F5 Agility, August 2016

Introduction to Automation & Orchestration – v1.3

Participant Hands-on Lab Guide

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GETTING STARTED

Please follow the instructions provided by the instructor to start your lab and access your jump host.

ALL WORK FOR THIS LAB WILL BE PERFORMED EXCLUSIVELY FROM THE WINDOWS JUMPHOST. NO INSTALLATION OR INTERACTION WITH YOUR LOCAL SYSTEM IS REQUIRED.

LAB TOPOLOGY

The network topology implemented for this lab is very simple. Since the focus of the lab is Control Plane programmability rather that Data Plane traffic flow we can keep the data plane fairly simple. The following components have been included in your lab environment:

- 2 x F5 BIG-IP VE (v12.0)
- 1 x F5 iWorkflow VE (v2.0.0)
- 1 x Linux Webserver
- 1 x Windows Jumphost

The following table lists VLANS, IP Addresses and Credentials for all components:

Component	VLAN: IP Address(es)	Credentials
Windows Jumphost	MGMT: 10.1.1.3 Internal: 10.1.10.250 External: 10.1.20.250	user/Agility1
BIG IP A	MGMT: 10.1.1.4 Internal: 10.1.10.1 External: 10.1.20.1	root/default admin/admin
BIG-IP B	MGMT: 10.1.1.5 Internal: 10.1.10.2 External: 10.1.20.2	root/default admin/admin
iWorkflow	MGMT: 10.1.1.6	root/default admin/admin
Linux Webserver	MGMT: 10.1.1.7 Internal: 10.1.10.10-13	root/default

MODULE 1 – REST API BASICS & DEVICE ONBOARDING

In this module you will learn the basic concepts required to interact with the BIG-IP iControl REST API. Additionally, you will walk through a typical Device Onboarding workflow that results in a fully functional BIG-IP Active/Standby pair. It's important to note that this module will focus on showing an **Imperative** approach to automation.

NOTE: The Ravello Deployment for this lab includes two BIG-IP devices. For most of the labs we will focus on configuring only the BIG-IP-A device (management IP and licensing have already been completed). BIG-IP-B already has some minimal configuration loaded. In a real-world environment it would be necessary to perform Device Onboarding functions on ALL BIG-IP devices. We are only performing them on a single device in this lab so we are able to cover all topics in the time allotted.

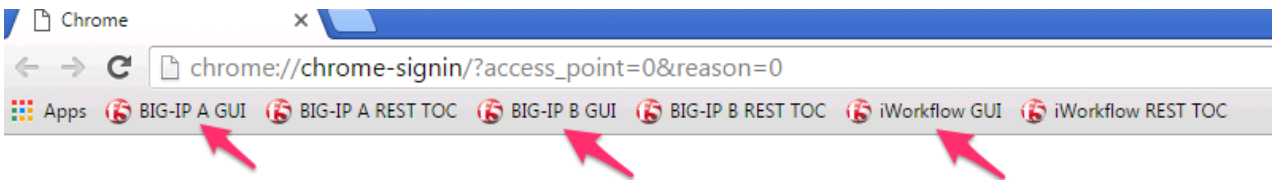
NOTE: It's beneficial to have GUI/SSH sessions open to BIG-IP and iWorkflow devices while going through this lab. Feel free to verify the actions taken in the lab against the GUI or SSH. You can also watch the following logs:
BIG-IP: /var/log/ltm, /var/log/restjavad.0.log
iWorkflow: /var/log/restjavad.0.log

Lab 1.1 – Exploring the iControl REST API

Task 1 – Explore the API using the TMOS Web Interface

In this lab we will explore the API using an interface that is built-in to TMOS. This utility is useful for understanding how TMOS objects map to the REST API. The interfaces implement full Create, Read, Update and Delete (CRUD) functionality, however, in most practical use cases it's far easier to use this interface as a 'Read' tool rather than trying to Create objects directly from it. It's usually far easier to use TMUI or TMSH to create the object as needed and then use this tool to view the created object with all the correct attributes already populated.

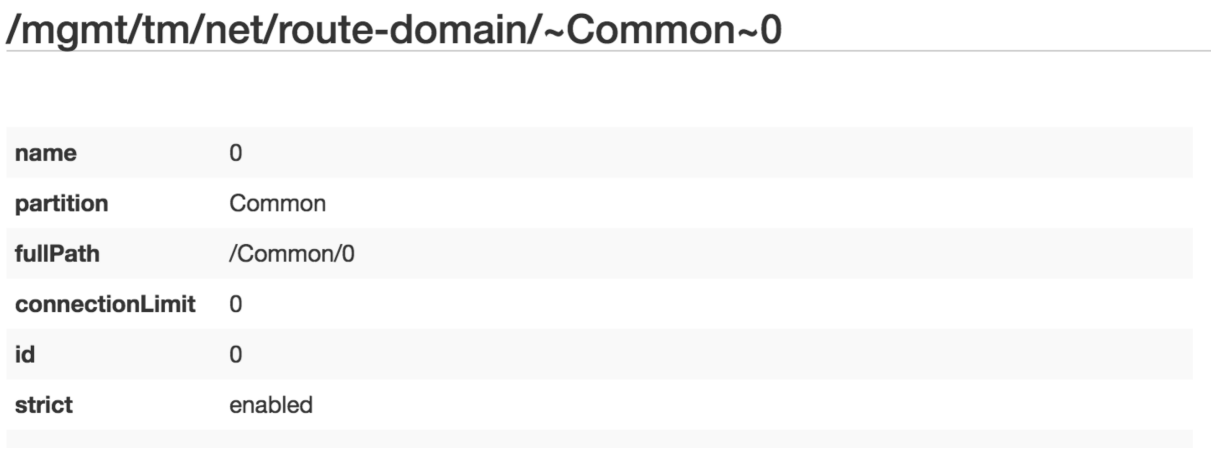
1. Open Google Chrome and navigate to the following bookmarks: BIG-IP A GUI, BIG-IP B GUI and iWorkflow GUI. Bypass any SSL errors that appear and ensure you see the login screen for each bookmark.



2. Navigate to the URL https://10.1.1.4/mgmt/toc (or click the BIG-IP A REST TOC bookmark). The '/mgmt/toc' path in the URL is available on all TMOS versions 11.6 or newer.
3. Authenticate to the interface using the default admin/admin credentials.

4. You will now be presented with a top-level list of various REST resources. At the top of the page there is a search box filter worker... that can be used to find items on the page. Type 'net' in the search box and then click on the 'net' link under iControl REST Resources:

5. Find the '/mgmt/tm/net/route-domain' **Collection** and click it.
6. You will now see a listing of the **Resources** that are part of the route-domain(s) collection. As you can see the default route domain of '0' is listed. You can also create new objects by clicking the + button. Additionally resources can be deleted using the 🗑 button or edited using the ✎ button.
7. Click the '0' resource to view the attributes of route-domain 0 on the device:



Take note of the full path to the resource. Here is how the path is broken down:

```
/ mgmt / tm / net / route-domain / ~Common~0
|Root  | OC | OC  | Collection   | Resource

*OC=Organizing Collection
```

Lab 1.2 – REST API Authentication & 'example' Templates

One of the many basic concepts related to interaction with REST API's is how a particular consumer is authenticated to the system. BIG-IP and iWorkflow support two types of authentication: HTTP BASIC and Token based. It's important to understand both of these authentication mechanisms, as

consumers of the API will often make use of both types depending on the use case. This lab will demonstrate how to interact with both types of authentication.

Task 1 – HTTP BASIC Authentication

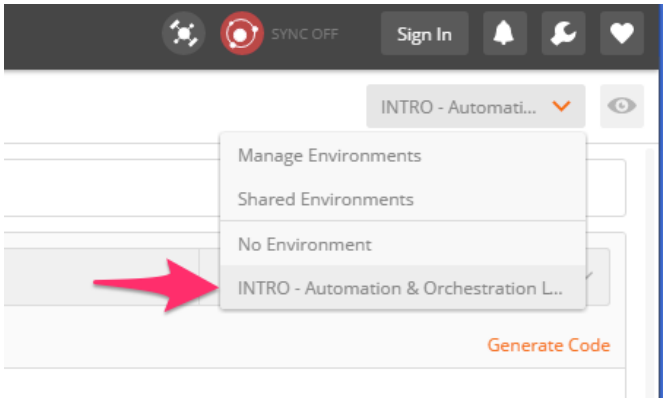
In this task we will use the Postman tool to send API requests using HTTP BASIC authentication. As its name implies this method of authentication encodes the user credentials via the existing BASIC authentication method provided by the HTTP protocol. The mechanism this method uses is to insert an HTTP header named 'Authorization' with a value that is built by Base 64 encoding the string "<username>:<password>". The resulting header takes this form:

```
Authorization: Basic YWRtaW46YWRtaW4=
```

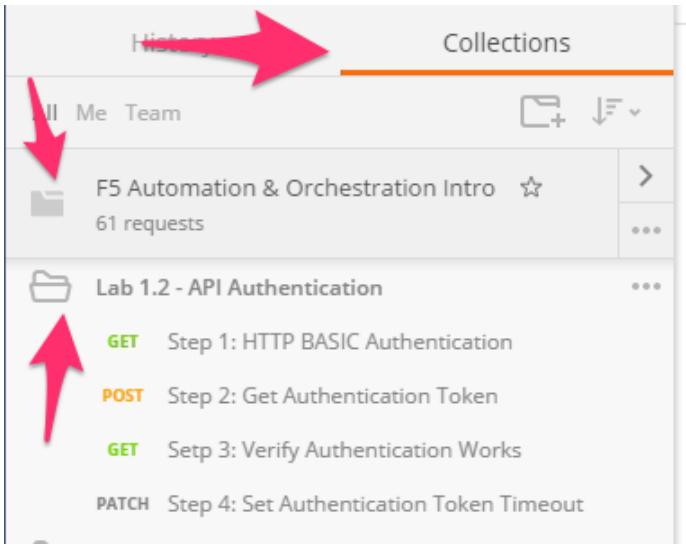
It should be noted that cracking the method of authentication is TRIVIAL; as a result API calls should always be performed using HTTPS (F5 default) rather than HTTP.

Perform the following steps to complete this task:

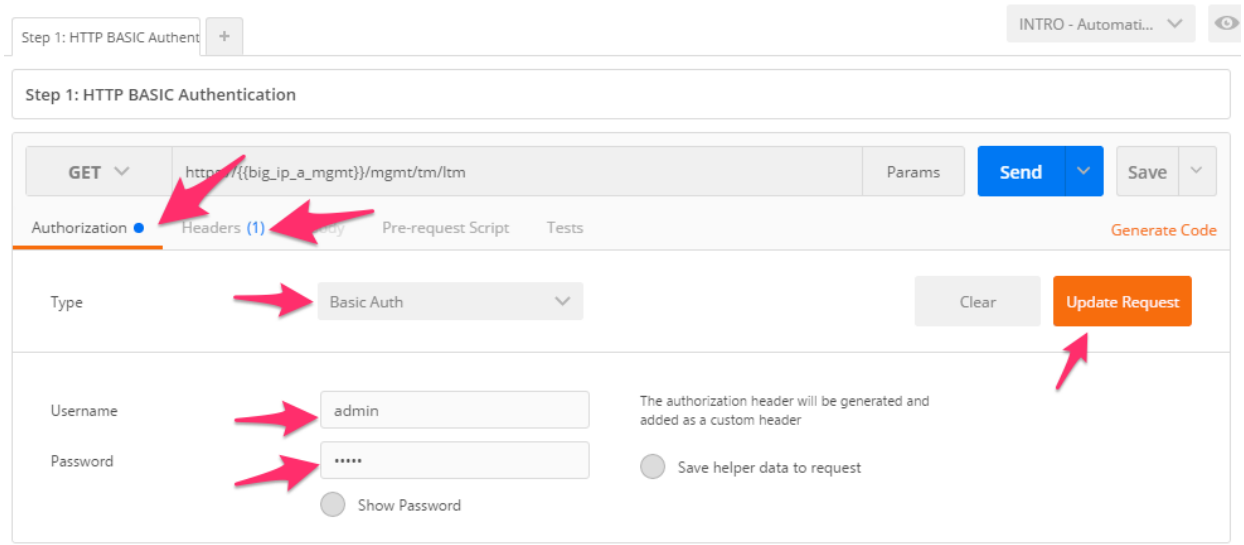
1. Open the Postman tool by clicking the  icon of the taskbar of your Windows Jumphost
2. To assist in multi-step procedures we make heavy use of the 'Environments' capability in Postman. This capability allows us to set various global variables that are then substituted into a request before it's sent. When you open Postman please verify that your environment is set the 'INTRO - Automation & Orchestration Lab' environment:



3. Click the 'Collections' tab on the left side of the screen, expand the 'F5 Automation & Orchestration Intro' collection on the left side of the screen, expand the 'Lab 1.2 – API Authentication' folder:



4. Click the 'Step 1: HTTP BASIC Authentication' item. Click the 'Authorization' tab and select 'Basic Auth' as the Type. Fill in the username and password (admin/admin) and click the 'Update Request' button. Notice that the number of Headers in the Headers tab changed from 1 to 2. This is because Postman automatically created the HTTP header and updated your request to include it. Click the 'Headers' tab and examine the HTTP header:



5. Click the 'Send' button to send the request. If the request succeeds you should be presented with a listing of the '/mgmt/tm/ltm' Organizing Collection.
6. Update the credentials and specify an INCORRECT password. Send the request again and examine the response:

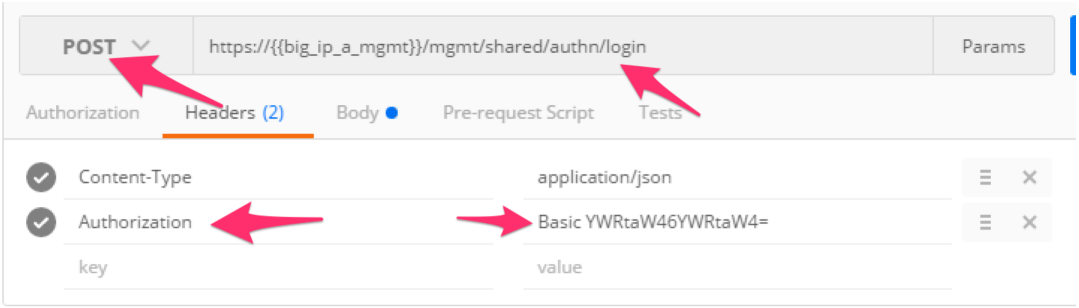
Task 2 – Token Based Authentication

One of the disadvantages of BASIC Authentication is that credentials are sent with each and every request. This can result in a much greater attack surface being exposed unnecessarily. As a result Token Based Authentication (TBA) is preferred in many cases. This method only sends the credentials once, on the first request. The system then responds with a unique token for that session and the consumer then uses that token for all subsequent requests. Both BIG-IP and iWorkflow support token-based authentication that drops down to the underlying authentication subsystems available in TMOS. As a result the system can be configured to support external authentication providers (RADIUS, TACACS, AD, etc) and those authentication methods can flow through to the REST API. In this task we will demonstrate TBA using the local authentication database, however, authentication to external providers is fully supported.

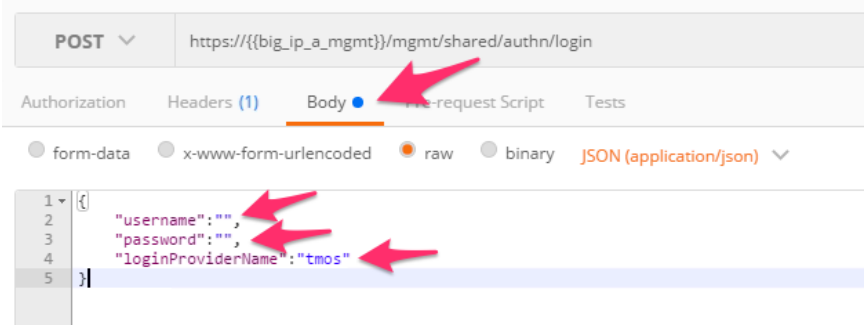
> For more information about external authentication providers see the section titled "**About external authentication providers with iControl REST**" in the iControl REST API User Guide available at https://devcentral.f5.com

Perform the following steps to complete this task:

1. Click the 'Step 2: Get Authentication Token' item in the Lab 1.2 Postman Collection
2. Notice that we send a POST request to the '/mgmt/shared/authn/login' endpoint. Additionally, BASIC Authentication is required on the initial token request:

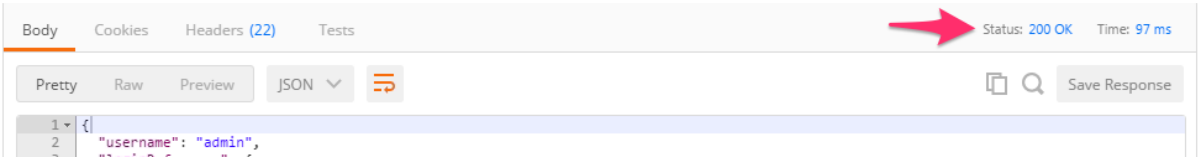


3. Click the 'Body' tab and examine the JSON that we will send to BIG-IP to provide credentials and the authentication provider:



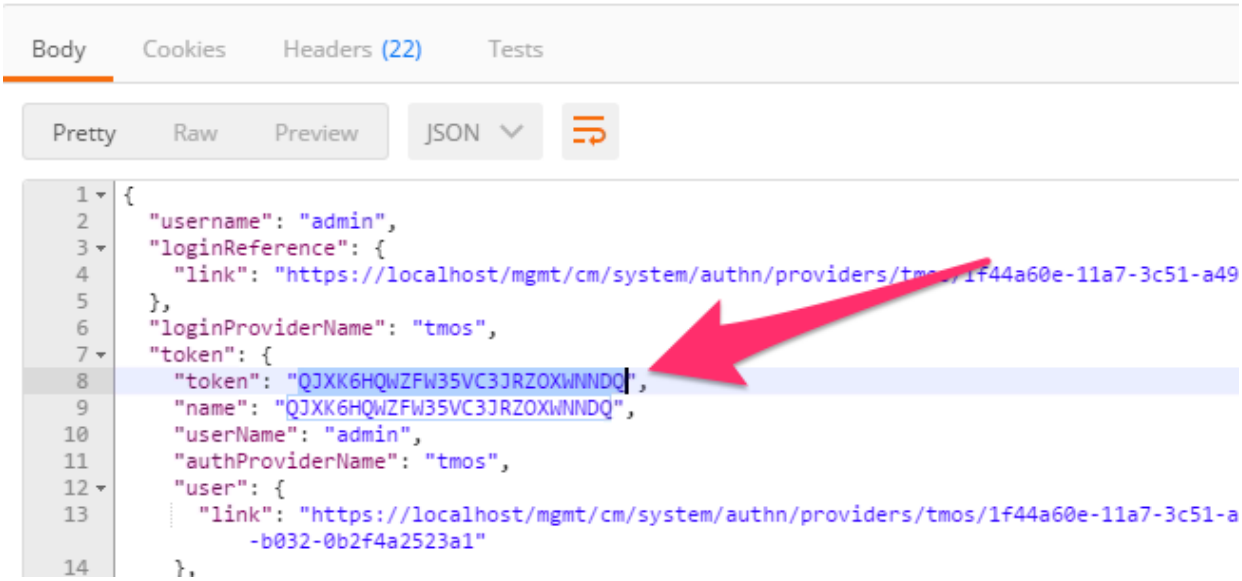
4. Modify the JSON body and add the required credentials (admin/admin). Then click the 'Send' button.
5. Examine the response status code. If authentication succeeded and a token was generated the response will have a 200 OK status code. If the status code is 401 then check your credentials:

Successful:

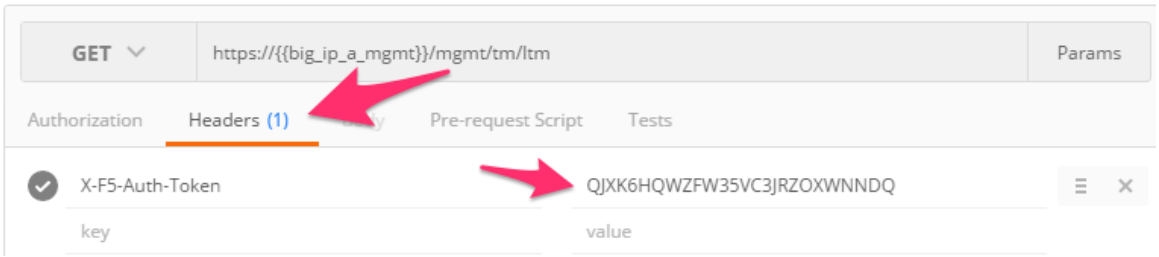


Unsuccessful:

6. Once you receive a 200 OK status code examine the response body. The various attributes show the parameters assigned to the particular token. Find the 'token' attribute and copy it into your clipboard (Ctrl+c) for use in the next step:

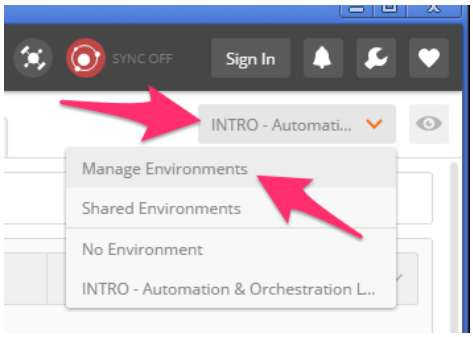


7. Click the 'Step 3: Verify Authentication Works' item in the Lab 1.2 Postman collection. Click the 'Headers' tab and paste the token value copied above as the VALUE for the 'X-F5-Auth-Token' header. This header is required to be sent on all requests when using token based authentication.

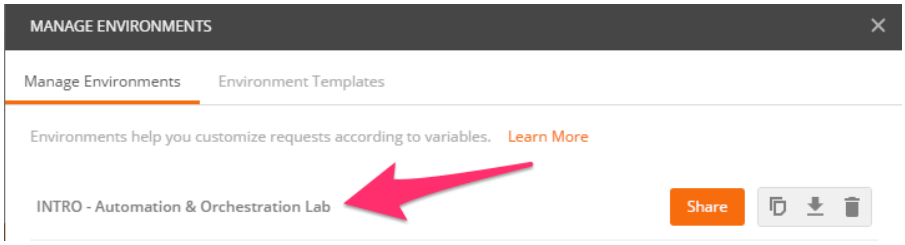


8. Click the 'Send' button. If you're request is successful you should see a '200 OK' status and a listing of the 'ltm' Organizing Collection.

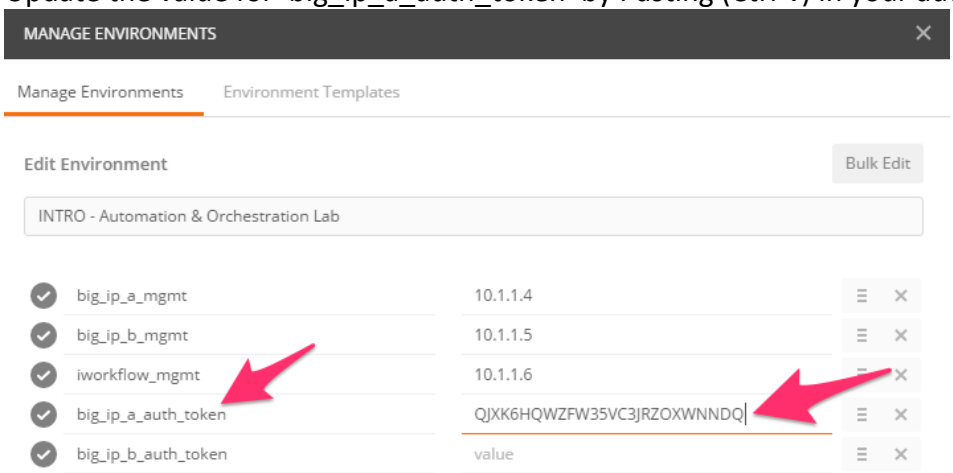
9. We will now update your Postman environment to use this auth token for the remainder of the lab. Click the Environment menu in the top right of the Postman window and click 'Manage Environments':



10. Click the 'INTRO – Automation & Orchestration Lab' item:

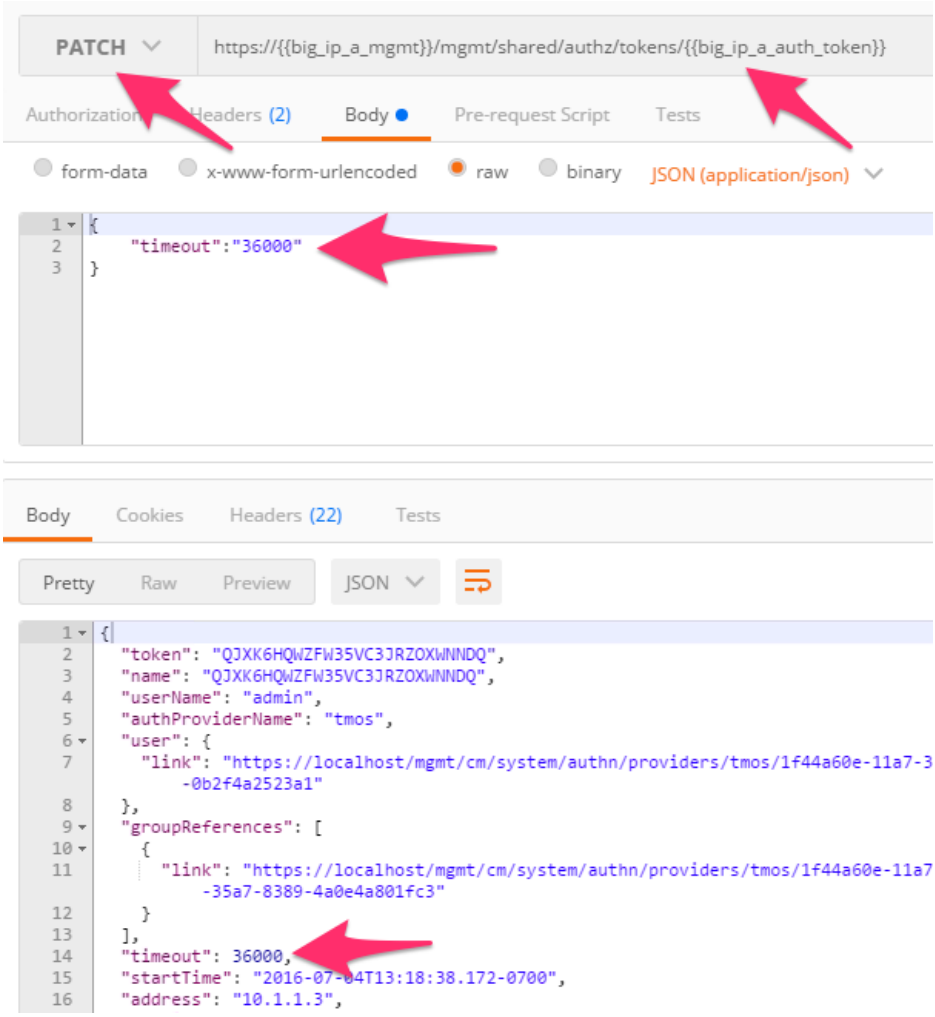


11. Update the value for 'big_ip_a_auth_token' by Pasting (Ctrl-v) in your auth token:



12. Click the 'Update' button and then close the 'Manage Environments' window. You're subsequent requests will now automatically include the token.

13. Click the ‘Step 4: Set Authentication Token Timeout’ item in the Lab 1.2 Postman collection. This request will PATCH your token Resource (check the URI) and update the timeout attribute so we can complete the lab easily. Examine the request type and JSON Body and then click the ‘Send’ button. Verify that the timeout has been changed to ‘36000’ in the response:



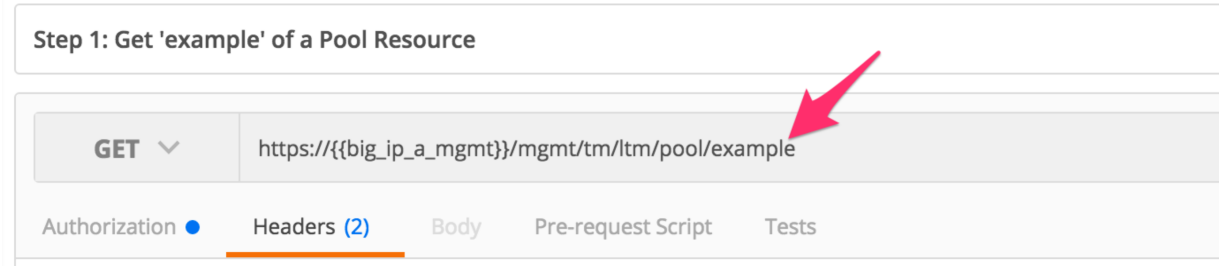
Task 2 – Get a pool ‘example’ Template

In order to assist with REST API interactions you can request a template of the various attributes of a Resource type in a Collection. This template can then be used as the body of a POST, PUT or PATCH request as needed.

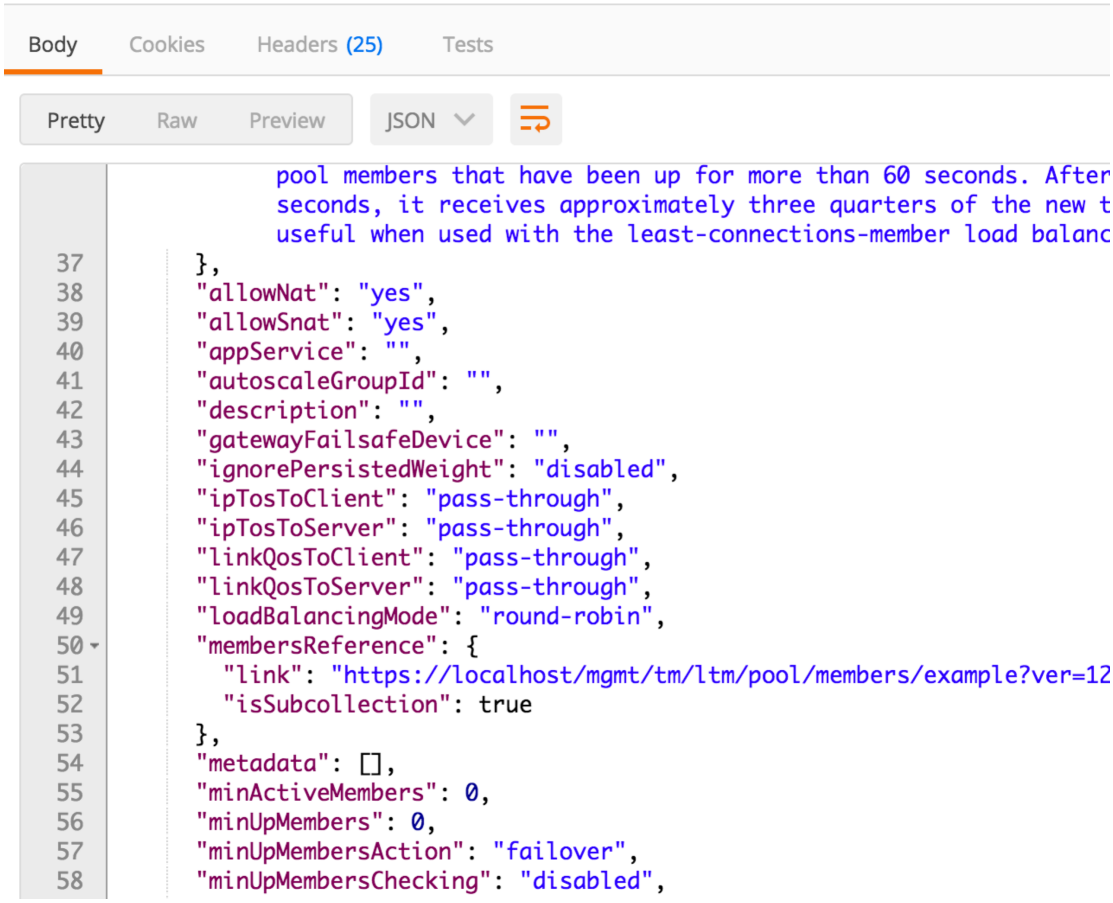
Perform the following steps:

1. Click the ‘Step 5: Get ‘example’ of a Pool Resource’ item in the Lab 1.2 Postman collection

2. Examine the URI. Notice the addition of example at the end of the collection name:



3. Click 'Send' and examine the FULL response. You will see descriptions and then all the attributes for the Pool resource type. The response also shows the default values for the attributes if applicable:



Lab 1.3 – Review/Set Device Settings

Your BIG-IP-A device is already licensed, so now we can focus on configuring the basic infrastructure related settings to complete the Device Onboarding process. The remaining items include (list not exhaustive):

- Device Settings
  - **NTP/DNS Settings**
  - Remote Authentication
  - **Hostname**
  - **Admin Credentials**
- L1-3 Networking
  - Physical Interface Settings
  - L2 Connectivity (**VLAN**, VXLAN, etc.)
  - L3 Connectivity (**Self IPs, Routing**, etc.)
- HA Settings
  - **Global Settings**
    - **Config Sync IP**
    - **Mirroring IP**
    - **Failover Addresses**
  - **CMI Device Trusts**
  - **Device Groups**
  - **Traffic Groups**
  - **Floating Self IPs**

We will specifically cover the items in **BOLD** above in the following labs. It should be noted that many permutations of the Device Onboarding process exist due to the nature of customer environments. This class is designed to teach enough information so that you can then apply the knowledge learned and help articulate and/or deliver a specific solution for your environment.

Task 1 – Set Device Hostname & Disable GUI Setup Wizard

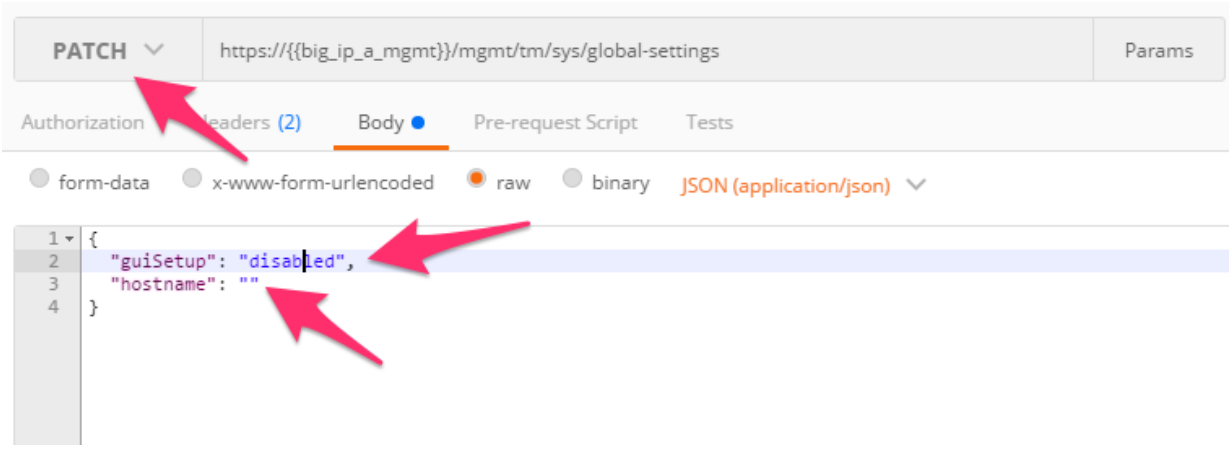
In this task we will modify the device hostname and disable the GUI Setup Wizard. The Resource that contains these settings is '/mgmt/tm/sys/global-settings'.

Perform the following steps to complete this task:

1. Expand the "Lab 1.3 – Review/Set Device Settings" folder in the Postman collection
2. Click the "Step 1: Get System Global-Settings" item. Click the 'Send' button and review the response body to see what the current settings on the device are.
3. Click the "Step 2: Set System Global-Settings" item. This item uses a PATCH request to the global-settings resource to modify the attributes contained within it. We will update the 'guiSetup' and 'hostname' attribute.

   Review the JSON body and modify the 'hostname' attribute to set the hostname to "bigip-a.f5se.local".

Also notice that we are disabling the GUI Setup Wizard as part of the same request:



4. Click the 'Send' button and review the response body. You should see that the attributes modified above have been updated. You can also GET the global-settings again to verify they have been updated.

Task 2 – Modify DNS/NTP Settings

Much like the previous task we can update system DNS and NTP settings by sending a PATCH request to the correct resource in the 'sys' Organizing Collection. The relevant Resources for this task are:

URL	Type
/mgmt/tm/sys/dns	DNS Settings
/mgmt/tm/sys/ntp	NTP Settings

Perform the following steps to complete this task:

1. Click the "Step 3: Get System DNS Settings" item in the collection. Click 'Send' and review the current settings
2. Click the "Step 4: Set System DNS Settings" item in the collection. Modify the JSON body to add a name server with IP '4.2.2.2'. Additionally add a search domain of 'f5se.local'. You will modify a JSON array for both of these attributes. The format of a JSON array is:

```
"myAttribute": [ "item1","item2","item3" ]
```

3. Click the 'Send' button and verify the requested changes were successfully implemented
4. Click the "Step 5: Get System NTP Settings" item in the collection. Click 'Send' and review the current settings
5. Click the "Step 6: Set System NTP Settings" item in the collection. Modify the JSON body to add a NTP server with hostname 'pool.ntp.org' to the 'servers' attribute (another JSON array!)
6. Click the 'Send' button and verify the requested changes were successfully implemented

Task 3 – Update default user account passwords

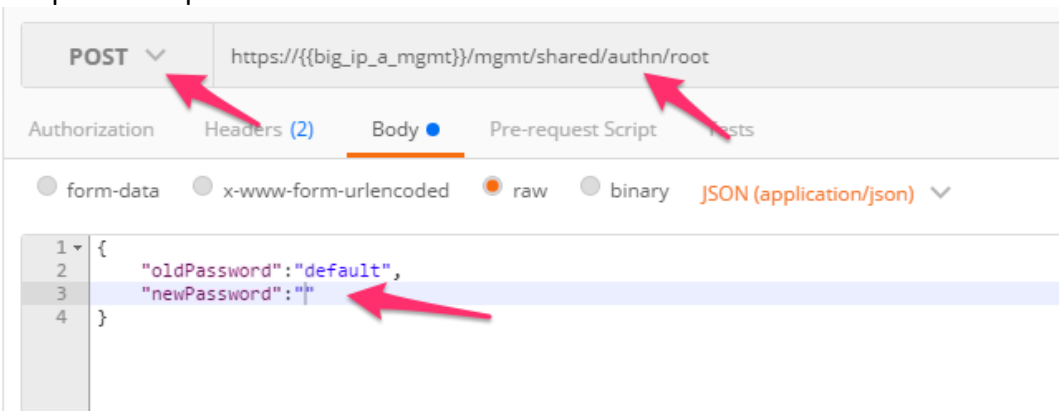
In this task we will update the passwords for the 'root' and 'admin' accounts. The process for updating the root account is different then other system accounts due to the special nature of the root account.

To update the root account password we will use a POST to a shared REST worker at /mgmt/shared/authn/root

To update all other system accounts we will PATCH the /mgmt/auth/user/<username> Resource

Perform the following steps to change the **root** user password:

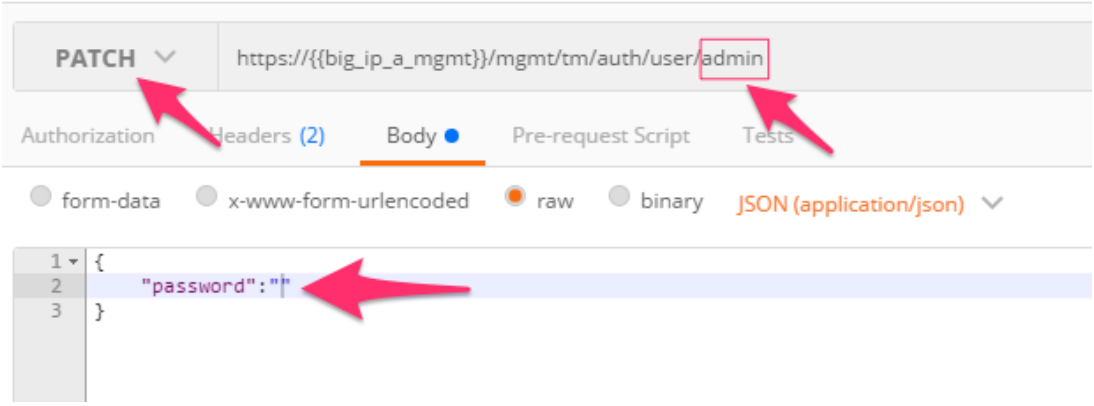
1. Click the "Step 7: Set root User Password" item in the collection.
2. Notice that we a performing a POST operation to a shared REST worker. Modify the JSON body to update the password to the value "newdefault" and click the 'Send' button.



3. You can verify the password was changed by opening an SSH session using PuTTY to BIG-IP-A.
4. **Repeat the procedure above to change the password back to "default"**

Perform the following steps to change the **admin** user password:

1. Click the "Step 8: Set admin User Password" item in the collection.
2. Notice that we a performing a PATCH operation to admin user Resource. Modify the JSON body to update the password to the value "newadmin" and click the 'Send' button.



3. You can verify the password was changed by opening an SSH session using PuTTY to BIG-IP-A OR by logging into TMUI in a Chrome browser tab.
4. **Repeat the procedure above to change the password back to "admin"**

Lab 1.4 – Basic Network Connectivity

This lab will focus on configuration of the following items:

- L1-3 Networking
  - Physical Interface Settings
  - L2 Connectivity (**VLAN**, VXLAN, etc.)
  - L3 Connectivity (**Self IPs, Routing**, etc.)

We will specifically cover the items in **BOLD** above in the following labs. It should be noted that many permutations of the Device Onboarding process exist due to the nature of customer environments. This class is designed to teach enough information so that you can then apply the knowledge learned and help articulate and/or deliver a specific solution to your customer.

The following table lists the L2-3 network information used to configure connectivity for BIG-IP-A:

Type	Name	Details
VLAN	Internal	Interface: 1.1 Tag: 10
VLAN	External	Interface: 1.2 Tag: 20
Self IP	Self-Internal	Address: 10.1.10.1/24 VLAN: Internal
Self IP	Self-External	Address: 10.1.20.1/24 VLAN: External
Route	Default	Network: 0.0.0.0/0 GW: 10.1.20.254

Task 1 – Create VLANs

Perform the following steps to configure the VLAN objects/resources:

1. Expand the "Lab 1.4 – Basic Network Connectivity" folder in the Postman collection.
2. Click the "Step 1: Create a VLAN" item in the collection. Examine the JSON body; the values for creating the Internal VLAN have already been populated.
3. Click the 'Send' button to create the VLAN
4. Repeat Step 1, however, this time modify the JSON body to create the External VLAN using the parameters in the table above.
5. Click the "Step 2: Get VLANs" item in the collection. Click the 'Send' button to GET the VLAN collection. Examine the response to make sure both VLANs have been created.

Task 2 – Create Self IPs

Perform the following steps to configure the Self IP objects/resources:

1. Click the "Step 3: Create a Self IP" item in the collection. Examine the JSON body; the values for creating the Self-Internal Self IP have already been populated.
2. Click the 'Send' button to create the Self IP
3. Repeat Step 1, however, this time modify the JSON body to create the Self-External Self IP using the parameters in the table above.
4. Click the "Step 4: Get Self IPs" item in the collection. Click the 'Send' button to GET the Self IP collection. Examine the response to make sure both Self IPs have been created.

Task 3 – Create Routes

Perform the following steps to configure the Route object/resource:

1. Click the "Step 5: Create a Route" item in the collection. Examine the JSON body; the values for creating the Default Route have already been populated.
2. Click the 'Send' button to create the Route
3. Click the "Step 6: Get Routes" item in the collection. Click the 'Send' button to GET the routes collection. Examine the response to make sure the route has been created.

Lab 1.5 – Build a BIG-IP Cluster

In this lab we will build a active-standby cluster between BIG-IP-A and BIG-IP-B. As mentioned previously, to save time, BIG-IP-B already has already been licensed and had its device level settings configured. This lab will walk you through creating the cluster step by step. As you will see complex operation such as this start to become less effective using the **Imperative** model of automation. Clustering is one of the 'transition' points for most customer to move into the **Declarative** model (if not already done) due to the need to abstract device/vendor level specifics from Automation consumers.

The high-level procedure required to create the cluster is:

1. Rename the CMI 'Self' Device name to match the hostname of the Device
2. Set BIG-IP-A & BIG-IP-B CMI Parameters (Config Sync IP, Failover IPs, Mirroring IP)
3. Add BIG-IP-B as a trusted peer on BIG-IP-A
4. Check the device_trust_group Sync Group Status
5. Create a sync-failover Device Group
6. Check the status of the created Device Group
7. Perform initial sync of the Device Group
8. Check status (again)
9. Change the Traffic Group to use HA Order failover (not required but shown as an example)
10. Create Floating Self IPs

Task 1 – Rename objects and Setup CMI Global Parameters

In this task we will complete Items 1&2 from the list high-level procedure at the beginning of the lab. One of the idiosyncrasies of BIG-IP is that when you use the GUI Setup Wizard to set the hostname of the device, the wizard automatically renames the CMI 'Self' device to match the hostname. Since we configured the hostname via a REST call earlier this action did not take place.

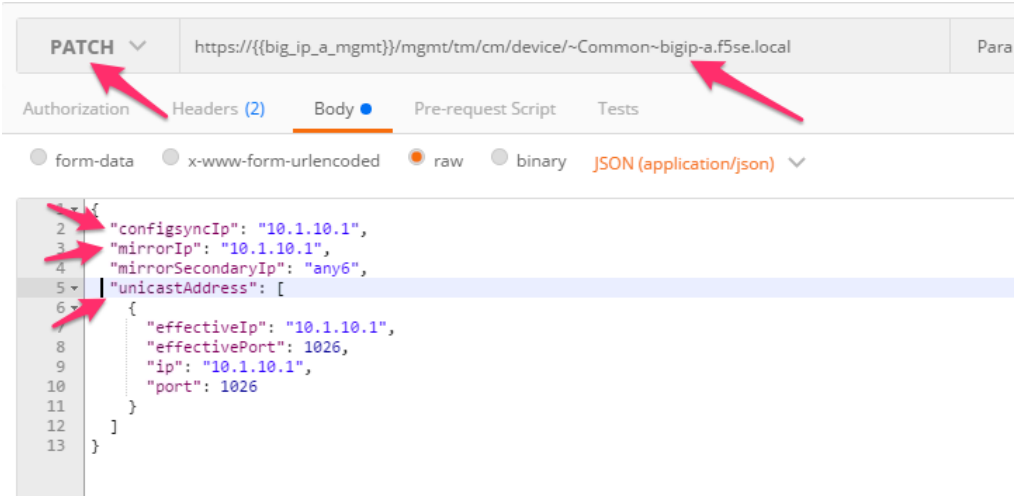
Perform the following steps to rename the CMI 'Self' device:

1. Expand the "Lab 1.5 – Build a Cluster" folder in the Postman collection
2. Click the "Step 1: Rename the CMI Self Device' item in the collection
3. Examine the URI and JSON body. We are sending a POST request to execute the equivalent of a tmsh 'mv' command to rename the existing object to the '/mgmt/tm/cm/device' Collection.

   The 'name' attribute specifies the current name of the object (the factory default name), while the 'target' attribute specifies the new name of the object.
4. Click the 'Send' button to rename the Resource.
5. Change the request type from a POST to a GET and click 'Send'. Examine the response to make sure the name was changed successfully.

Perform the following steps to set CMI Device Parameters

1. Click the "Step 2: Set BIGIP-A CMI Device Parameters" item in the collection. Examine the operation (PATCH), URI and JSON body. We will PATCH the newly renamed object (from the previous step) and assign the Config Sync IP, Unicast Failover Address/Port and Mirroring IPs:



2. Click the 'Send' button and examine the response to ensure the settings were changed
3. Click the "Step 3: Set BIGIP-B CMI Device Parameters" item in the collection. Examine the operation (PATCH), URI and JSON body. We will PATCH the newly renamed object (from the previous step) and assign the Config Sync IP, Unicast Failover Address/Port and Mirroring IPs.

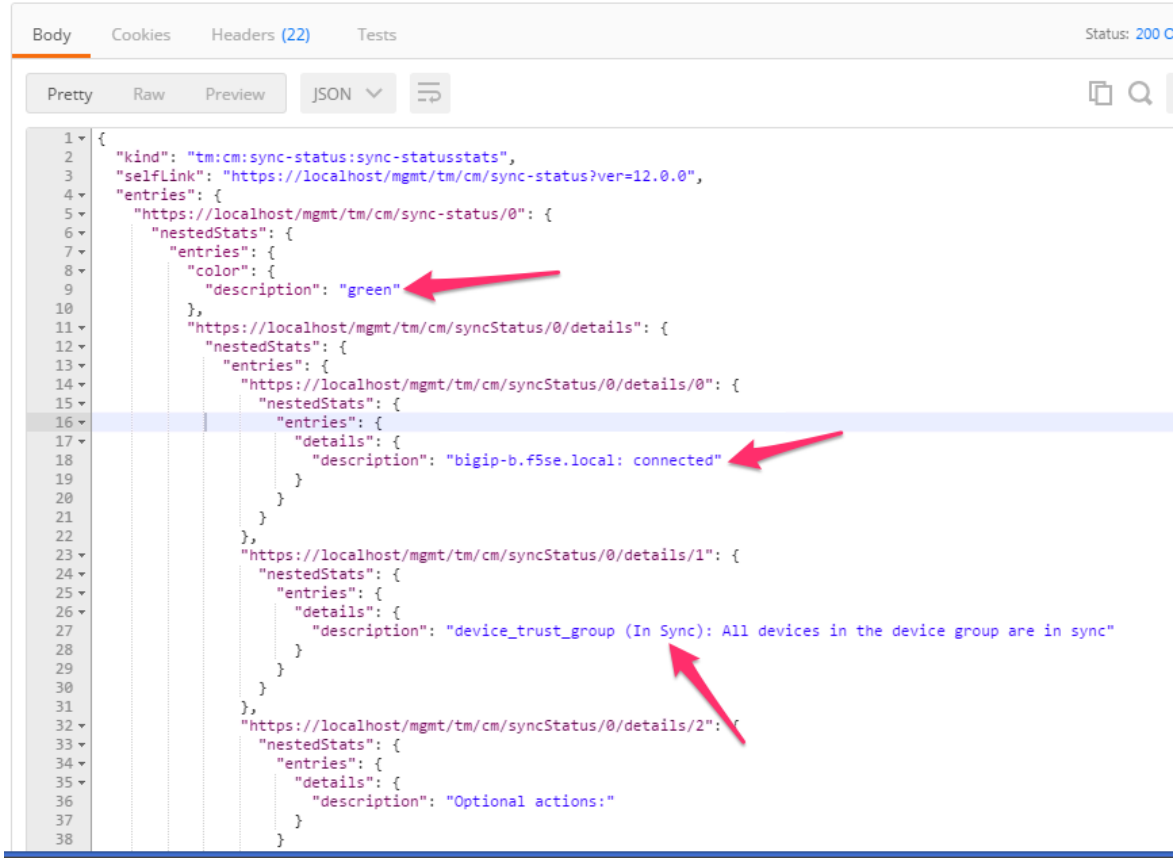
   EXTRA CREDIT: How is authentication to BIG-IP-B working if we never got an authentication token? (Hint: we cheated)
4. Click the 'Send' button and examine the response to ensure the settings were changed

Task 2 – Add BIG-IP-B as a Trusted Peer

The CMI subsystem relies on a PKI based device trust model to establish relationships between BIG-IP systems. In this task we will add BIG-IP-B as a trusted peer of BIG-IP-A. Establishing a trust relationship is automatically a bi-directional operation. As a result, when we establish the trust relationship, BIG-IP-B will automatically establish a trust relationship with BIG-IP-A. This task corresponds to items 3&4 in the high-level procedure.

Perform the following steps to complete this task:

1. Click the "Step 4: Add BIGIP-B Device to CMI Trust on BIGIP-A" item in the collection
2. Examine the operation (POST), URI and JSON body. We are using a special REST worker to add the device to the CMI trust. Additionally the JSON body must be specified in a very specific manner to ensure this step completes successfully. To minimize the chance for error the values have been completed for you already. You should, however, review and understand this step fully before continuing.
3. Click the 'Send' button. The response for this request does NOT indicate success, only that the command is running.
4. To check for success we have to check the status of the Sync Group named "device_trust_group". To do this click the "Step 5: Check Sync Group Status" item in the collection. This request will GET the sync status for all sync groups on the system
5. Click the 'Send' button and examine the response. The should indicate a color of 'green', that bigip-b.f5se.local is connected and 'In Sync' (please notify an instructor of any issue):

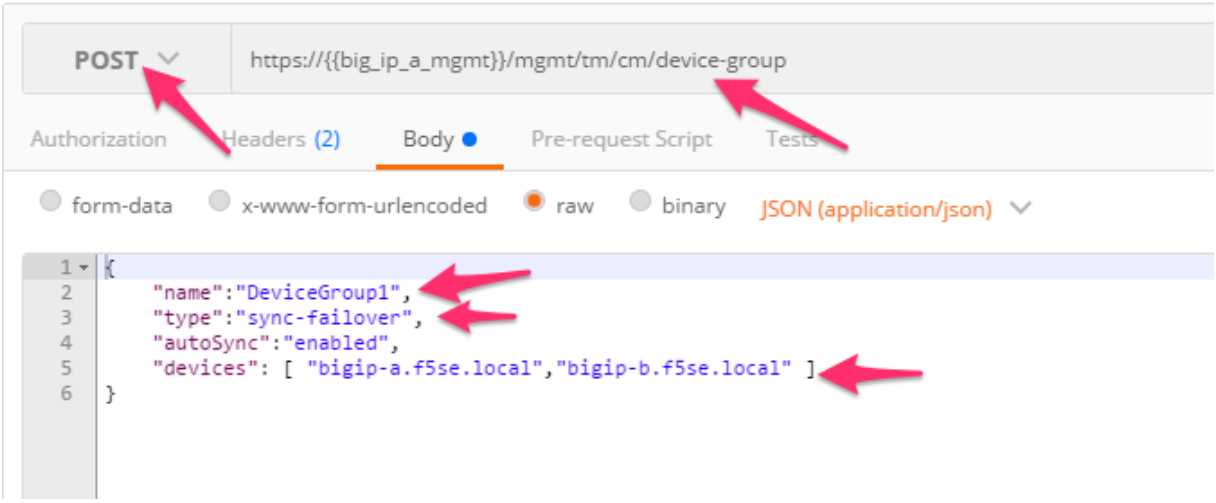


Task 3 – Create a sync-failover Device Group

This task will create a Device Group object that will contain the two BIG-IP systems. The type of device-group will be a 'sync-failover' group, however, 'sync-only' groups can also be created with the same procedure but different attribute values. This task corresponds to items 5-8 in the high-level procedure.

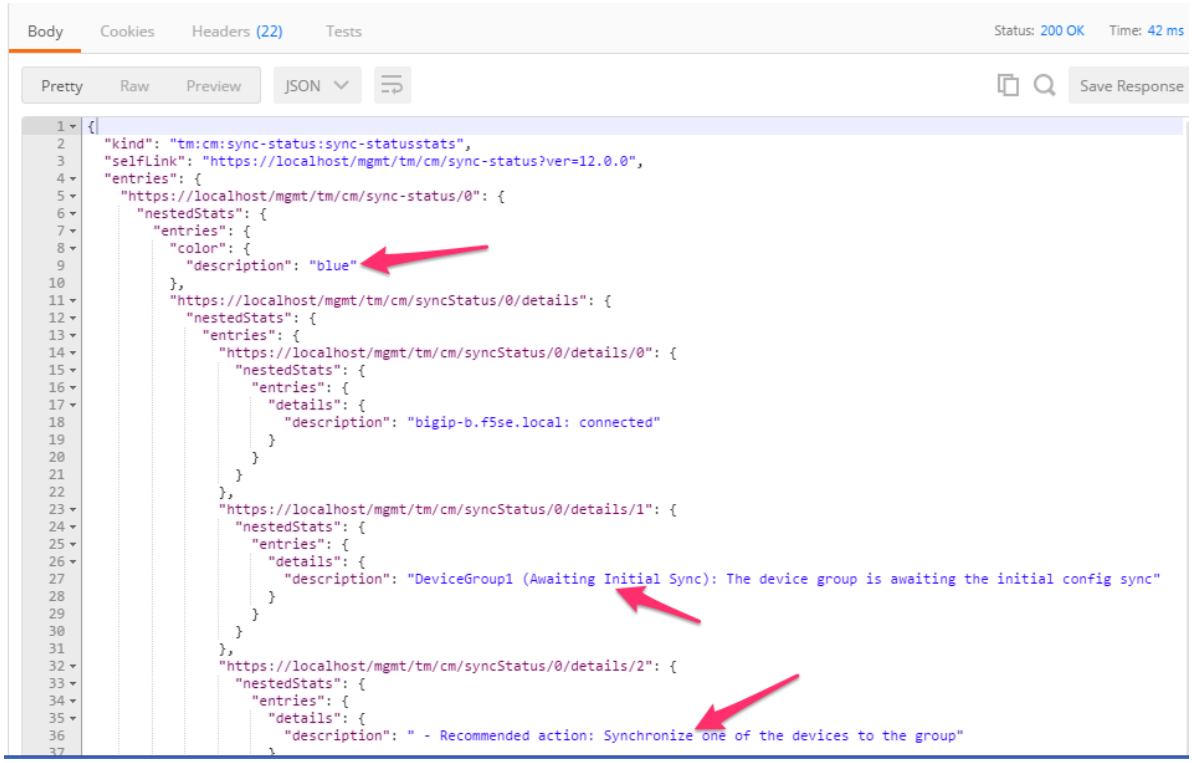
Perform the following steps to complete this task

1. Click the "Step 6: Create Device Group" item in the collection. Examine the request type, URL and JSON body. We will POST to the '/mgmt/tm/cm/device-group' collection and create a new Resource called DeviceGroup1 that includes both BIG-IP devices and is set to 'sync-failover' type. We are also setting the device-group to 'autosync' so manual syncing is not required when configuration changes occur:

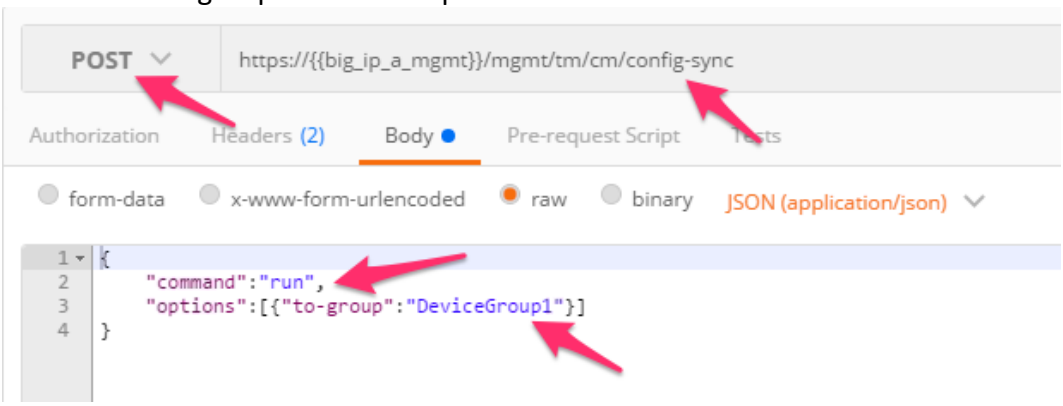


2. Click the 'Send' button and examine the response.

3. To check the status of the device-group we have to check the status of the underlying sync group on the system. Click the 'Step 7: Check Sync Group Status' item in the collection and click 'Send'. Examine the response and take note that the system is 'Awaiting Initial Sync':



4. We will now manually sync DeviceGroup1 to fulfill the need for the Initial Sync. Click the 'Step 8: Manually Sync DeviceGroup1' item in the collection. Examine the request type, URL and JSON body. We will POST the the '/mgmt/tm/cm/config-sync' worker and tell it to 'run' a config-sync of BIG-IP-A 'to-group' DeviceGroup1:



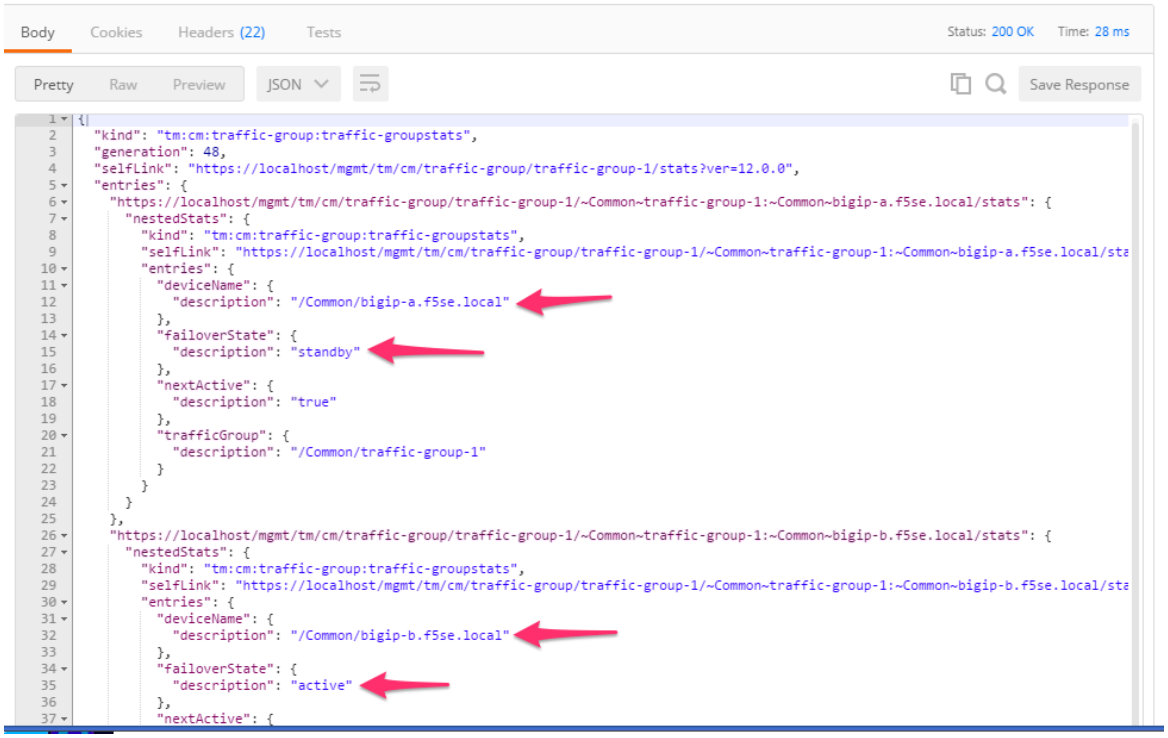
5. Click 'Send' to initiate the sync
6. Click the 'Step 9: Check Sync Group Status' item in the collection and click the 'Send' button. Examine the response to make sure that DeviceGroup1 is 'In Sync'. You may have to click 'Send' multiple times as the sync operation can take a while to complete.

Task 4 – Perform Additional Operations

The remainder of the steps show how to manipulate various common items related to the HA config. In this task we will change the Traffic Group to use the 'HA Order' failover method. We will then initiate a failover and show how to view the status of the traffic-group.

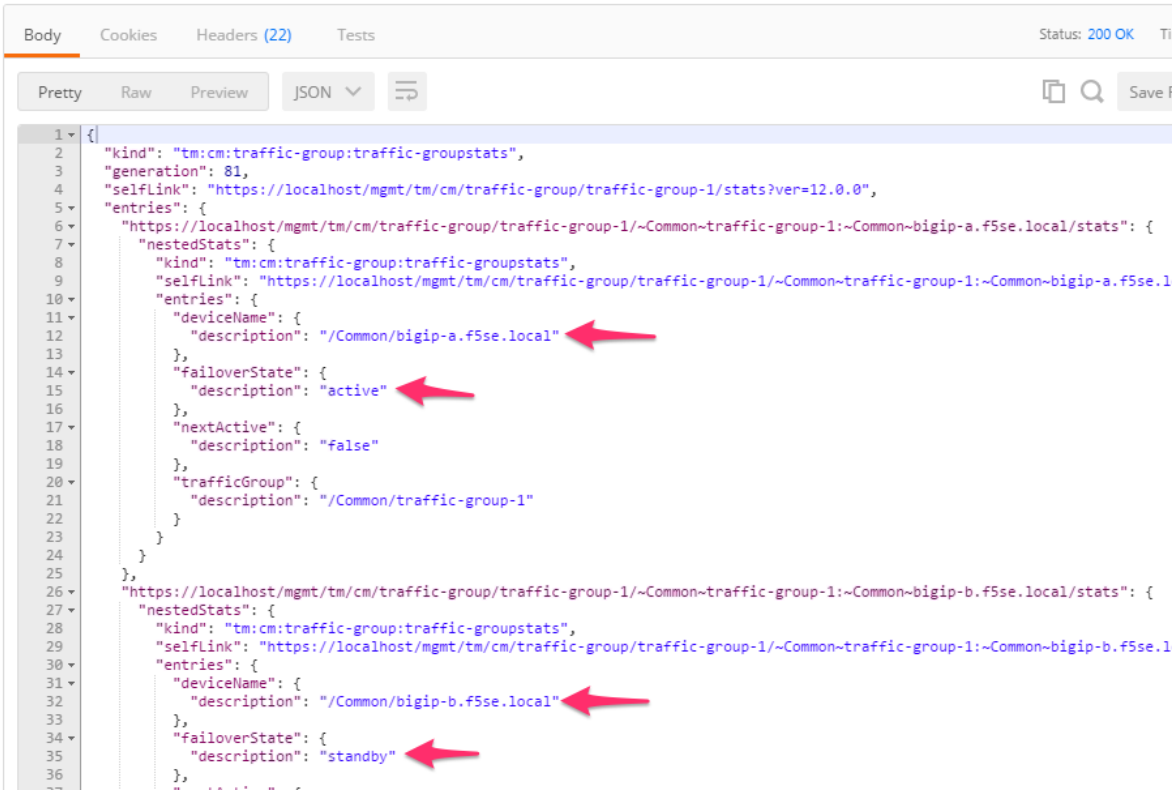
Perform the following steps to complete this task:

1. Click the "Step 10: Get Traffic Group Properties" item in the collection. Examine the URL, we will GET the attributes of the 'traffic-group-1' resource from the traffic-group collection. Click the 'Send' button and review the response.
2. Click the "Step 11: Change Traffic Group to use HA Order" item in the collection. Examine the request type, URL and JSON body. We will PATCH the existing resource and specify an 'haOrder' attribute to change the traffic-group behavior.
3. Click the 'Send' button and examine the response to verify the change was successful.
4. Click the "Step 12: Get Traffic Group Failover States" item in the collection and click the 'Send' button. Examine the response and determine which device is 'active' for the traffic-group:



5. Click EITHER the "Step 13A" or "Step 13B" item in the collection depending on which device is ACTIVE for the traffic group. Notice that we are sending the request to the ACTIVE device for the traffic group. Examine the JSON body and click the 'Send' button.

6. Click the “Step 14: Get Traffic Group Failover States” item in the collection and click the ‘Send’ button. Examine the response to determine that the failover occurred properly:



Task 5 – Create Floating Self IPs

To complete the HA config we will now create a Floating Self IP on the Internal VLAN.

Perform the following steps to complete this task:

1. Click the “Step 15: Create a Floating Self IP” item in the collection. Examine the request type, URL and JSON body. We will create a new resource in the ‘/mgmt/tm/net/self’ collection named ‘Self-Internal-Floating’ and an IP address of 10.1.10.3.
2. Click the ‘Send’ button and examine the response
3. Click the “Step 16: Get Self IPs” item in the collection and click ‘Send’. Examine the response and verify the Self IP was created.

Lab 1.6 – Build a Basic LTM Config

In this lab we will build a basic LTM Config using the Imperative automation model. While this lab may seem simple for basic configurations, the complexity involved with rich L4-7 services quickly makes the Imperative approach untenable for advanced configurations. The Imperative model relies on the user having in-depth knowledge of device specifics such as:

- Object types and their attributes

    - How many different objects/profiles/options do we have?
- Order of operations
    - Monitor before pool before profiles before virtual servers, etc.
    - What about L7 use cases like WAF?
        - WAF Policy -> HTTP Policy -> Virtual Server
- How does this all get deleted?
    - You have to reverse the order of operations and 'undo' the whole config
        - TMOS has lots of issues here

As a result of this it's recommended for customers to use Imperative automation only for legacy environments. New environments should shift to a Declarative model.

Task 1 – Build a Basic LTM Config

Perform the following steps to complete this task:

1. Expand the "Lab 1.6 – Build a Basic LTM Config" folder in the Postman collection
2. Click each Step in the folder and 'Send' the request. Verify each component is created on the BIG-IP device using the GUI.
3. After the steps are completed you should be able to connect to http://10.1.20.129 in your browser.

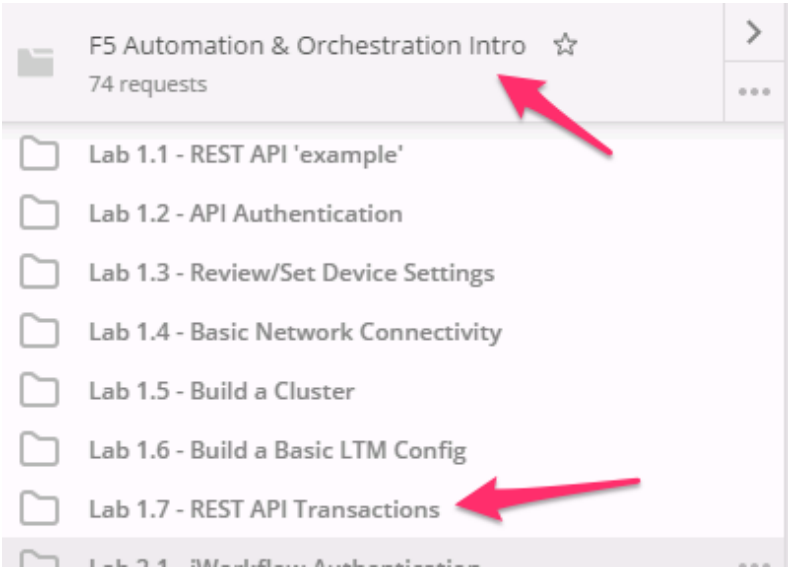
Lab 1.7 – REST API Transactions

Task 1 – Create a Transaction

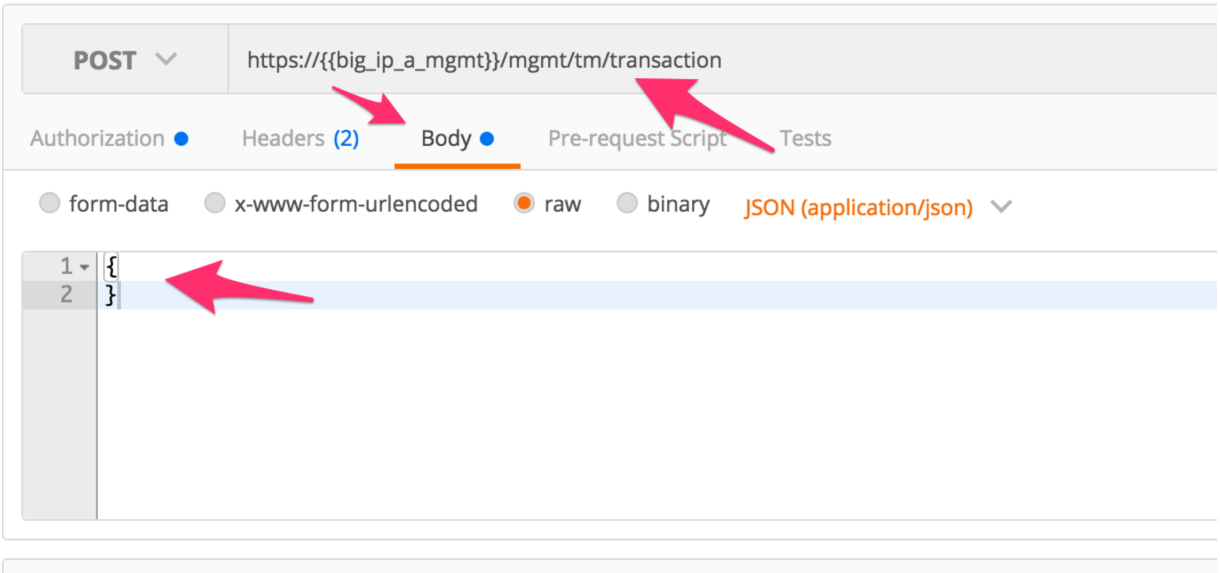
In this lab we will create a transaction using the REST API. Transactions are very useful in cases where you would want discreet REST operations to act as a batch operation. As a result the nature of a transaction is that either all the operations succeed or none of them do. This is very useful when creating a configuration that is linked together because it allows the roll back of operations in case one fails.

Perform the following steps to complete this task:

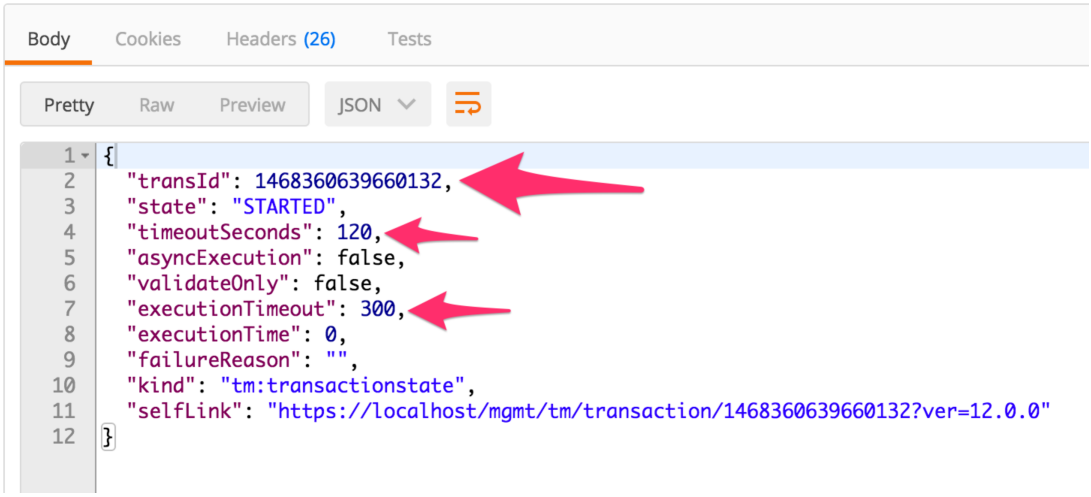
1. Expand the 'Lab 1.7 – Rest API Transactions' folder in the Postman collection:

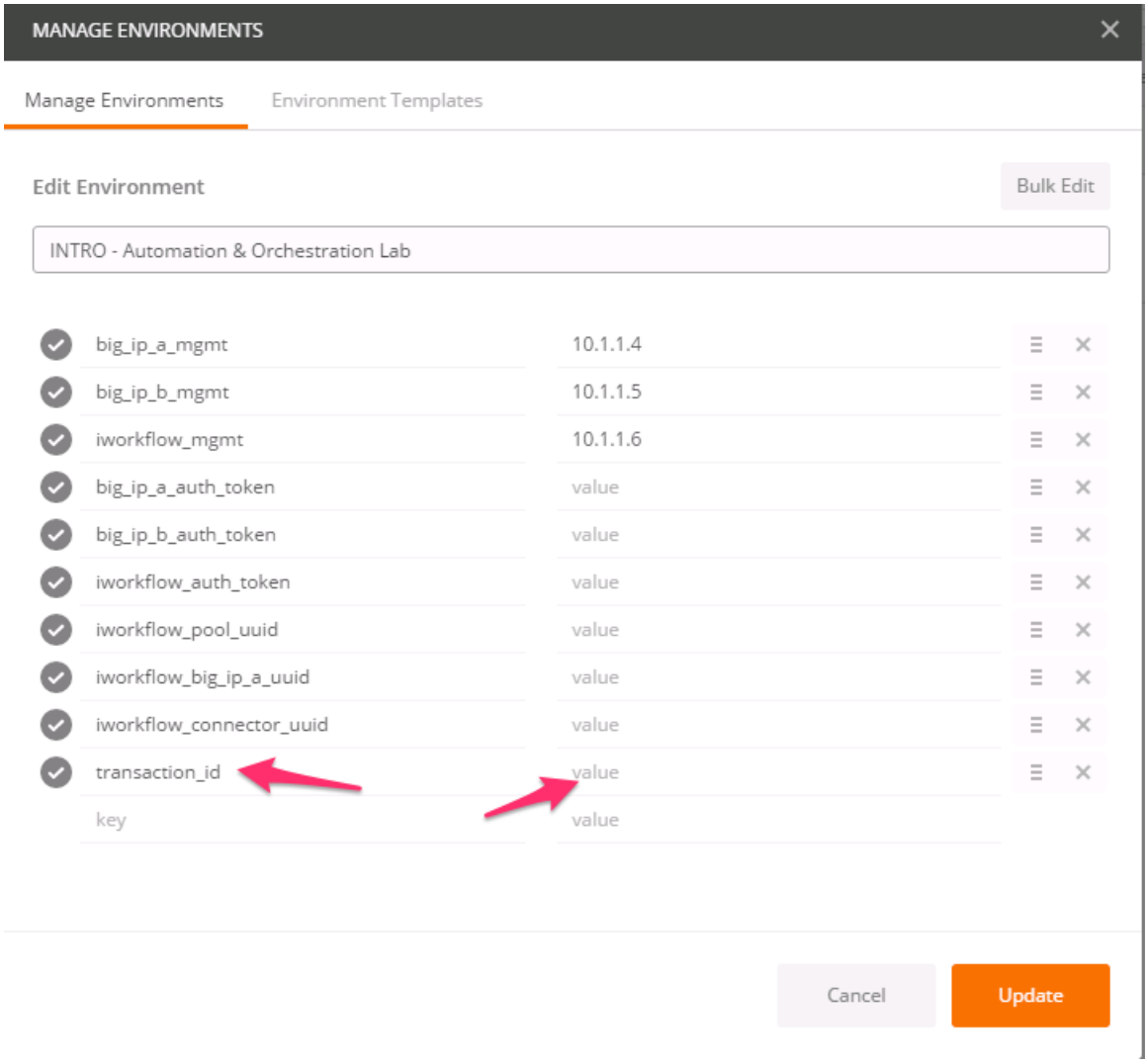


2. Click the 'Step 1: Create a Transaction' item. Examine the URL and JSON body. We will send a POST to the /mgmt/tm/transaction worker with an empty JSON body to create a new transaction.



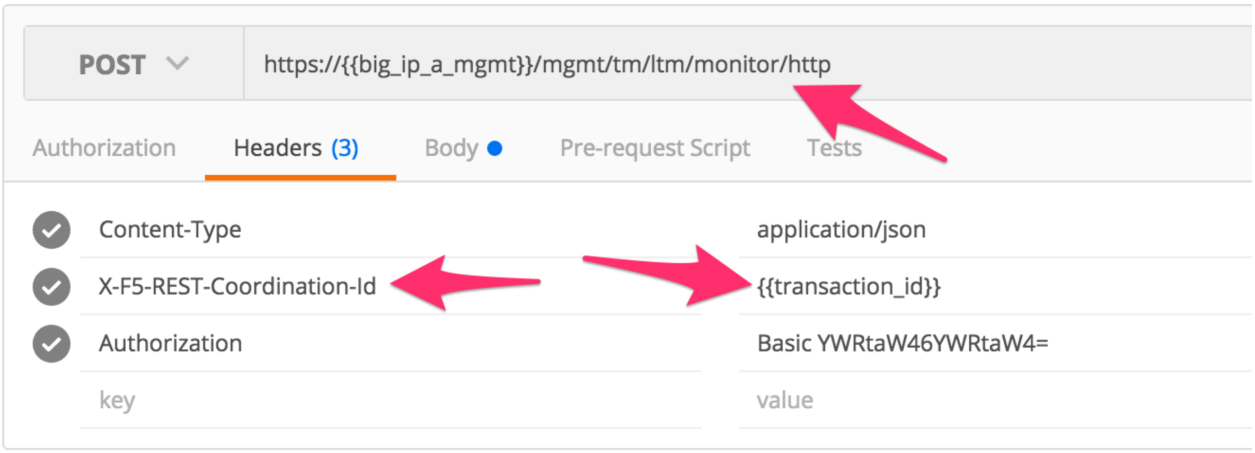
3. Click the 'Send' button to send the request. Examine the response and find the 'transId' attribute. Save the value of this attribute in the 'transaction_id' environment variable. Additionally notice that there are timeouts for both the submission of the transaction and how long it should take to execute:



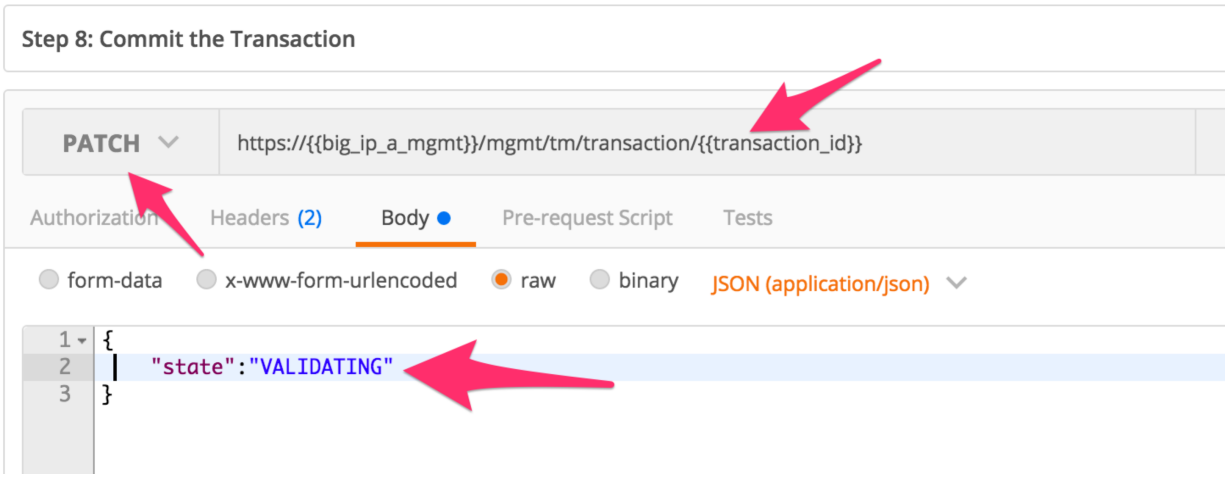


4. Click the 'Step 2: Add to Transaction: Create a HTTP Monitor' item in the Postman collection. This request is the same as a non-transaction enabled request in terms of the request type (POST), URI and JSON body. The difference is we add a 'X-F5-REST-Coordination-Id' header with

a value of the 'transId' attribute to add it to the transaction:



5. Click the 'Send' button and examine the response
6. Examine and click 'Send' on Steps 3-6 in the collection
7. Click 'Step 7: View the Transaction'. Examine the request type and URI and click 'Send'. This request allows you to see the current list of commands (ordered) that are in the transaction.
8. Click the 'Step 8: Commit the Transaction' item in the collection. Examine the request type, URI and JSON body. We will PATCH our transaction resource and change the value of the 'state' attribute to submit the transaction:



9. Click the 'Send' button and examine the response.
10. Verify the config was created using TMUI or REST requests.

MODULE 2 – IWORKFLOW

In this module we will explore how to use F5's iWorkflow platform to further abstract application services and deliver those services to tenants. iWorkflow has two main purposes in the Automation & Orchestration toolchain:

- Provide simplified but customizable Device Onboarding workflows
- Provide a tenant/provider interface for L4 – L7 service delivery

When moving to an iWorkflow based toolchain it's important to understand that L1-3 Automation (Device Onboarding, Networking, etc) and L4-7 (Deployment of Virtual Servers, Pools, etc) are separated and delivered by different features.

L1-3 Networking and Device Onboarding are delivered by 'Cloud Connectors' that are specific to the third party technology ecosystem (e.g. vCMP, AWS, Cisco APIC, VMware NSX, BIG-IP, etc).

L4-7 service delivery is accomplished by:

- Declarative: Consuming F5 iApp templates from BIG-IP devices and creating a Service Catalog.
- Imperative: Consuming the iWorkflow REST Proxy to drive API calls to BIG-IP devices

The labs in the module will focus on the high level features in place to achieve full L1-7 automation. As mentioned above, iApps are a key component of this toolchain. For our purposes we will use the f5.http iApp to create simple examples. For more advanced use cases it's often required to use a 'Declarative' or 'Deployment-centric' iApp template. A community-supported template of this nature called the App Services Integration iApp is available at https://github.com/0xHiteshPatel/appsvcs_integration_iapp for this purpose.

Lab 2.1 – iWorkflow Authentication

iWorkflow supports the same authentication mechanisms as BIG-IP (HTTP BASIC, Token Based Auth). In this lab we will quickly review TBA on iWorkflow.

Task 1 – Token Based Authentication

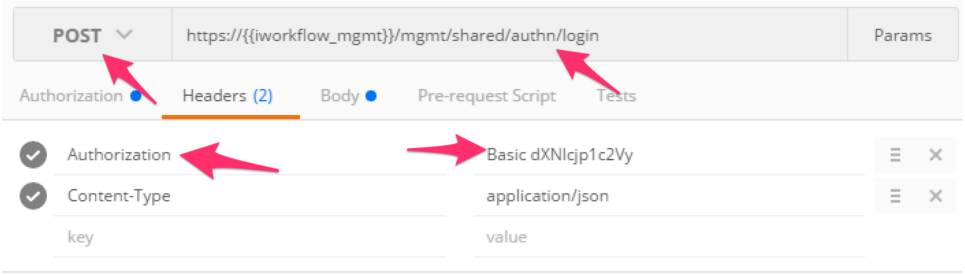
In this task we will demonstrate TBA using the local authentication database, however, authentication to external providers is fully supported.

> For more information about external authentication providers see the section titled "**About external authentication providers with iControl REST**" in the iControl REST API User Guide available at https://devcentral.f5.com

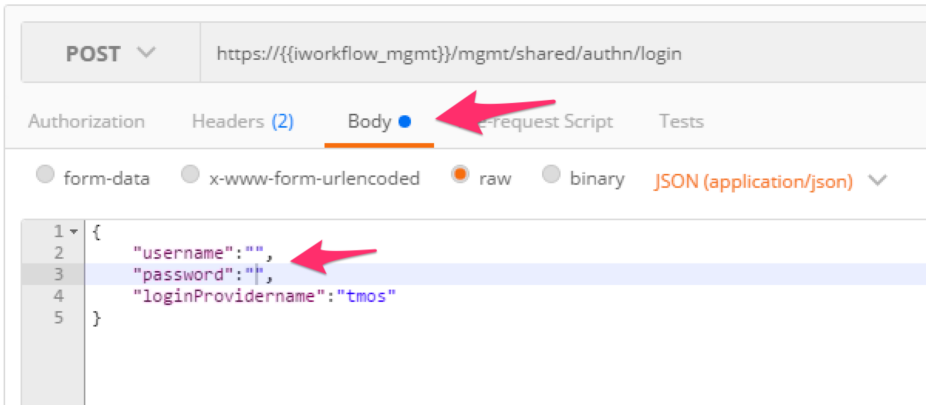
Perform the following steps to complete this task:

1. Click the 'Step 1: Get Authentication Token' item in the Lab 2.1 Postman Collection

2. Notice that we are sending a POST request to the '/mgmt/shared/authn/login' endpoint. Additionally, BASIC Authentication is required on the initial token request:

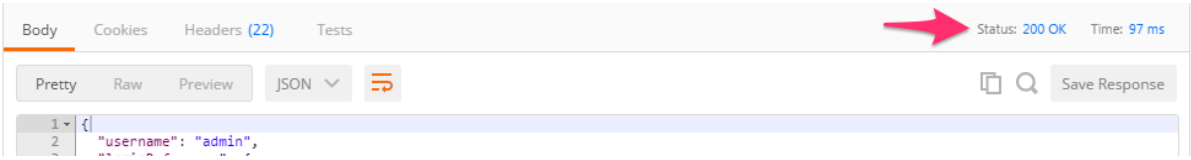


3. Click the 'Body' tab and examine the JSON that we will send to iWorkflow to provide credentials:



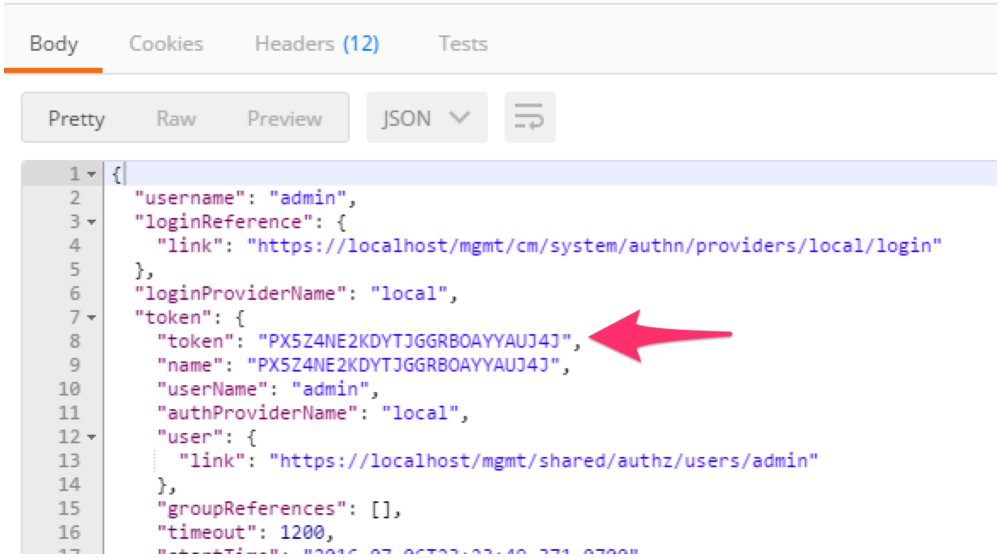
4. Modify the JSON body and add the required credentials (admin/admin). Then click the 'Send' button.
5. Examine the response status code. If authentication succeeded and a token was generated the response will have a 200 OK status code. If the status code is 401 then check your credentials:

Successful:

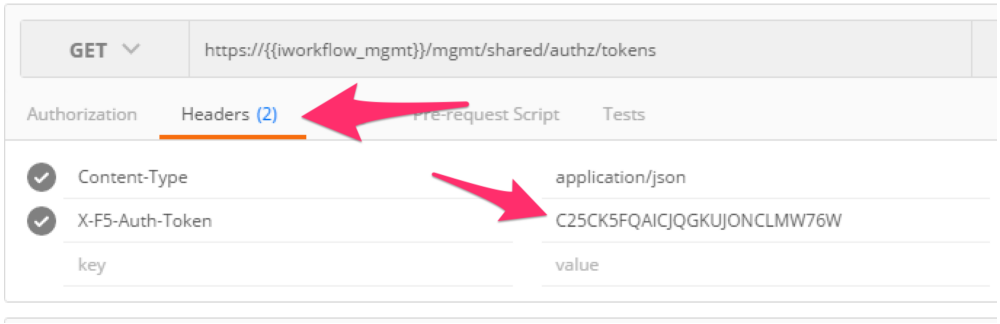


Unsuccessful:

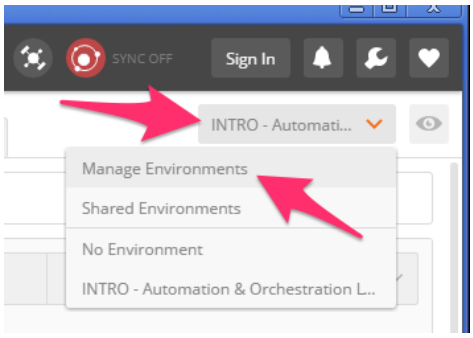
6. Once you receive a 200 OK status code examine the response body. The various attributes show the parameters assigned to the particular token. Find the 'token' attribute and copy it into your clipboard (Ctrl+c) for use in the next step:



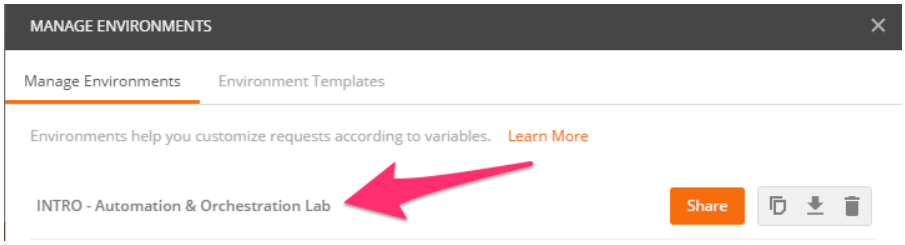
7. Click the 'Step 2: Verify Authentication Works' item in the Lab 2.1 Postman collection. Click the 'Headers' tab and paste the token value copied above as the VALUE for the 'X-F5-Auth-Token' header. This header is required to be sent on all requests when using token based authentication.



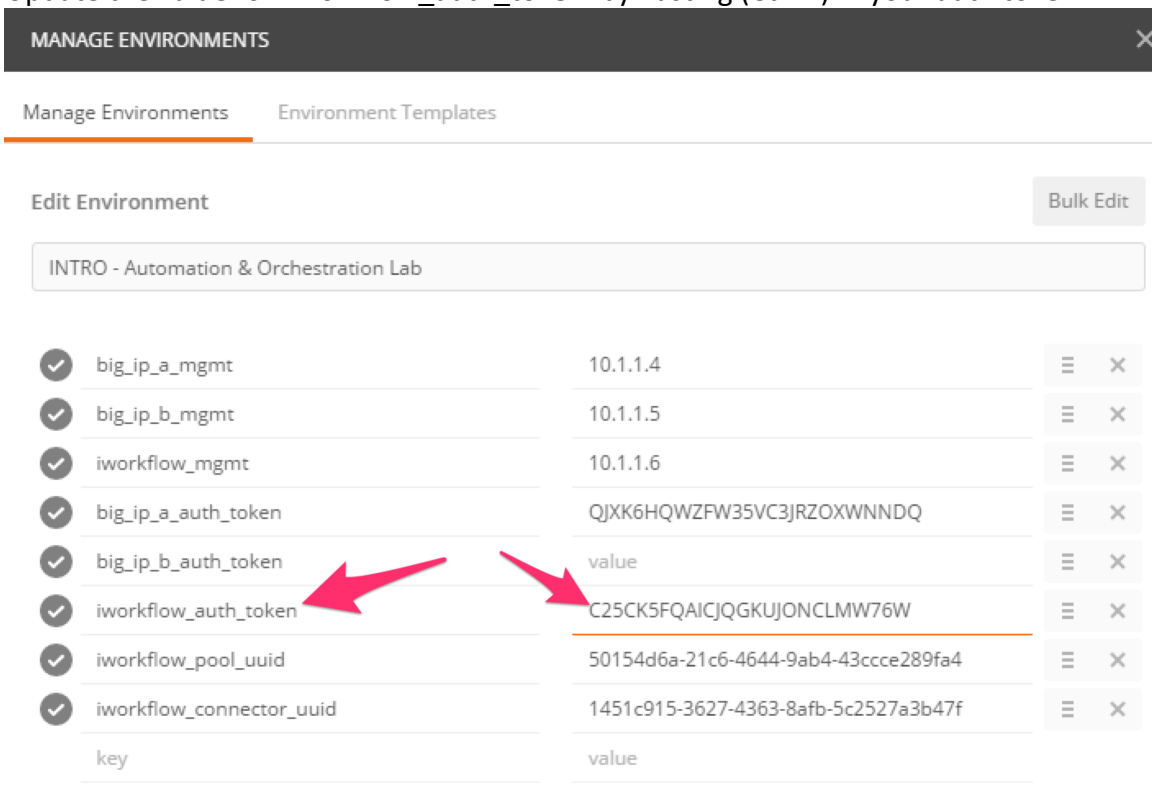
8. Click the 'Send' button. If you're request is successful you should see a '200 OK' status and a listing of the 'ltm' Organizing Collection.
9. We will now update your Postman environment to use this auth token for the remainder of the lab. Click the Environment menu in the top right of the Postman window and click 'Manage Environments':



10. Click the 'INTRO – Automation & Orchestration Lab' item:

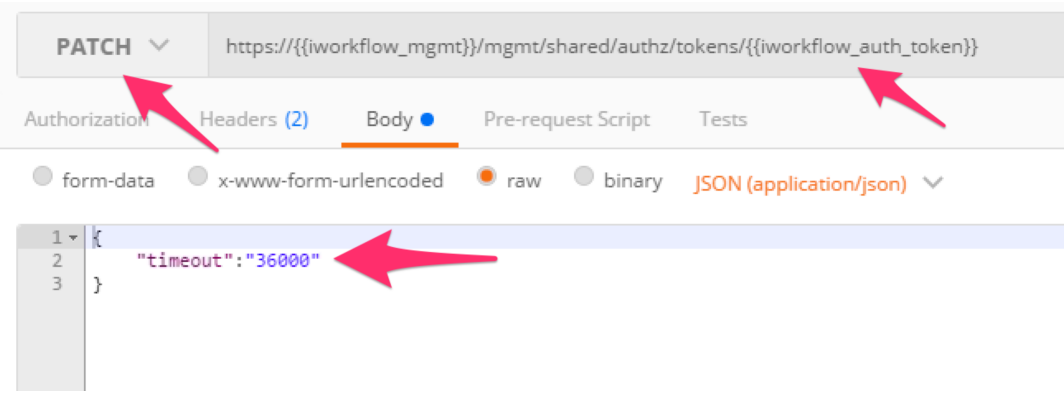


11. Update the value for 'iworkflow_auth_token' by Pasting (Ctrl-v) in your auth token:



12. Click the 'Update' button and then close the 'Manage Environments' window. You're subsequent requests will now automatically include the token.

13. Click the 'Step 3: Set Authentication Token Timeout' item in the Lab 1.2 Postman collection. This request will PATCH your token Resource (check the URI) and update the timeout attribute so we can complete the lab easily. Examine the request type and JSON Body and then click the 'Send' button. Verify that the timeout has been changed to '36000' in the response:



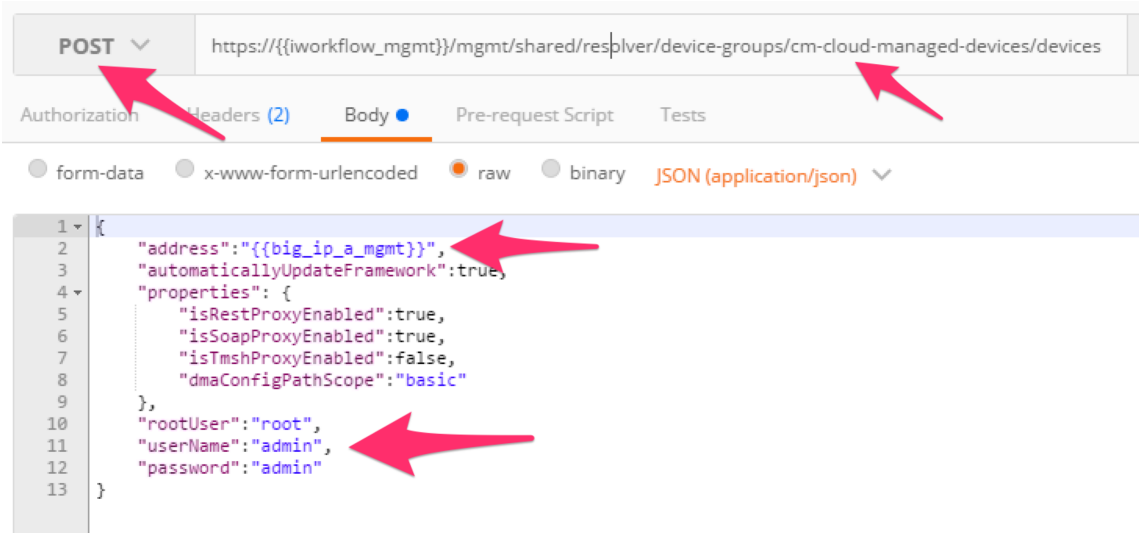
Lab 2.2 – Discover BIG-IP Devices

In order for iWorkflow to interact with a BIG-IP device it must be discovered by iWorkflow. The device discovery process leverages the existing CMI Device Trust infrastructure on BIG-IP. Currently there is a limitation that a single BIG-IP device can only be 'discovered' by ONE of iWorkflow or BIG-IQ CM at a time. In this lab will we discover the existing BIG-IP devices from your lab environment.

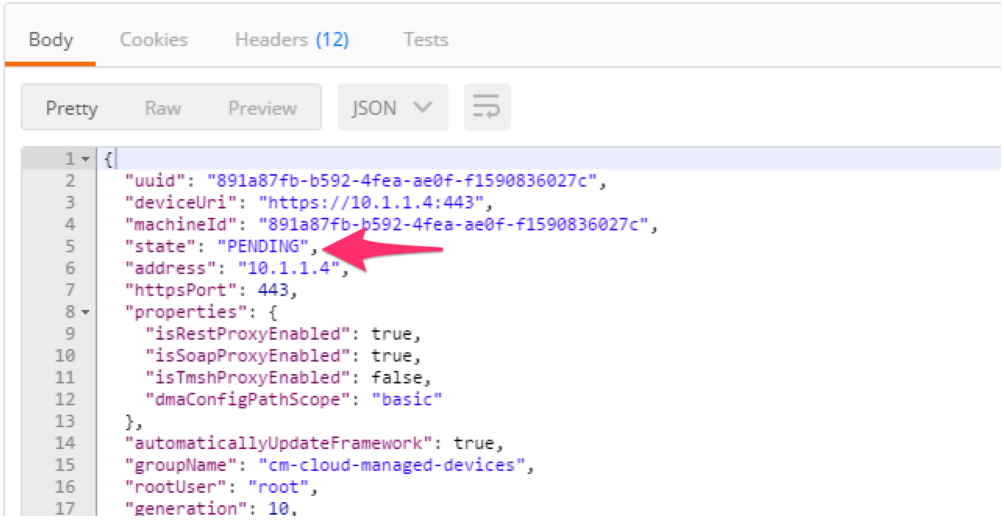
Task 1 – Discover BIG-IP Devices

Perform the following steps to complete this task:

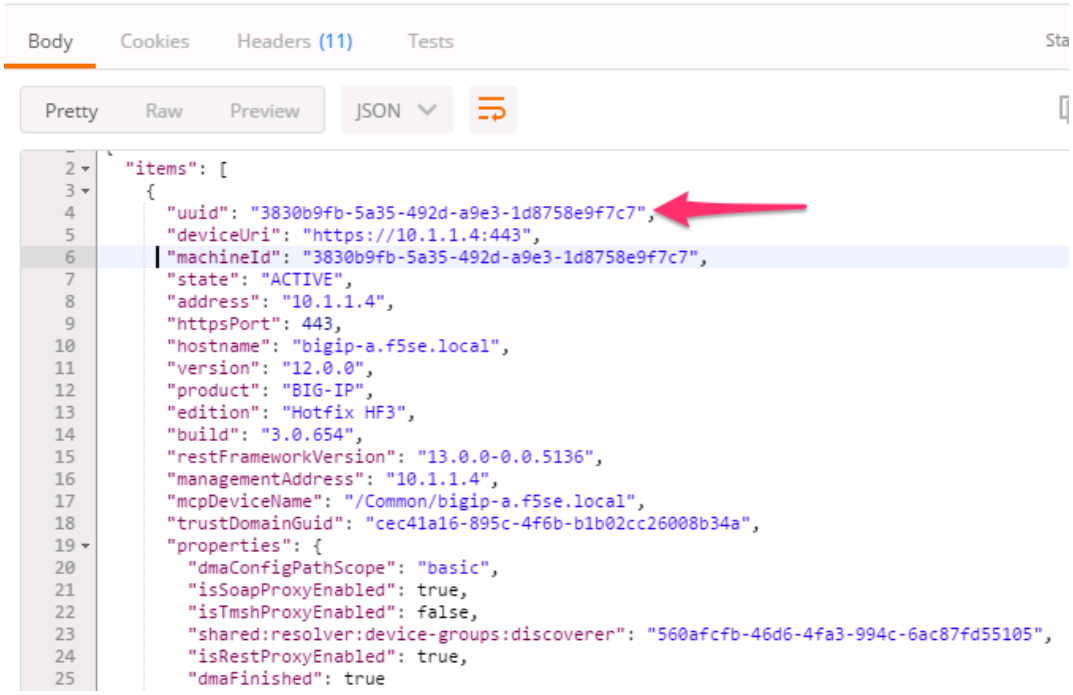
1. Expand the "Lab 2.2: Discover & License BIG-IP Devices" folder in the Postman collection
2. Open a Google Chrome window/tab to your iWorkflow device (https://10.1.1.6) and login with default credentials (admin/admin). You can use this window to monitor actions while they are being performed in Postman. Find the 'Devices' pane and make if viewable if it isn't already.
3. Click the "Step 1: Discover BIGIP-A Device" item in the Postman collection. This will request will perform a POST to the '/mgmt/shared/resolver/device-groups/cm-cloud-managed-devices/devices' worker to perform the device discovery process. Examine the JSON body so you understand what data is sent to perform the discovery process:

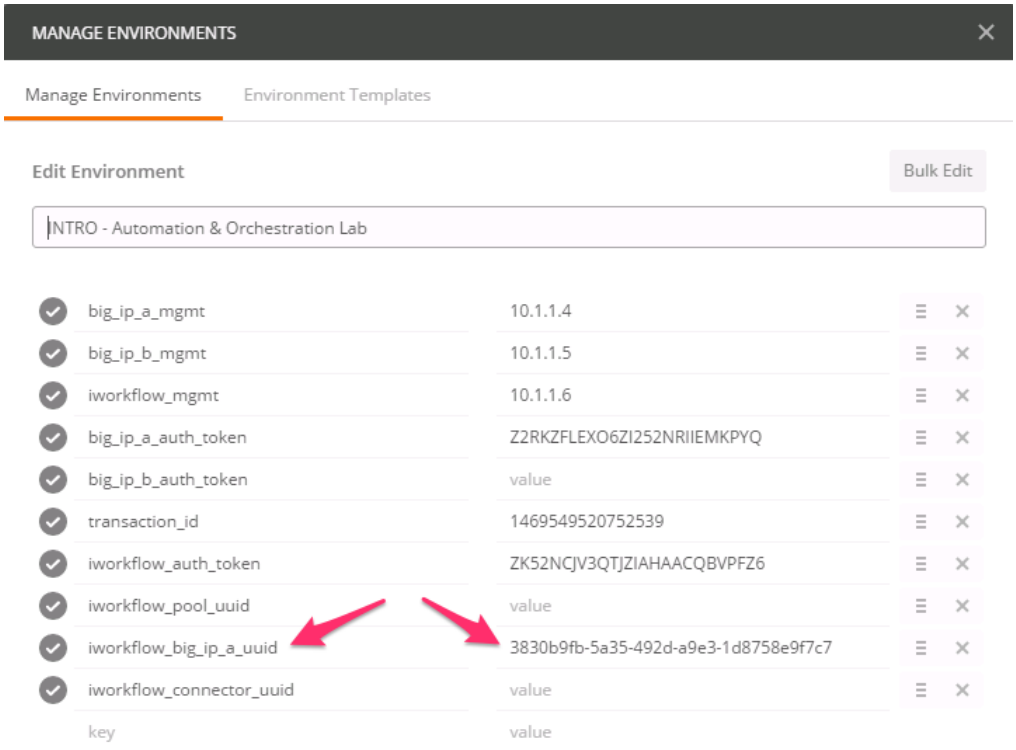


4. Click the 'Send' button. Examine the response and monitor the iWorkflow Chrome window you opened previously.



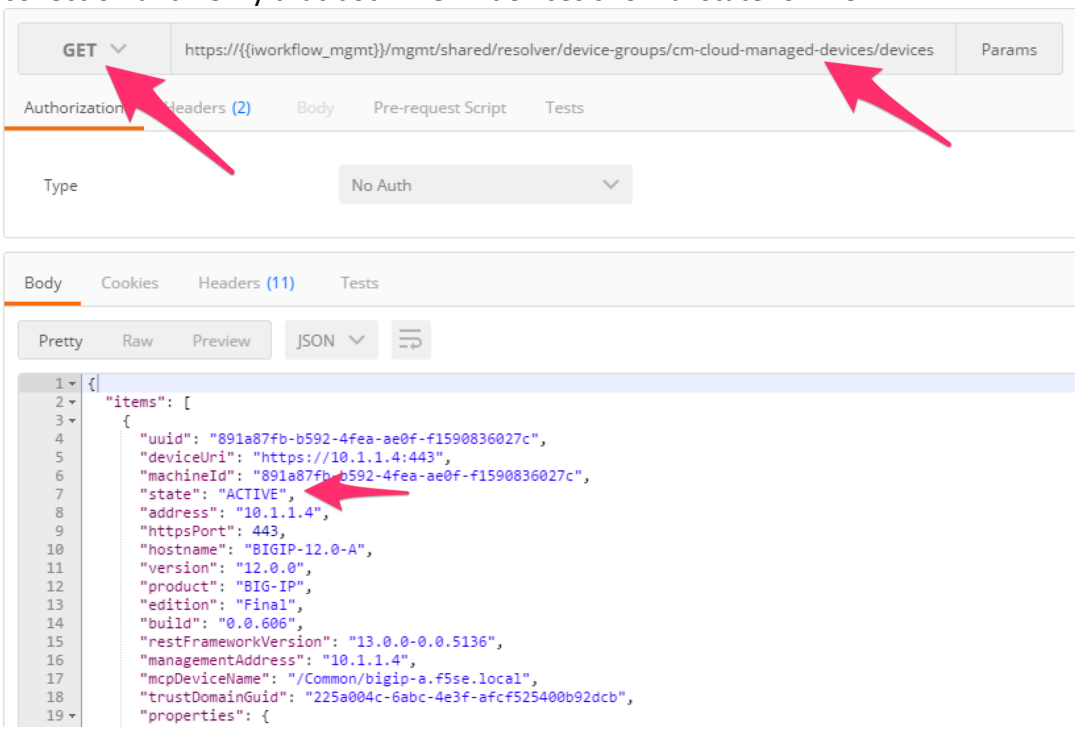
5. Copy the 'uuid' attribute for BIGIP-A and populate the 'iworkflow_big_ip_a_uuid' Postman environment variable with the value:





6. Repeat steps 1-4 with the “Step 2: Discover BIGIP-B Device” item in the collection.

7. Click the “Step 3: Get Discovered Devices” item in the collection. We will GET the devices collection and verify that both BIG-IP devices show a ‘state’ of ‘ACTIVE’:



Lab 2.3 – Create Local Connector

Cloud Connectors in iWorkflow serve as the L1-3 Network and Device Onboarding automation component in the automation toolchain. iWorkflow supports Cloud Connectors for various vendor integrations (F5 vCMP, F5 BIG-IP, Cisco APIC, vmWare NSX, etc.) In this lab we will create a ‘BIG-IP Connector’ for the BIG-IP devices in the UDF deployment. This connector will then allow you to drive a fully automated deployment from the iWorkflow Service Catalog.

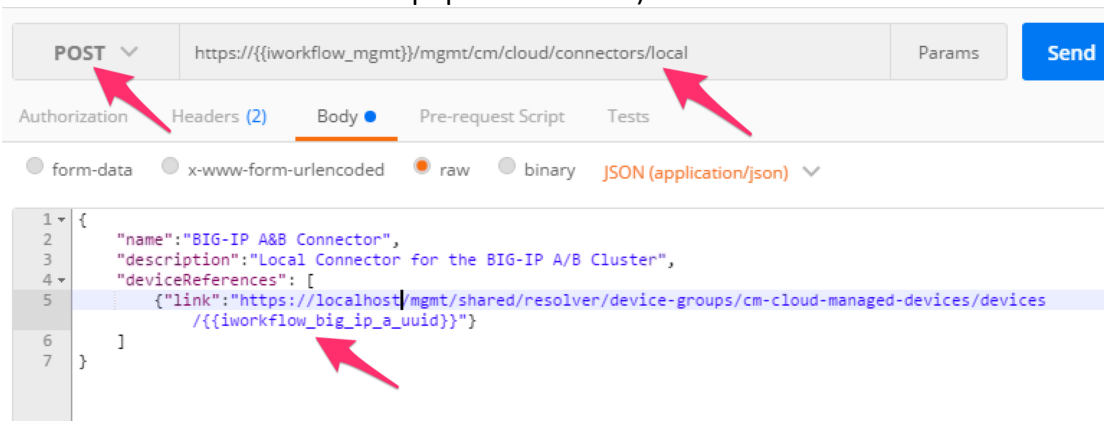
Task 1 – Create a Local Connector

In this task we will create a Local Connector that is linked to our BIG-IP devices. The Local Cloud Connector is DSC aware and will automatically detect that the BIG-IP devices are clustered and configure itself accordingly.

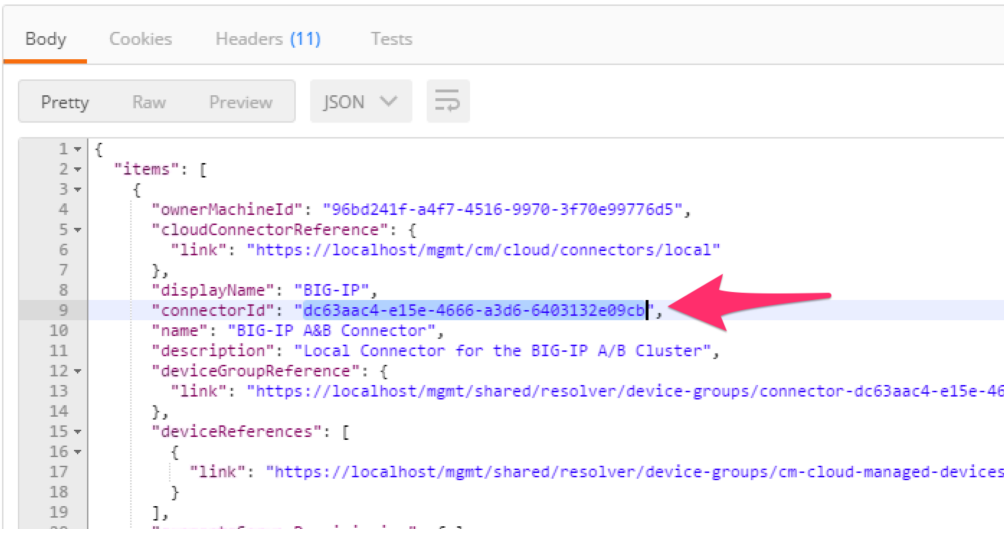
Perform the following steps to complete this task:

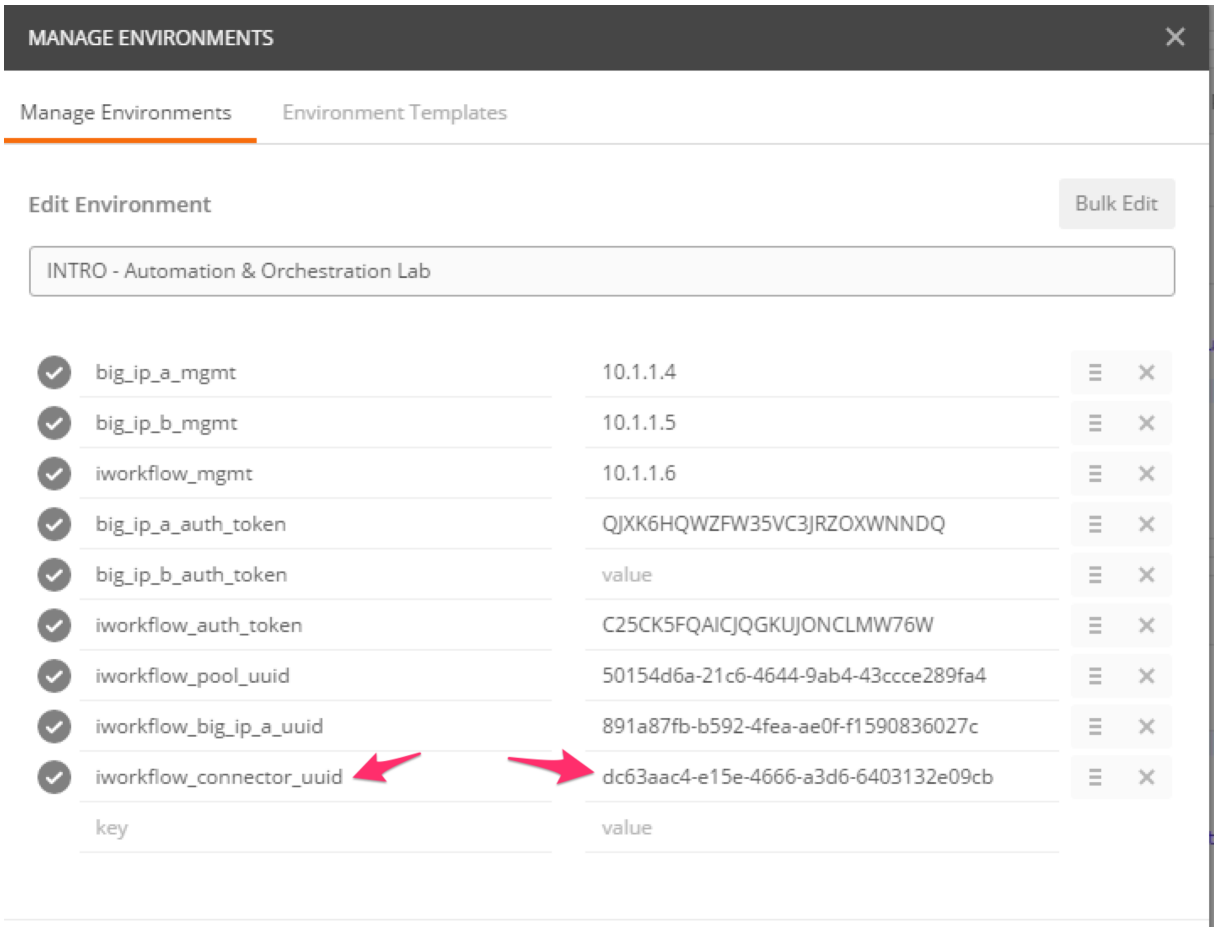
1. Expand the “Lab 2.3 – Create Local Connector” folder in the Postman collection.
2. Click the “Step 1: Create a Local Connector” item in the collection. We will create a new connector by performing a POST to the local connector collection. If you examine the JSON body you can see we are providing a reference to the URL for the BIG-IP-A device (using the

UUID environment variable we populated earlier):



3. Click the 'Send' button to create the connector.
4. Click the "Step 2: Get Local Connectors" item in the collection and click 'Send'. Examine the output to see how the connector was configured. Take note of the reference to the 'device-group'. This is how the connector determines the HA state of the underlying BIG-IP devices. Find the 'connectorId' of the connector and update your Postman environment to include the 'connectorId' as the value of the 'iworkflow_connector_uuid' variable:





5. Click the "Step 3: Assign Connector to Tenant" item in the collection. The iWorkflow device has been pre-configured with a tenant named 'MyTenant'. This request will assign this connector to to the 'MyTenant' tenant allowing service deployments from that tenant. Click the 'Send' button and examine the response.

Lab 2.4 – Create an L4 – L7 Service Template & L4 – L7 Service Deployment

To drive iApp automation-based L4-7 deployments, iWorkflow includes the capability to create a Tenant Service Catalog via L4 – L7 Service Templates. This model of deployment enables Declarative automation of F5 L4-7 services provided the underlying iApp templates are designed with a declarative presentation layer in mind. To demonstrate this capability we will create a simple Service Catalog Template and deploy and application from a tenant on our BIG-IP devices.

Task 1 – Create L4 – L7 Service Template

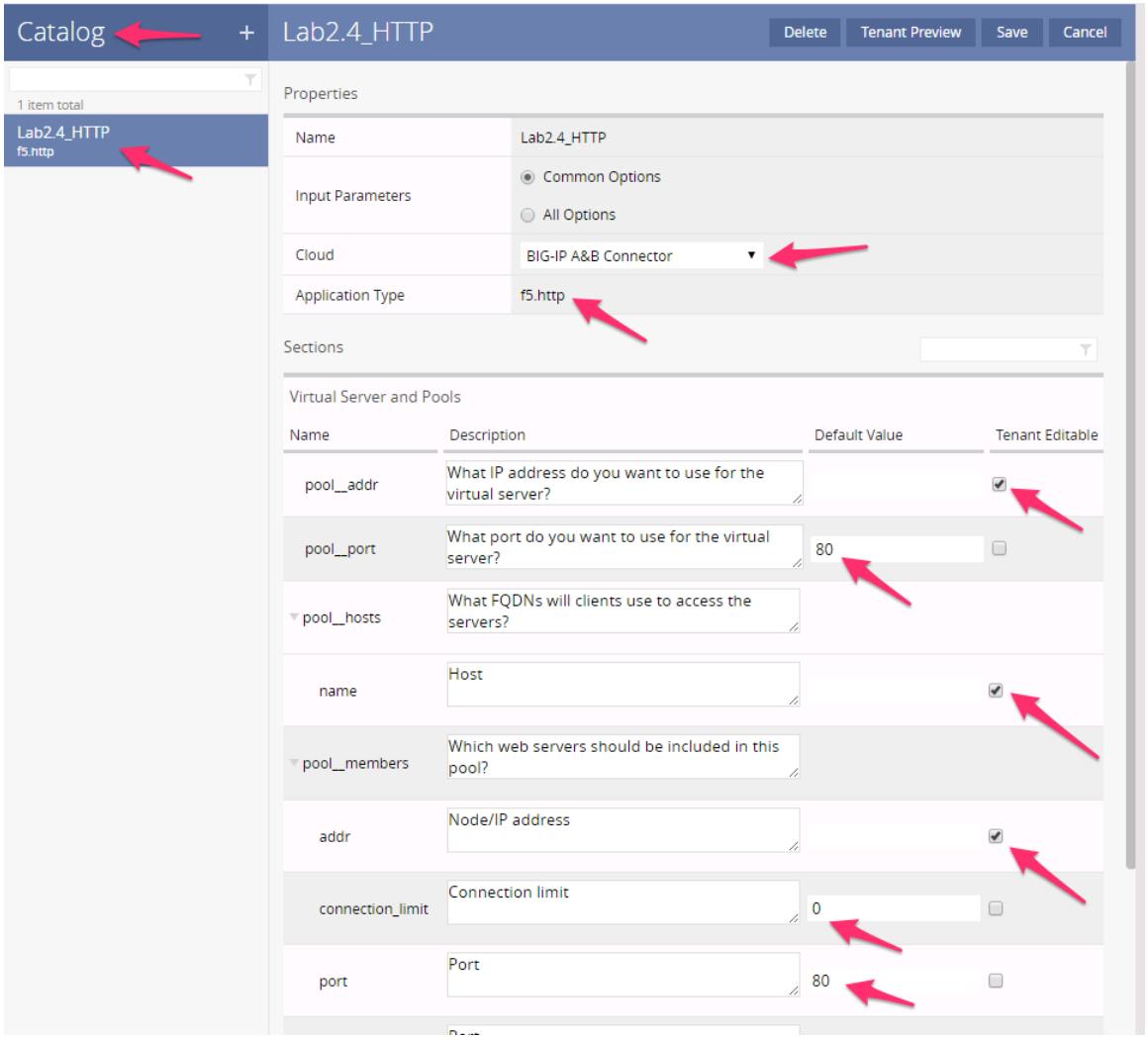
An L4-7 Service Deployment on iWorkflow is driven by the creation of an L4 – L7 Service Template. These templates allow a provider (administrator) to specify the values of specific fields from an origin iApp presentation layer. Additionally, the provider also defines the tenant interface to the service by

marking which fields are '**Tenant Editable**' and therefore visible during service deployment from the tenant. You can think of a Service Catalog Template and a filter that allows the vast majority of fields to be filled in or defaulted while only exposing the minimal set of fields required to deploy a service.

In this task we will create a Service Catalog Template that utilizes the f5.http iApp.

Perform the following steps to complete this task:

1. Expand the "Lab 2.4 – iWorkflow Service Catalog & Service Deployment" folder in the Postman collection
2. Click the "Step 1: Create PROVIDER Service Catalog Template" item in the collection. This request is pre-built and will create a new template using the f5.http iApp. Click the 'Send' button to create the template.
3. Open a Chrome tab to iWorkflow (https://10.1.1.6) and login with admin/admin credentials. Expand the 'Catalog' pane and double-click the "Lab2.4_HTTP" template. Notice the cloud connector was associated as part of the REST request, various defaults have been populated (e.g. port '80' for the pool__port variable) and some fields have been marked as 'Tenant Editable':



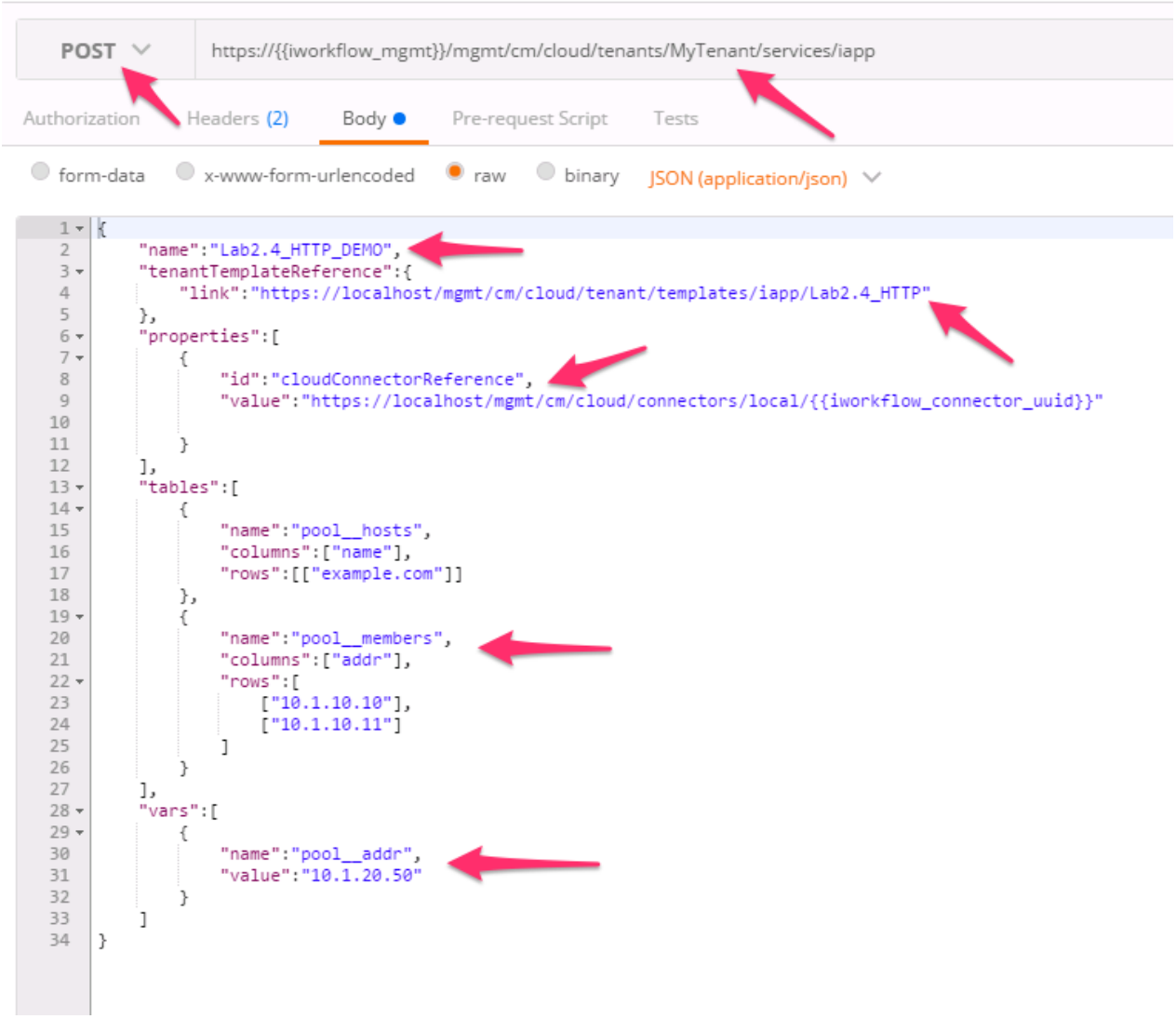
4. Go back to the Postman window and select the “Step 2: Get TENANT Service Catalog Template” item in the collection. Click the ‘Send’ button and examine the response. Notice that the TENANT definition of the service only shows fields that were marked ‘Tenant Editable’

Task 2 – Tenant Service Deployment

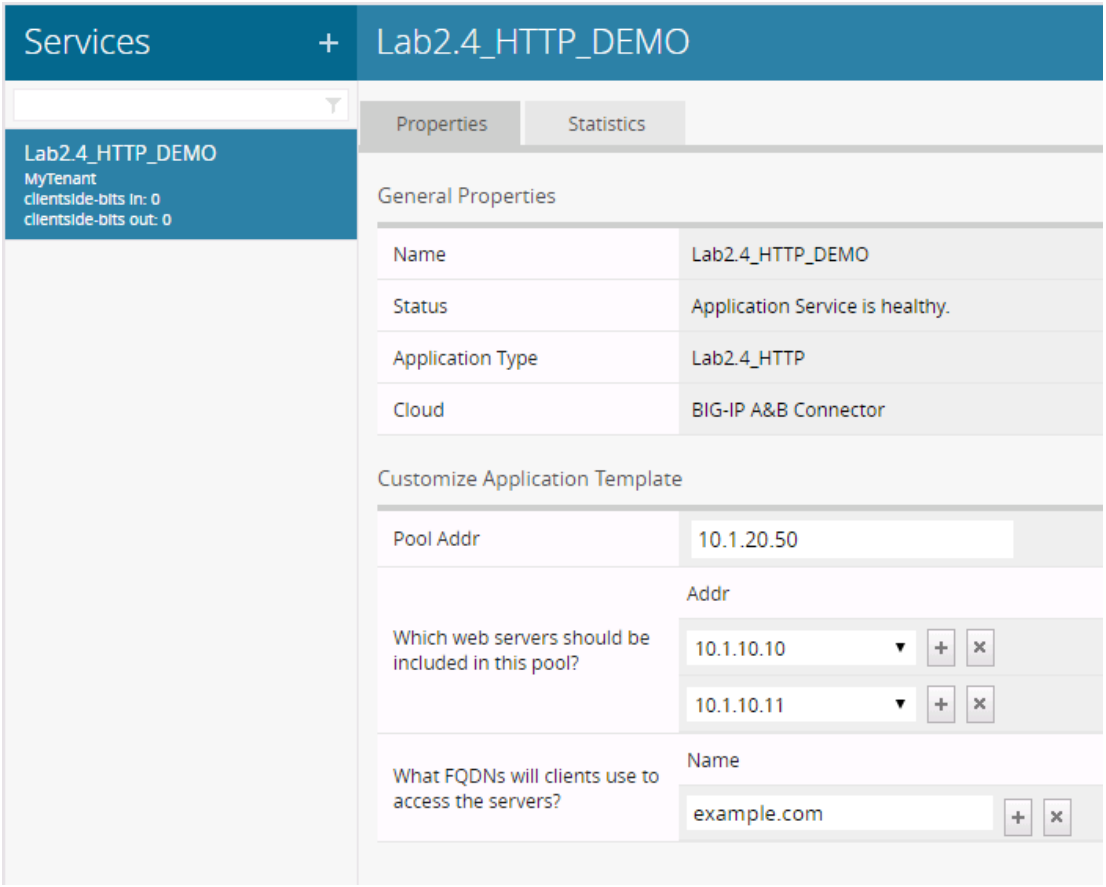
In this task we will perform CRUD operations based on a deployment of the Service Catalog Template created in the previous task.

Perform the following steps to complete this task:

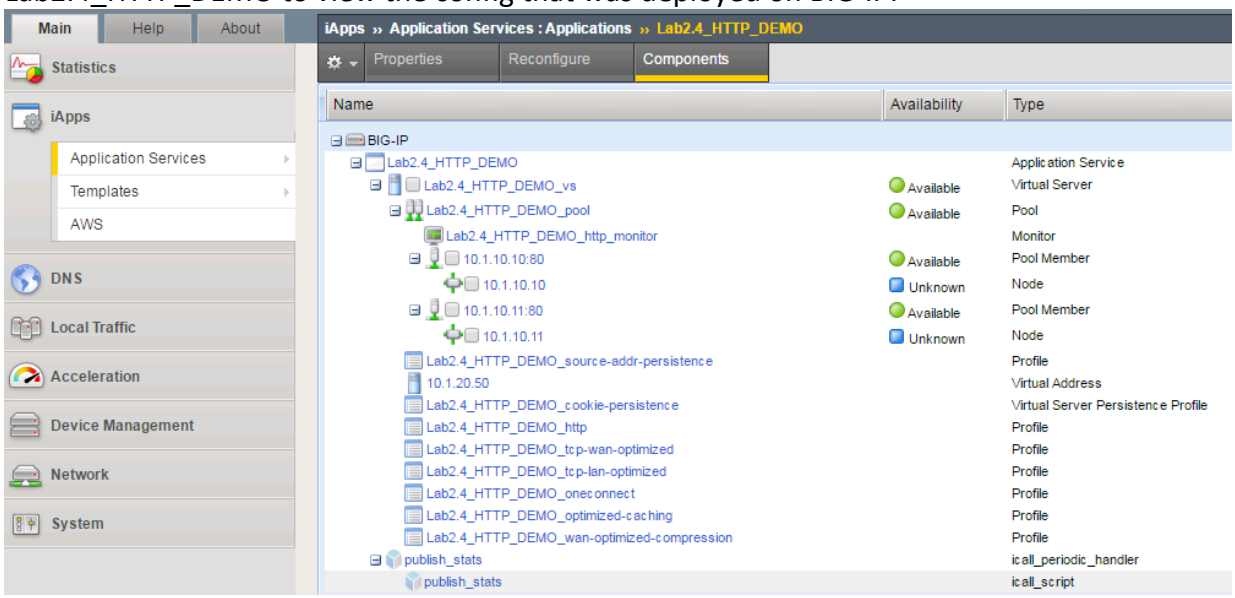
1. Open a new Chrome tab to iWorkflow (https://10.1.1.6) and login with the credentials Username: tenant, Password: tenant. Expand the ‘Services’ pane.
2. Click the “Step 3: Create TENANT Service Deployment” item in the collection. Examine the URL and JSON body. We will be creating a new Tenant Service Deployment under ‘MyTenant’ with the properties marked as ‘Tenant Editable’ provided:



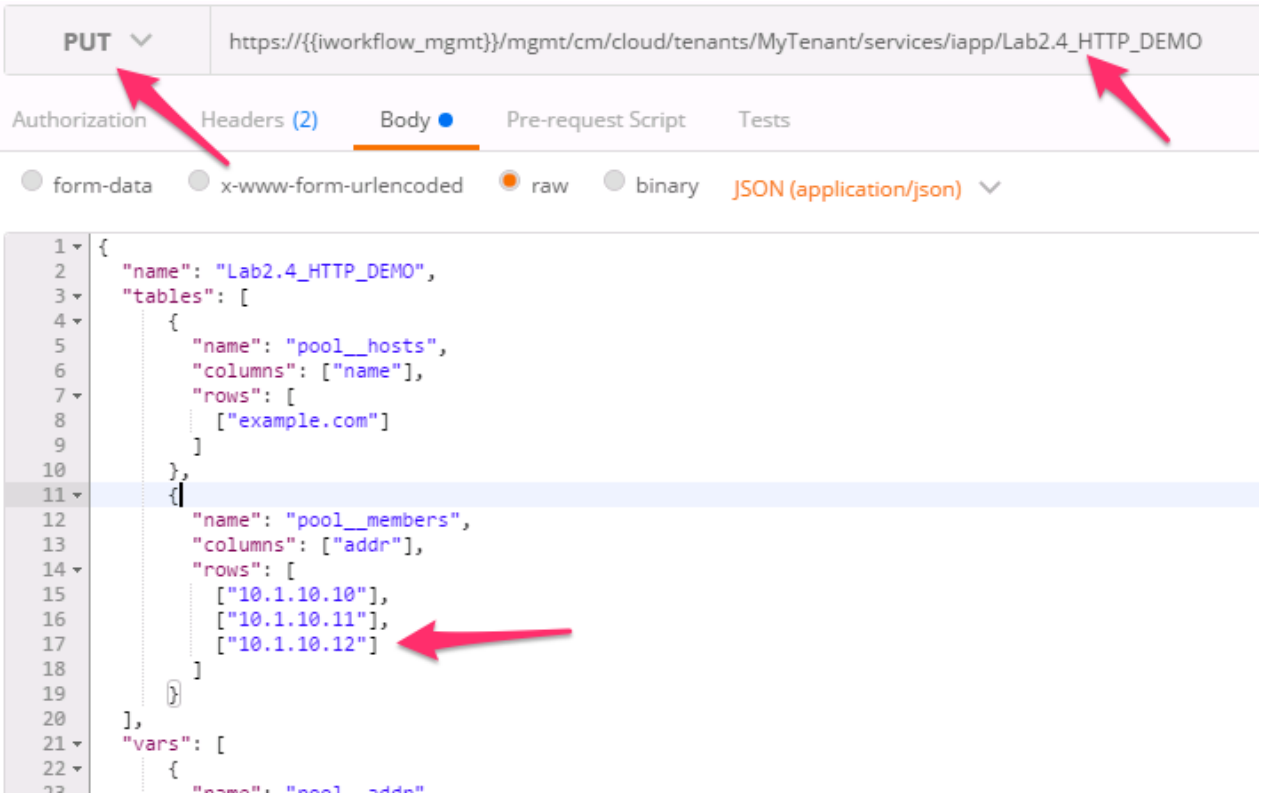
3. Click the 'Send' button to create the Service Deployment. Examine the response. The iWorkflow GUI in your Chrome tab will also reflect a new item in the Services pane:



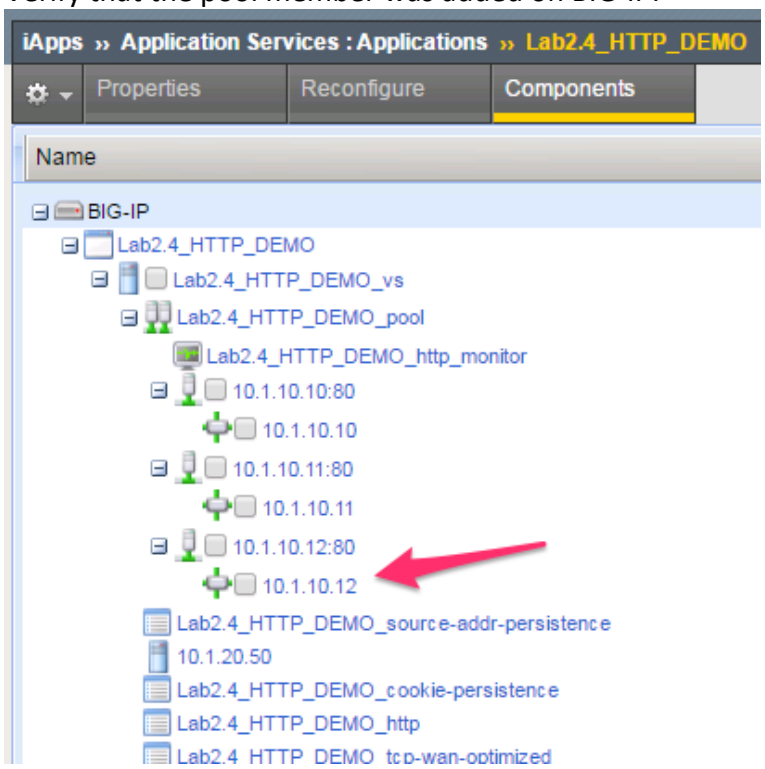
4. Open a Chrome tab to BIGIP-A. Click on Application Services -> Applications -> Lab2.4_HTTP_DEMO to view the config that was deployed on BIG-IP:



5. Go back to Postman and click the “Step 4: Get TENANT Service Deployment” item in the collection and click ‘Send’. This item is example of a GET of the service definition. The response should match what you see in the iWorkflow GUI when viewing the properties of a deployment.
6. Click the “Step 5: Modify TENANT Service Deployment” item in the collection. This request is an example of an Update operation. Notice that we are sending a PUT request to the URL representing the service deployment. Examine the JSON body and modify the ‘pool__members’ table to add an additional pool member with an IP of 10.1.10.12. Click the ‘Send’ button to re-deploy the service:



7. Verify that the pool member was added on BIG-IP:



8. Go back to Postman and click the "Step 6: Delete TENANT Service Deployment" item. This item will send a DELETE request to the URL for the service deployment. Click 'Send' and verify that the deployment has been removed in the iWorkflow and BIG-IP GUIs.

Lab 2.5 – iWorkflow REST Proxy

In order to enable Imperative automation use cases, iWorkflow includes a REST proxy that allows pass-through of REST requests to devices managed by iWorkflow. The REST proxy feature allows customers to simplify automation by:

- Providing a centralized API endpoint for BIG-IP infrastructure
  - No need to communicate with individual BIG-IP devices, only with iWorkflow
- Simplified authentication
  - Strong authentication can be implemented at iWorkflow rather than on each BIG-IP
- Simplified RBAC
  - RBAC can be implemented at iWorkflow for all devices rather on individual devices in the environment

The rest proxy works by passing data sent to a specific URL through to the BIG-IP device. The root URL for a particular devices REST proxy is:

```
/mgmt/shared/resolver/device-groups/cm-cloud-managed-devices/devices/<device_uuid>/rest-proxy/
```

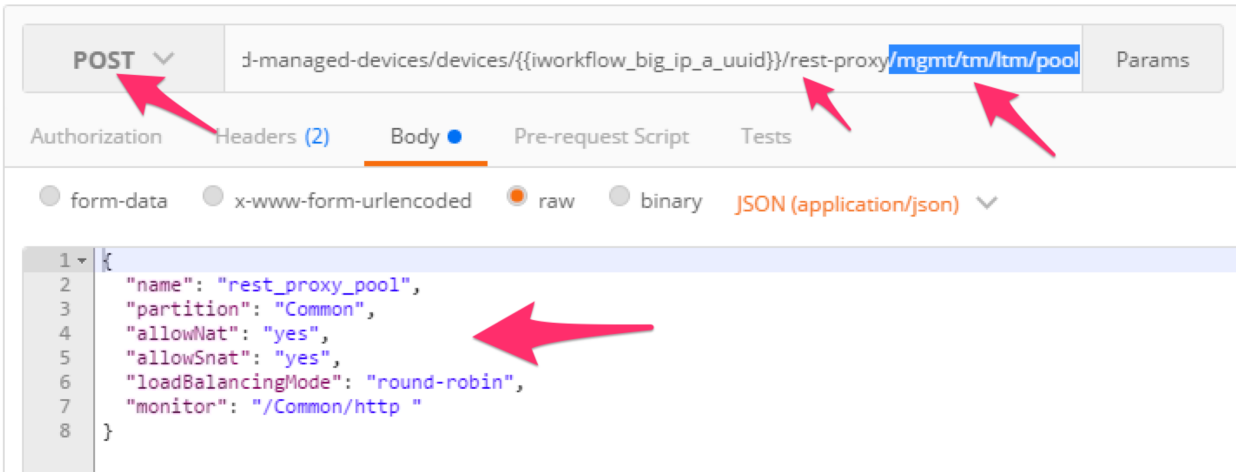
Any URL segments included after '…/rest-proxy/' are forwarded unaltered to the BIG-IP device. Query parameters (e.g. ?expandSubcollections=true) are also passed unaltered along with the request type and request body.

Task 1 – Perform REST operations via the REST Proxy

In this task we will perform a sample CRUD operation utilizing the REST Proxy. The intent of this task is to show the basic mechanism use to perform these tasks. Simply changing the URL to include the iWorkflow REST Proxy root for that device could easily change all the Imperative operations we have completed in this lab to use the REST Proxy.

Perform the following steps to complete this task:

1. Expand the "Lab 2.5 – iWorkflow REST Proxy" folder in the Postman collection.
2. Click the "Step 1: Create pool on BIGIP-A". Examine the request type, URL and JSON body. Essentially we are performing a POST to the '/mgmt/tm/ltm/pool' collection on BIGIP-A. The last part of the URL includes this URI path (the part after '…./rest-proxy/'). The JSON body and all other parameters are passed unaltered. Also, notice that we are still using our iWorkflow Token to authenticate, not the BIG-IP one.



3. Click the "Send" button and examine the response.
4. Repeat steps 1-3 for the remaining items in the "Lab 2.5 – iWorkflow REST Proxy" collection. Examine each request carefully so you understand what is happening.

MODULE 3: PYTHON SDK

This module will cover the newly released F5 Python SDK. This SDK is released and maintained as a public GitHub repository at https://github.com/F5Networks/f5-common-python

The goal of the Python SDK is to provide a simple interface that abstracts many of the F5-specific nuances of the iControl REST API away from the user. As you learned in Module 1, when interacting directly with the API it's often necessary to build out requests in a very manual fashion. In order to provide a simpler interface the SDK was developed to abstract away many of the eccentricities of the API and provide a clean, Pythonic interface.

For example, when creating a pool in, an Imperative automation model, without the SDK you would be required to do something like the following (this code is not complete):

```
import requests
import sys
base_url = "https://10.1.1.4/mgmt/tm/ltm/pool/"
pool_attributes = {
   "name": "test_pool",
   "partition": "Common",
   "loadBalancingMode": "least-connections-member",
   "minUpMembers": 1
}
s = requests.session()
s.auth = ("admin", "admin")
resp = s.post(base_url, data=json.dumps(pool_attributes))
if resp.status_code != requests.codes.ok:
   print "Error creating pool"
   sys.exit(1)
```

When using the Python SDK the equivalent code is:

```
from f5.bigip import ManagementRoot
mgmt = ManagementRoot("10.1.14","admin","admin")
pool = mgmt.tm.ltm.pools.pool.create(partition="Common", name="test_pool")
pool.loadBalancingMode = "least-connections-member"
pool.minUpMembers = 1
pool.update()
```

As you can see the code utilizing the SDK is much more condensed and far easier to read. This is a result of the SDK exposing abstracted methods to build the URL. Additionally the SDK creates standard CURDLE (create, update, refresh, delete, load, exists) methods that behave correctly depending on REST

object type (Organizing Collection, Collection, Resource, etc.) you are interacting with (e.g., you cannot DELETE an Organizing Collection, therefore a delete() method is not available).

Full documentation for the API exists at https://f5-sdk.readthedocs.io

For the purpose of this lab your Windows Jumphost has everything pre-installed, however, since the SDK is a standard python package the process is trivial on any system (Windows, Linux, Mac, etc.) that has Python installed.

It's important to keep in mind while going through this module that we are only demonstrating what is possible with the SDK from a high level in order to drive a conversation with your customer. For example the same scripts used in this module are designed to run from the command line with arguments, however, they could easily be modified to use JSON files as the input mechanism.

Lab 3.1 – create_pool.py

In this lab we will review, line-by-line an example script that has been created to allow creation of a BIG-IP Pool with Pool Members directly from the command line.

Task 1 – Review create_pool.py

1. Open Notepad++ using the  located in the Windows Taskbar.
2. Double click the file "create_pool.py" in the menu on the left side of the Notepad++ screen
3. We will now review the code line-by-line:

```
from f5.bigip import ManagementRoot
import pprint
import argparse

pp = pprint.PrettyPrinter(indent=3)
```

These lines import in various Python libraries. The first line imports the F5 Python SDK. The pprint and argparse libraries are standard Python libraries that aid in print data to the console and parsing command line arguments.

```
parser = argparse.ArgumentParser(description='Script to create a pool on a BIG-IP device')
parser.add_argument("host",             help="The IP/Hostname of the BIG-IP device")
parser.add_argument("pool_name",        help="The name of the pool")
parser.add_argument("pool_members",     help="A comma seperated string in the format
<IP>:<port>[,<IP>:<port>]")
parser.add_argument("-P", "--partition", help="The partition name", default="Common")
parser.add_argument("-u", "--username", help="The BIG-IP username", default="admin")
parser.add_argument("-p", "--password", help="The BIG-IP password", default="admin")
args = parser.parse_args()
```

These lines setup the command line arguments for the script and store those arguments in a python dictionary names 'args'. The argparse library automatically generates help text, checks for required arguments, sets defaults, etc.

```
mgmt = ManagementRoot(args.host, args.username, args.password)
```

This line creates a new Python object that refers to the BIG-IP device. We are calling the ManagementRoot method with 3 arguments:

- The value of the 'host' argument
- The value of the 'username' argument
- The value of the 'password' argument

This method automatically performs a test to ensure that we are able to reach the device and authenticate successfully.

```
pool_path = "/%s/%s" % (args.partition, args.pool_name)
```

This line just stores the human-readable path to the pool name for later use

```
if mgmt.tm.ltm.pools.pool.exists(partition=args.partition, name=args.pool_name):
     raise Exception("Pool '%s' already exists" % args.pool_name)
```

This if statement checks to see if a pool with the same name already exists on the specified partition on the device. The return value of the exists() method is a Boolean value of True or False. In this case we want the Exception to execute if a pool DOES exist and stop execution of the script.

```
pool = mgmt.tm.ltm.pools.pool.create(partition=args.partition, name=args.pool_name)
print "Created pool %s" % pool_path
```

The first line in this block actually creates the new pool. The partition and name of the pool are specified as arguments to the create() method and the 'pool' variable represents an object that holds the created pool's properties. The second line simply prints a message that the pool has been created.

```
member_list = args.pool_members.split(',')
```

This line uses a built-in python method called split() to separate the value of the command line argument into discrete strings using a ',' as a separator. The return type of the split() is a python list (lists = arrays)

```
for member in member_list:
       pool_member = pool.members_s.members.create(partition=args.partition, name=member)
       print " Added member %s" % member
```

This for loop iterates over the elements in the list generated above and creates a new member in the pool.

Task 2 – Run create_pool.py

1. Open Console2 using the  icon on the Windows Taskbar
2. The console window automatically opens in the Desktop\Module 3 – Python SDK directory
3. Type `set PYTHONWARNINGS=ignore` to disable the printing of SSL/TLS warnings about self-signed certificates.

4. Type `python create_pool.py` and examine the help output:

```
C:\Users\user\Desktop\Module 3 - Python SDK>python create_pool.py
usage: create_pool.py [-h] [-P PARTITION] [-u USERNAME] [-p PASSWORD]
                      host pool_name pool_members
create_pool.py: error: too few arguments
```

5. Type `python create_pool.py 10.1.1.4 test_pool 10.1.10.10:80,10.1.10.11:80` to create a new pool:

```
C:\Users\user\Desktop\Module 3 - Python SDK>python create_pool.py 10.1.1.4 test_pool 10.1.10.10:80,10.1.10.11:80
Created pool /Common/test_pool
 Added member 10.1.10.10:80
 Added member 10.1.10.11:80
```

6. Using Chrome open a tab to BIGIP-A (https://10.1.1.4). Examine the pool that was created.

Lab 3.2 – read_pool.py

In this lab we will review, line-by-line an example script that has been created to view the attributes of a BIG-IP Pool directly from the command line.

Task 1 – Review read_pool.py

1. Open 'read_pool.py' in Notepad++
2. We will review the code. For brevity we have removed lines that are common with previous examples:

```
if not mgmt.tm.ltm.pools.pool.exists(partition=args.partition, name=args.pool_name):
     raise Exception("Pool '%s' does not exist" % args.pool_name)
```

This if statement checks to see if a pool with the same name exists in the specified partition on the device. The key difference between this and the example in the previous lab is the inclusion of the 'not' keyword. This inverses the logic of the statement so that the Exception is raised when the pool DOES NOT exist

```
pool = mgmt.tm.ltm.pools.pool.load(partition=args.partition, name=args.pool_name)
```

This line loads the configuration of the pool into a variable

```
print "Pool %s:" % pool_path
pp.pprint(pool.raw)
```

These lines print the human-readable pool path and then uses the PrettyPrint library to dump all the attributes associated with the pool

Task 2 – Run read_pool.py

1. In the command prompt type `python read_pool.py 10.1.1.4 test_pool` and examine the output:

```
C:\Users\user\Desktop\Module 3 - Python SDK>python read_pool.py 10.1.1.4 test_pool
Pool /Common/test_pool:
{  '_meta_data': {  'allowed_commands': [],
                    'allowed_lazy_attributes': [  <class 'f5.bigip.tm.ltm.pool.Members_s'>],
                    'attribute_registry': {  'tm:ltm:pool:memberscollectionstate': <class 'f5.bigip.tm.ltm.pool.Members_s'>},
                    'bigip': <f5.bigip.ManagementRoot object at 0x02FDCB90>,
                    'container': <f5.bigip.tm.ltm.pool.Pools object at 0x02FF5EB0>,
                    'creation_uri_frag': '',
                    'creation_uri_qargs': {  u'ver': [u'12.0.0']},
                    'exclusive_attributes': [],
                    'icontrol_version': '',
                    'icr_session': <icontrol.session.iControlRESTSession object at 0x02FDCA50>,
                    'minimum_version': '11.6.0',
                    'read_only_attributes': [],
                    'required_command_parameters': set([]),
                    'required_creation_parameters': set(['name']),
                    'required_json_kind': 'tm:ltm:pool:poolstate',
                    'required_load_parameters': set(['name']),
                    'uri': u'https://10.1.1.4:443/mgmt/tm/ltm/pool/~Common~test_pool/'},
   u'allowNat': u'yes',
   u'allowSnat': u'yes',
   u'fullPath': u'/Common/test_pool',
   u'generation': 5191,
   u'ignorePersistedWeight': u'disabled',
   u'ipTosToClient': u'pass-through',
   u'ipTosToServer': u'pass-through',
   u'kind': u'tm:ltm:pool:poolstate',
   u'linkQosToClient': u'pass-through',
   u'linkQosToServer': u'pass-through',
   u'loadBalancingMode': u'round-robin',
   u'membersReference': {  u'isSubcollection': True,
                           u'link': u'https://localhost/mgmt/tm/ltm/pool/~Common~test_pool/members?ver=12.0.0'},
   u'minActiveMembers': 0,
   u'minUpMembers': 0,
   u'minUpMembersAction': u'failover',
   u'minUpMembersChecking': u'disabled',
   u'name': u'test_pool',
   u'partition': u'Common',
   u'queueDepthLimit': 0,
   u'queueOnConnectionLimit': u'disabled',
   u'queueTimeLimit': 0,
   u'reselectTries': 0,
   u'selfLink': u'https://localhost/mgmt/tm/ltm/pool/~Common~test_pool?ver=12.0.0',
   u'serviceDownAction': u'none',
   u'slowRampTime': 10}
```

2. Notice the various attributes that are associated with the pool. Take note of the value of the 'loadBalancingMode' attribute for the next lab

Lab 3.3 – update_pool.py

In this lab we will review, line-by-line an example script that has been created to allow updating any attribute of a pool using the command-line. This script is a good example of creating generic tools that enable many use cases. Rather than creating a script that just updates a specific attribute we created one that updates ANY pool attribute, greatly expanding it's potential use cases.

Task 1 – Review update_pool.py

1. Open update_pool.py in Notepad++
2. We will review the code. For brevity we have removed lines that are common with previous examples:

```
pool = mgmt.tm.ltm.pools.pool.load(partition=args.partition, name=args.pool_name)
pp.pprint("Current: %s=%s" % (args.attribute, getattr(pool, args.attribute)))
```

These lines load the pool from the device and print the current value of the attribute specified on the the command line. The second line is a little bit tricky because the SDK dynamically populates the objects attributes based on the type of object (pool, virtual server, etc.). Normally we could just use something like 'pool.loadBalancingMode' to get the current lb-method for the pool, however, since this script implements a way to change ANY attribute in the object we have to dynamically substitute the attribute name at run-time. To do this we use the getattr() python built-in function to resolve the mapping at runtime and return the value of the attribute specified on the command line.

```
kwargs = {args.attribute: args.value}
```

This line creates a new python dictionary with one entry specifying a key-value pair using the command line arguments. For example if you were updated the loadBalancingMode attribute to 'least-connections-member' the dictionary would look like {"loadBalancingMode":"least-connections-member"}

```
pool.update(**kwargs)
```

The first line updates the pool we loaded previously with the new value for the attribute. The **kwargs argument to the update() method triggers a special mechanism in python called 'keyword unpacking' which allows us to pass the attribute to be updated to the update() method.

```
pool.refresh()
pp.pprint("New: %s=%s" % (args.attribute, getattr(pool, args.attribute)))
```

The first line refreshes the data in the object from the BIG-IP device. The second line prints this refreshed information to the console so the user can verify the update completed successfully.

Task 2 – Run update_pool.py

1. In the command prompt type `python update_pool.py 10.1.1.4 test_pool loadBalancingMode least-connections-member` and examine the output:

```
C:\Users\user\Desktop\Module 3 - Python SDK>python update_pool.py 10.1.1.4 test_pool loadBalancingMode least-connections-member
u'Current: loadBalancingMode=round-robin'
Updating pool /Common/test_pool
u'New: loadBalancingMode=least-connections-member'
```

2. You can manually verify the load balancing method was changed via TMUI or by re-running read_pool.py (it's not required since the line that prints the new value forces a refresh())
3. Experiment with changing other pool attributes

Lab 3.4 – update_pool_member_state.py

One of the most common tasks asked for by customers is the ability to set a pool member's state via a script. We have included an example of such a script in the lab that can be used to show customers how easy it's to automate specific operational tasks.

Task 1 – Run update_pool_member_state.py

1. In the command prompt type `python update_pool_member_state.py 10.1.1.4 test_pool 10.1.10.10:80 disabled` and examine the output.
2. Verify the pool member was disabled via TMUI
3. Re-run the script with as `python update_pool_member_state.py --help` to see additional options.
4. Re-enable the pool member using the script

Lab 3.5 – delete_pool.py

In this lab we will review, line-by-line an example script that has been created to allow deletion of a pool using the command-line.

Task 1 – Review delete_pool.py

1. Open delete_pool.py in Notepad++
2. We will review the code. For brevity we have removed lines that are common with previous examples:

```
pool = mgmt.tm.ltm.pools.pool.load(partition=args.partition, name=args.pool_name)
pool.delete()
print "Deleted pool %s" % pool_path
```

   These lines should be fairly self-explanatory at this point. First we load the pool and the we delete() it and print that we have done so.

Task 2 – Run delete_pool.py

1. In the command prompt type `python delete_pool.py 10.1.1.4 test_pool` and examine the output:

```
C:\Users\user\Desktop\Module 3 - Python SDK>python delete_pool.py 10.1.1.4 test_pool
Deleted pool /Common/test_pool
```

2. If desired verify the pool was deleted using TMUI or the read_pool.py script (it should return an error)

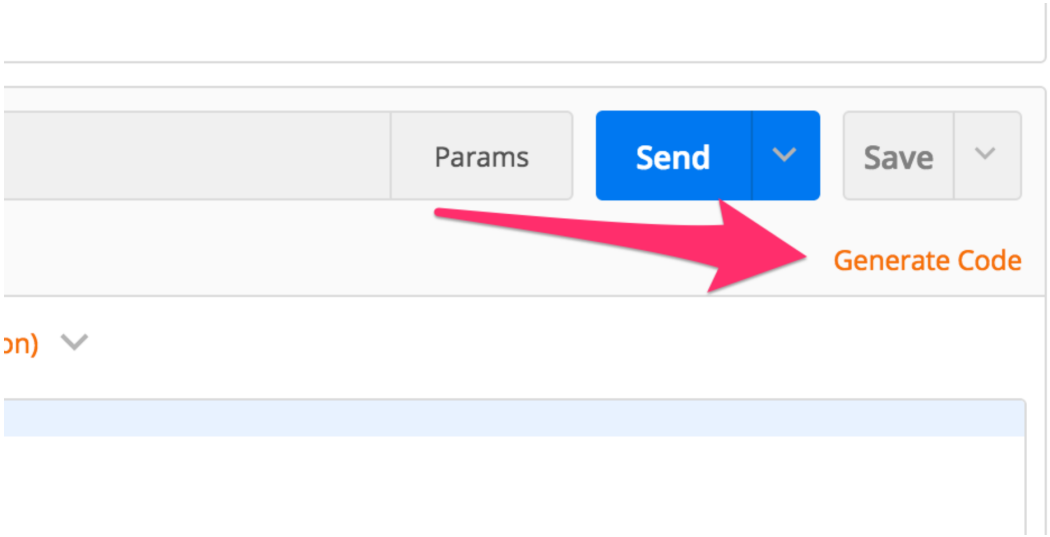
Lab 3.6 – Create a Python Script

In this lab we will use the 'Generate Code' feature of Postman to create a python script from a collection of requests.

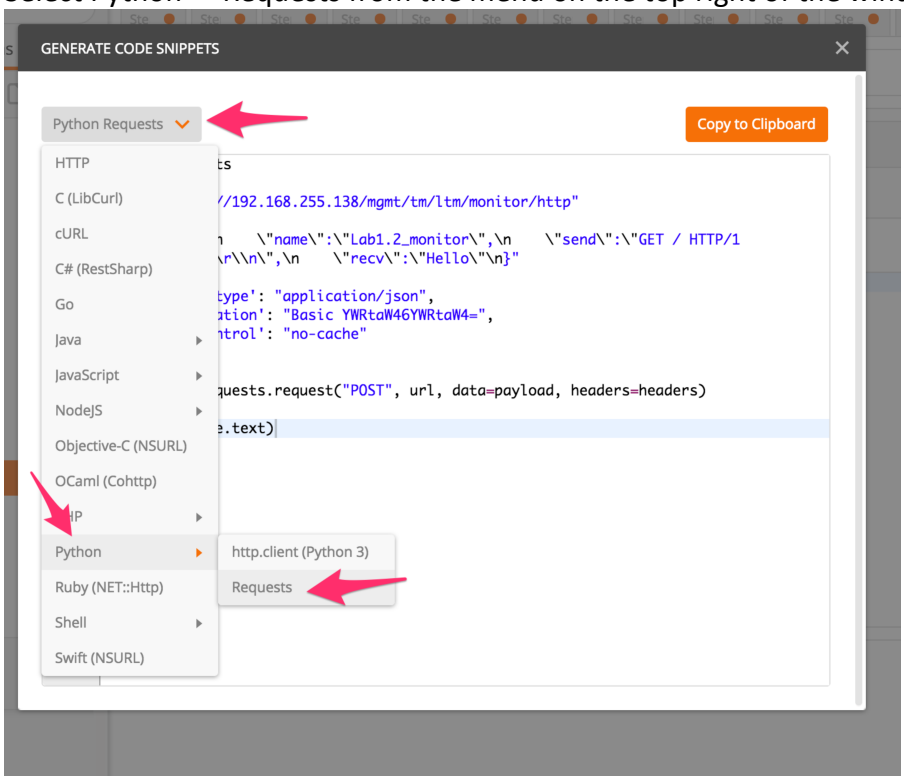
Task 1 – Create a simple script

Perform the following steps to complete this task:

1. Expand the 'Lab 3.6 – Create a Python Script' folder in the Postman collection
2. Click the 'Step 1 – Create a HTTP Monitor' item in the collection
3. Click the 'Generate Code' link in the Postman window:



4. Select Python -> Requests from the menu on the top right of the window:



5. Examine the Python code that was generated. Click the 'Copy to Clipboard' button
6. Open a new text file and paste the generated code. We need to modify the line that sends the request to DISABLE SSL certificate verification. Find the following line:

```
response = requests.request("POST", url, data=payload,
headers=headers)
```

And add a verify=False option to it:

```
response = requests.request("POST", url, data=payload,
headers=headers, verify=False)
```

Save the file on your Desktop as lab3_6.py

7. Open a command prompt and run the script by typing 'python lab3_6.py':

```
C:\Users\user\Desktop>python lab1_2.py
C:\Python27\lib\site-packages\requests\packages\urllib3\connectionpool.py:821: InsecureRequestWarning: Unverified HTTPS re
quest is being made. Adding certificate verification is strongly advised. See: https://urllib3.readthedocs.org/en/latest/s
ecurity.html
  InsecureRequestWarning)
{"kind":"tm:ltm:monitor:http:httpstate","name":"Lab1.2_monitor","fullPath":"Lab1.2_monitor","generation":0,"selfLink":"htt
ps://localhost/mgmt/tm/ltm/monitor/http/Lab1.2_monitor?ver=12.0.0","adaptive":"disabled","adaptiveDivergenceType":"relativ
e","adaptiveDivergenceValue":25,"adaptiveLimit":200,"adaptiveSamplingTimespan":300,"defaultsFrom":"/Common/http","destinat
ion":"*:*","interval":5,"ipDscp":0,"manualResume":"disabled","recv":"Hello","reverse":"disabled","send":"GET / HTTP/1.0\r\
n\r\n","timeUntilUp":0,"timeout":16,"transparent":"disabled","upInterval":0}

C:\Users\user\Desktop>
```

8. Verify the monitor was created on BIG-IP
9. **Delete the monitor to prepare for the next task**

Task 2 – Chain together multiple requests

In this task we will repeat the process from Task 1 to chain together multiple requests.

Perform the following steps:

1. Repeat the procedure from Task 1 with each of the items in the 'Lab 3.6' postman collection. Append each snippet of code to your existing script until you have all 5 requests in the script. **You will need to remove the duplicate 'import requests' lines and update each request with the 'verify=False' option.**
2. Save the file
3. Run the script and verify the config was created.

Lab 3.7 – EXTRA CREDIT – Modify create_pool.py

This is an open-ended exercise. Copy create_pool.py to create_vs.py and modify it to create a Virtual Server. You could also cheat and look at you_cheated.py!

Lab 3.8 – EXTRA CREDIT – Review super_pool.py

This is an open-ended exercise. Review and run the super_pool.py script. This script allows bulk creation/deletion of pools using CSV files.