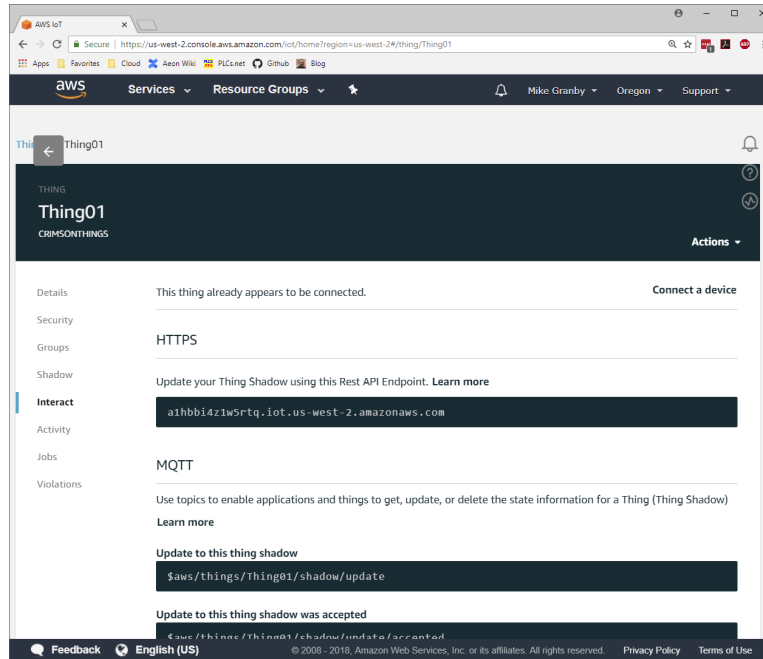


Figure 9.

Referring to Figure 9, even though we are using MQTT, the host name we need is shown under the HTTPS section. Select this host name in your browser and place it on to your clipboard so that you can take a copy. We shall be pasting this into Crimson when we first go to configure the Amazon MQTT connector.

Step 7 - Creating an Outline Database

You should now open Crimson 3.1 and create a new database for your device. Before we configure the Amazon Connector, we shall need to perform a few steps to create the infrastructure used for testing. Red Lion will soon be making these so-called outline databases available via its website and including them in the Crimson installation. In the meantime, to manually create an outline database, start by navigating to the Communications category and selecting the *Ethernet 1* tab in the Network settings...

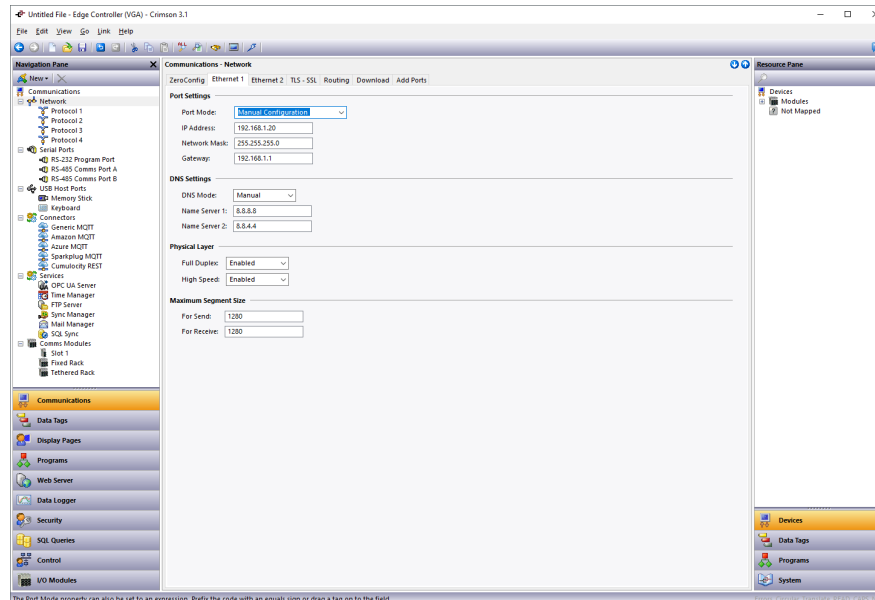


Figure 10.

Referring to Figure 10, if the device is connected to a network that automatically allocates IP addresses via a DHCP server, you may leave these settings unchanged. **If you are manually specifying an IP address, you must also define a default gateway and manually provide DNS servers.** The gateway is necessary for your device to push data to the Internet and the DNS servers are used to convert the cloud server name into an IP address. The default server addresses of 8.8.8.8 and 8.8.4.4 will be suitable for most applications, but the DNS Mode must be explicitly set to Manual if the Port Mode is set to Manual Configuration.

Next select the Time Manager settings within the Services group.

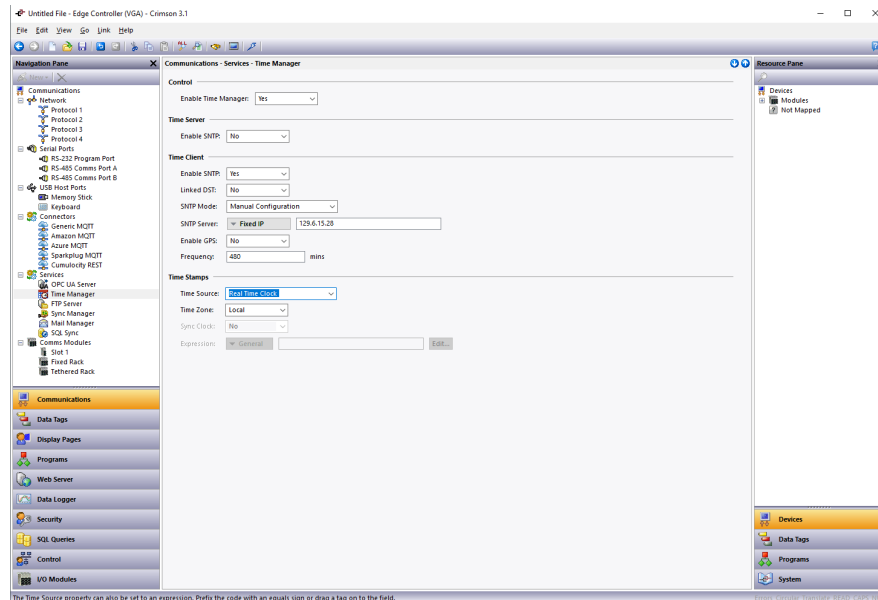


Figure 11.

Referring to Figure 11, perform the following actions...

1. In the Control section, set the Enable Time Manager property to Yes.
2. In the Time Client section, set the Enable SNTP setting to Yes.

The other settings may be left at their default values. These settings enable time synchronization, allowing your device to set its real-time clock from the Internet. Having an accurate real-time clock is important not only for time-stamping data, but also for ensuring the correct operation of certain security algorithms. **Once you have downloaded your outline database for the first time, select the Send Time option from the Link menu within Crimson to set the device's time zone to that of your PC.** If you need to set it to a different time zone, refer to the Crimson manuals for information on the time zone system variables.

Next navigate to the Data Tags category and press the *New* button five times...

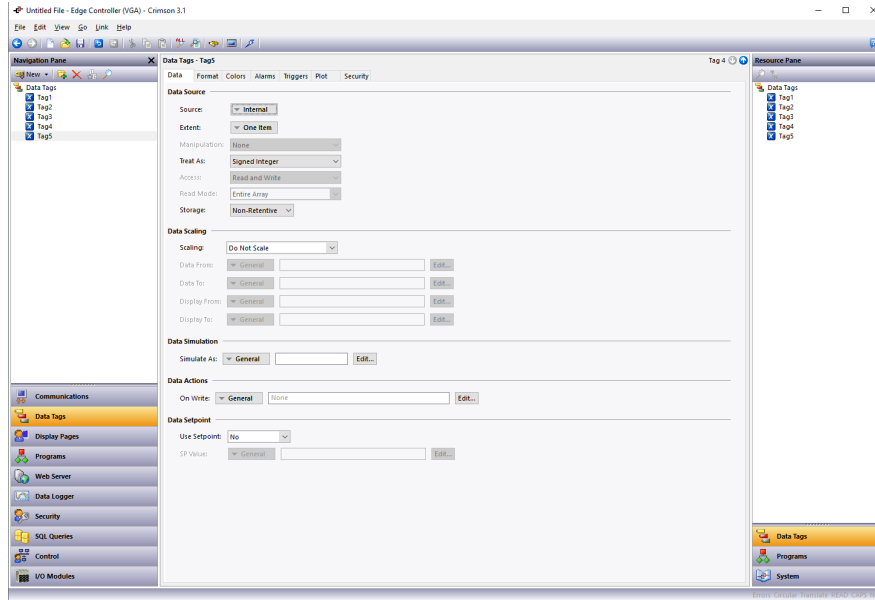


Figure 12.

Referring to Figure 12, select Tag5 in the Navigation pane and then rename it to Status.

Next navigate to the Display Pages category...

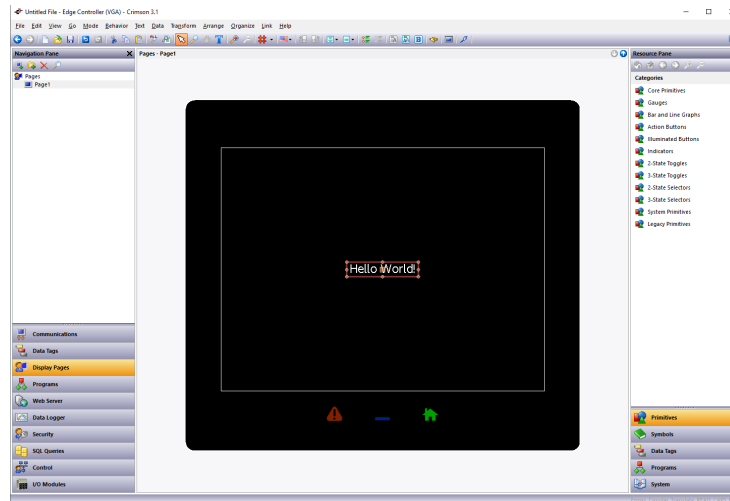


Figure 13.

Referring to Figure 13, perform the following actions...

1. Select the Hello World text and press *Delete* to remove it from the screen.
2. In the Resource Pane, select the *Data Tags* category.
3. In the Resource Pane, click on *Tag1* and, while holding down *Shift + Ctrl*, click on *Status*.
4. All five data tags should be selected.
5. Drag the resulting selection on to your display page.
6. Grab the bottom-right resizing handle and expand the data fields to a suitable size.
7. Click away from the data fields to deselect them.
8. Click on *Tag1* and check the **Data Entry** box in the floating toolbar.
 - Alternatively, *right-click* and select *Data* followed by *Data Entry*.
9. Repeat this operation for *Tag2*.

Your display page should now look like Figure 14.

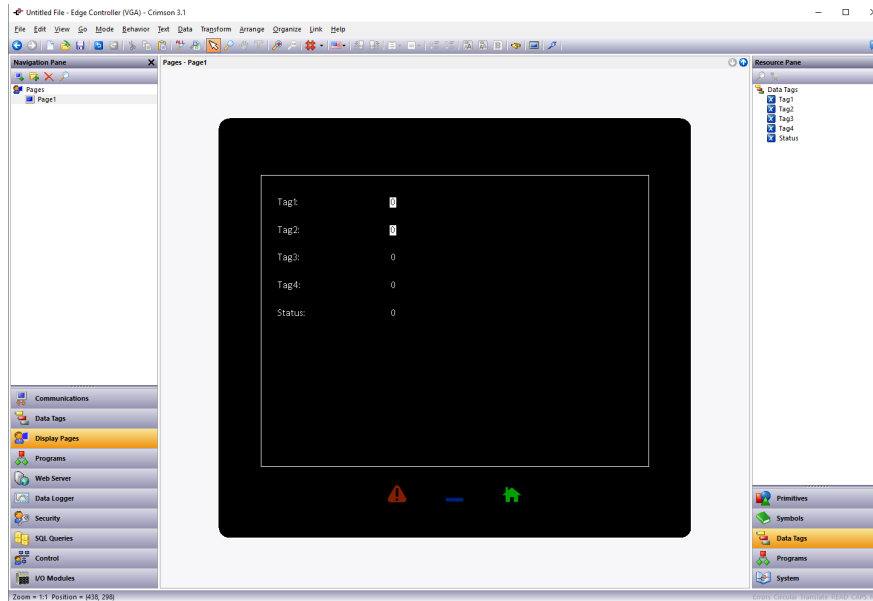


Figure 14.

Next *right-click* on the page and select *Properties...*

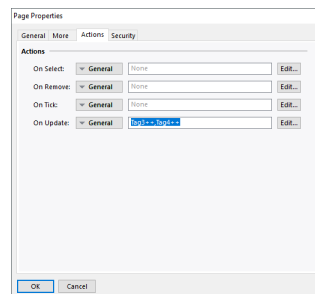


Figure 15.

Referring to Figure 15, perform the following actions...

1. Select the *Actions* tab.
2. Enter **Tag3++**, **Tag4++** in the On Update box.
3. Press *OK* to save the changes.

Next navigate to the Web Server category...

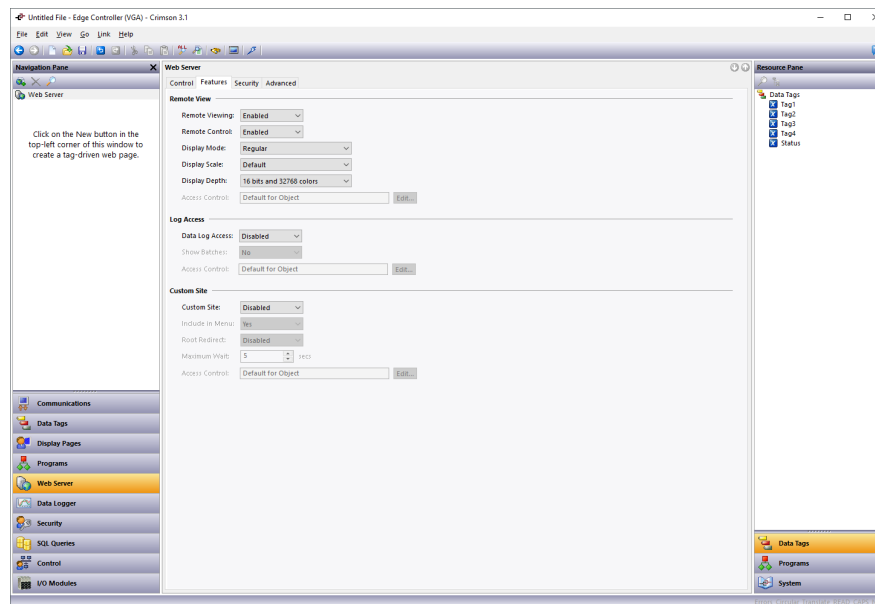


Figure 16.

Referring to Figure 16, perform the following actions...

1. Select the *Features* tab.
2. In the Remove View section, set the Remote Control property to *enabled*.

You have now created an outline database. Press *F9* to download this to your device, and if this is the first time you are doing so, select the Send Time option from the Link menu to set the device's time and time zone. If the device has a display, you should be able to see the five tags. You will be able to edit the first two tags using the touchscreen, and the next two will be incrementing steadily as the display updates.

If your device does not have a display, open your web browser. In the address bar, enter the `http://` followed by the IP address that you have allocated to your device to access the Crimson web server. Within the Crimson web server, select *Remote View* to view the device's virtual display and again note the behavior of the tags.

Step 8 - Configuring the Amazon Connector

We are now in a position to configure and test the Amazon Connector. We shall be configuring it to talk to the thing that we created in earlier sections and pushing four of the data tags that we have created. The fifth tag will be used to display the connection status. Start by returning to the Communications section and select the *Amazon MQTT* settings in the Connectors section...

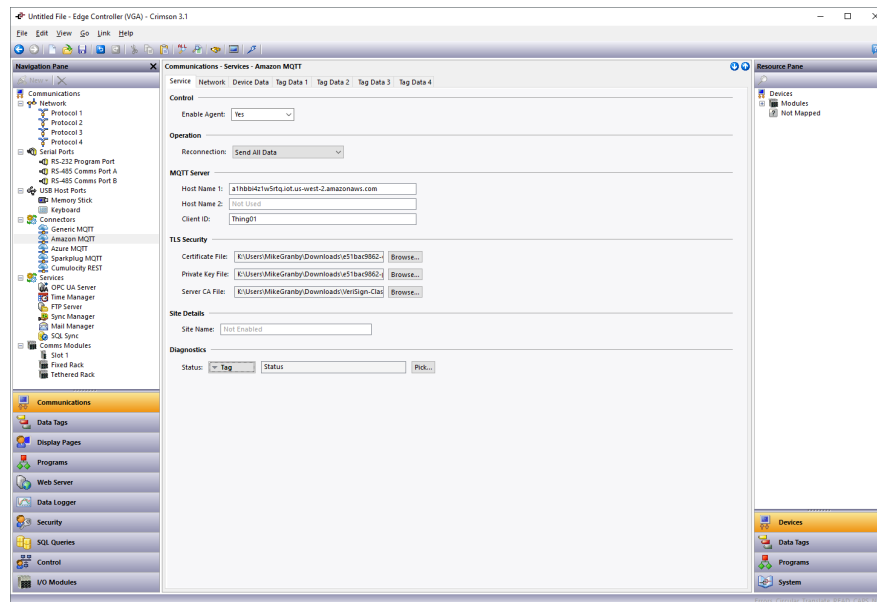


Figure 17.

Referring to Figure 17, perform the following actions...

1. In the Control section, set the Enable Agent property to *Yes*.
2. In the MQTT Server section, set the Host Name 1 property to the host name from **Step 6**.
3. In the MQTT Server section, set the Client ID property to *Thing01*
4. In the TLS Security section, set the Certificate File to the file you downloaded in **Step 5**.
5. In the TLS Security section, set the Private Key File to the file you downloaded in **Step 5**.
6. In the TLS Security section, set the Server CA File as described below.
7. In the Diagnostics section, set the Status property to *Status*

When setting the three files, navigate to the correct folder and Crimson should offer you only the files that are appropriate in that context. If you are dealing with many things, you should make sure you select the files that are associated with the thing to which this device will be talking.

The Server CA file is used to validate that Crimson is talking to the correct server. Amazon have recently updated their server certificates, and it is quite a complex task to find the one that is appropriate to the server to which you will be attaching. We thus recommend that you use a file that contains all the possible server certificates that you may encounter. You can download and extract this file from Red Lion's website at <http://www.redlion.net/node/38804>, or you can copy the text in Appendix A into a text file and save it with the **PEM** extension. For builds of Crimson including and after the January 2019 Feature Release, you may simply leave the field empty and allow Crimson to use the combined server certificate file by default.

Next select the *Tag Data 1* tab...

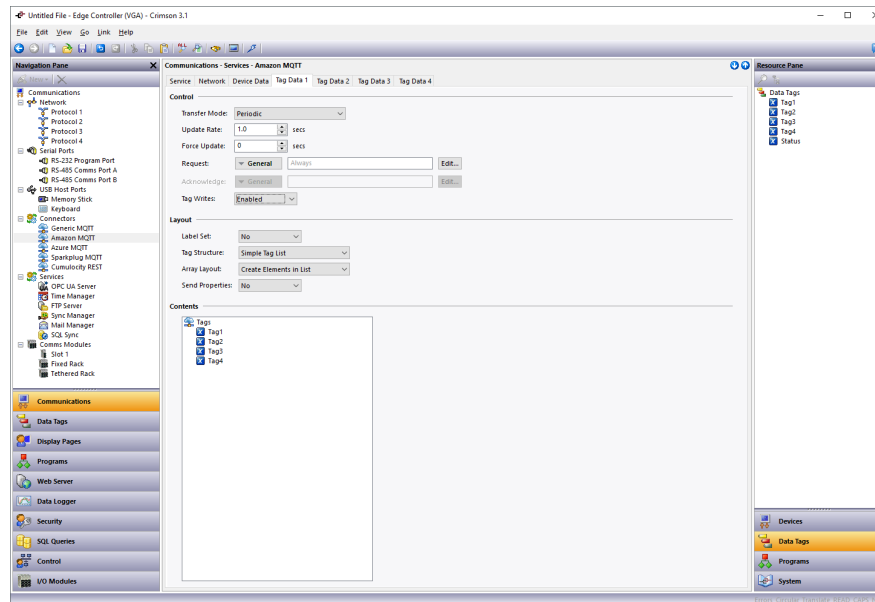


Figure 18.

Referring to Figure 18, perform the following actions...

1. In the Control section, set the Tag Writes property to *Enabled*.
2. Select the Data Tags category of the Resource Pane.
3. Drag *Tag1* through *Tag4* into the Contents field in the editing pane.

You have now configured Crimson to push Tag1 through Tag4 to the cloud once per second. Press *F9* to download the database to your device and check the Status tag on your display or via the web browser. A value of 4 should be displayed, indicating that the cloud connection has been established and that data is being pushed. A value of 0 typically indicates an issue with network connectivity or with DNS, while a value of 1 indicates that the server name was resolved but that the connection could not be established. A value of 3 indicates that the connection has been made, but that data has not been transferred. If you do not see a value of 4, check each item in this note carefully and ensure your Crimson configuration matches your AWS settings.

Step 9 - Interacting with the Device

Now that we have configured Crimson to pass data to the cloud, we can view this data from the Amazon web console and optionally write data back to the device. Return to the IoT Core web page within the console. If you are not already within Thing01, select the Manage option in the left-hand menu and select the Things option under that. Click on Thing01 to display its settings and properties, and select Shadow from the left-hand menu...

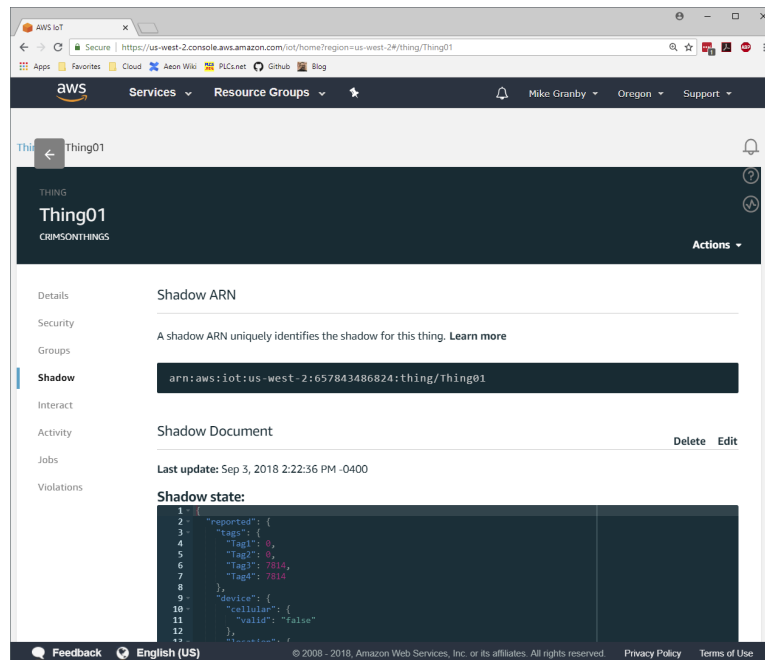


Figure 19.

Referring to Figure 19, note that the shadow state contains live data representing the tags in your device. The shadow is a persistent object that stores the values sent by the device, whether or not those values are included in the latest message. If you scroll down a little, you will be able to view the shadow more clearly...

```

{
  "reported": {
    "tags": {
      "Tag1": 0,
      "Tag2": 0,
      "Tag3": 8747,
      "Tag4": 8747
    },
    "device": {
      "cellular": {
        "valid": "false"
      },
      "location": {
        "valid": "false"
      },
      "status": "okay"
    }
  }
}

```

As you can see, the shadow is a JSON fragment contains an object called **reported**. Within this object, a further object called **tags** contains the data tags being pushed by Crimson, and an object called **device** acts as a placeholder for yet-to-be-supported device status information. Refer to the Crimson User Manual for details on how the format of this JSON fragment can be adjusted to suit your application.

To write data to the device, we must edit the JSON fragment to contain an object called **desired** that contains its own **tags** object that in turn contains the values that we want to write. To modify the shadow, select the *Edit* option within the AWS console and click on the Shadow State to make the changes...

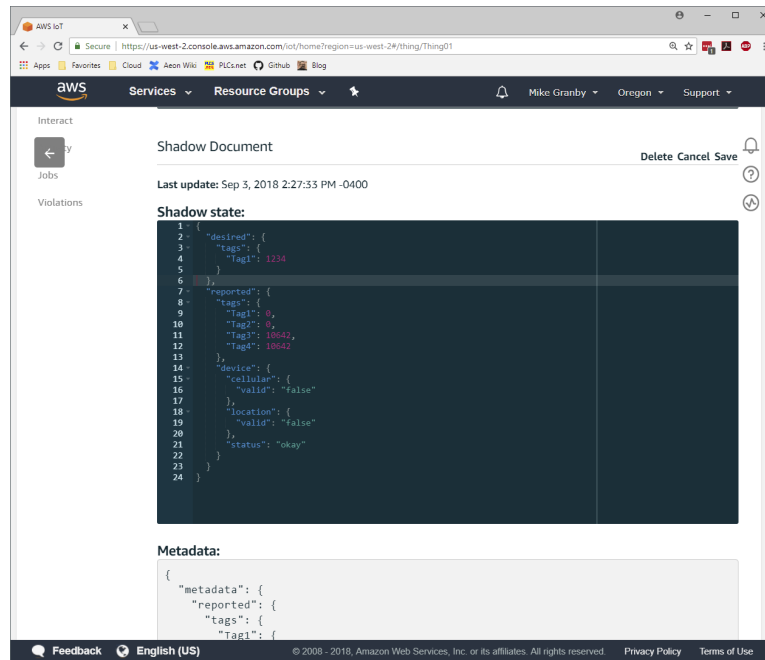


Figure 20.

It is very important that you get the formatting right when editing the shadow. JSON is particularly finicky about commas and other punctuation. The portion that you are creating is shown in red below...

```
{
  "desired": {
    "tags": {
      "Tag1": 1234
    }
  },
  "reported": {
    "tags": {
      "Tag1": 0,
      [balance omitted for brevity]
    }
  }
}
```

Note the comma at the end of line immediately before the **reported** object and note the absence of commas at the end of the other lines. JSON requires commas only when another element follows within the current object. If you get this wrong, a red cross should appear warning you of your error.

Once you have edited the JSON, press click Save to commit the change. The value of Tag1 in your device should be updated both on the device display and in **reported** object in the shadow, and the corresponding entry in the **desired** object should be removed. If this does not happen, check your formatting and check that you have writes enabled in the corresponding tag set.

Append A – Combined Server Certificates

-----BEGIN CERTIFICATE-----

```
MIIDQTCCAimgAwIBAgITBmyfz5m/jAo54vB4ikPmljZbyjANBgkqhkiG9w0BAQsF
ADA5MQswCQYDVQQGEwJVUzEPMA0GA1UEChMGQW1hem9uMRkwFwYDVQQDExBBBWF6
b24gUm9vdCBDQSAxMB4XDTE1MDUyNjAwMDAwMFoXDTM4MDE4NzAwMDAwMFowOTEL
MAKGA1UEBhMCVVMxZDZANBgNVBAoTBkFtYXpvbjEzMBcGA1UEAxMQW1hem9uIFJv
b3QgQ0EgMTCCASlWdQYJKoZIhvcNAQEBBQADggEPADCCAQoCggEBALJ4gHHKeNXj
ca9HgFB0fW7Y14h29Jlo91ghYPI0hAEvrAlthtOgQ3pOsqTQNroBvo3bSMgHFzZM
9O6II8c+6zf1tRn4SWiw3te5djgdYZ6k/ol2peVKVuRF4fn9tBb6dNqcmzU5L/qw
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U5PMCCjmmCXPI6T53iHTflUJrU6adTrCC2qJeHZERxhlbl1Bjtt/msv0tadQ1wUs
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rqXRfboQnoZsG4q5WTP468SQvvG5
```

-----END CERTIFICATE-----

-----BEGIN CERTIFICATE-----

```
MIIFQTCCAYmgAwIBAgITBmyf0pY1hp8KD+WGePhbJruKNzANBgkqhkiG9w0BAQwF
ADA5MQswCQYDVQQGEwJVUzEPMA0GA1UEChMGQW1hem9uMRkwFwYDVQQDExBBBWF6
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UjANBgkqhkiG9w0BAQwFAAOCAGEAqqiAjw54o+Ci1M3m9Zh6O+oAA7CXDP08Wqj2
Lixyh6mx/H9z/WNxeKWHWc8w4Q0QshNabYL1auAn6AFC2jkr2vHat+2/XcycuUY
+gn0oJMsXdKMdYV2ZZAMA3m3MSNjrXiDCYZohMr/+c8mmpJ5581LxedhpxfL86kS
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7uxMMne0nxrpS10gxdR9HlcWxkPo1LsmmkVwXqkLN1PiRnsn/eBG8om3zEK2yygm
btmlyTrIQRNg91CMFa6ybRoVGld45plq2WWQgj9sAq+uEjonlJYE1x2igGOpm/Hl
urR8FLBOybEfdF849IHqm/osohHUqS0nGkWxr7JOCq3AWEbWaQbLU8uz/mtBzUF+
fUwPfhJ5elnNXkoOrJupmHN5fLT0zLm4BwydyF4x2+loZcn9Kr5v2c69BoVYh63
n749sSmvZ6ES8lgQGVMDMBu4Gon2nL2XA46jCfMdiyHxtN/kHNGfZQIG6lzWE7OE
76KIXlx3KadowGuuQNKotOrN811LOJwZmhsoVLiJkO/KdYE+HvJkJMcyR07/R54H
9jVlpNMKVv/1F2Rs76giJUmTtt8AF9pYf13uxRuw0dFfIRDH+fO6AgonB8Xx1sfT
4PsJYGw=
```

-----END CERTIFICATE-----

-----BEGIN CERTIFICATE-----

```
MIIBtjCCAUVgAwIBAgITBmyf1XSXNmY/Owua2eiedgPySjAKBggqhkiOPQQDAjA5
```



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