

LoadCore AWS Deployment

Deployment Guide

Notices

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Documentation conventions

The following documentation conventions are used in this guide:

Describing interactions with the UI

You can interact with products by using different input methods: keyboard, mouse, touch, and more. So in most parts of the user documentation, generic verbs have been used that work with any input method. In cases where input-neutral verbs do not work, mouse-specific verbs are used as the first choice, followed by touch-specific verbs as the second choice.

See the following table for examples on how you can interpret the different input methods.

Input-neutral	Mouse	Touch
Select Modify .	Click Modify .	Tap Modify .
Select Accounts > Other accounts > Add an account .	Click Accounts > Other accounts > Add an account .	Tap Accounts > Other accounts > Add an account .
To open the document in Outline view, select View > Outline .	To open the document in Outline view, click View > Outline .	To open the document in Outline view, tap View > Outline .
Select Protocols .	Click the Protocols tab.	Tap Protocols .
-NA-	Double-click the Client wizard.	Double-tap the Client wizard.
Open the Packages context menu.	Right-click Packages to open the shortcut menu.	Long tap Packages to open the shortcut menu.

Deprecated words

The following words have been replaced with new words, considering the audience profile, our modern approach to voice and style, and our emphasis to use input-neutral terms that support all input methods.

Old usage...	New usage...
shortcut menu, right-click menu	context menu
click, right-click	select
drag and drop	drag

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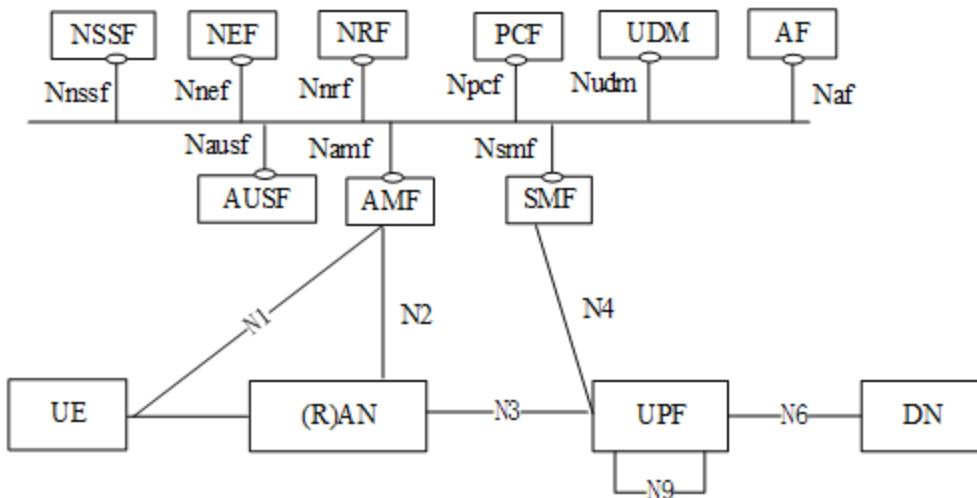
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CHAPTER 1**Test Methodologies for 5GC**

The 5G will lead in a large number of new applications – for use cases that are not even close to being possible in the 3G/4G regime. According to reasonable estimates, the world will have more than 1.1 billion 5G connections by 2025 (accounting for ~15% of the total connections). Along with artificial intelligence (AI) and edge computing, 5G wireless technology will be right at the heart of the burgeoning IoT revolution over the next half a decade or so, expected to play a major role in the development of Industry 4.0 in general, smart city applications, smart industrial software, powering connected cars, and smart homes & buildings. Seamless mobility, negligible latency, full scalability, and reliability will help 5G in making many high-end, mission-critical IoT projects implementable with ease.

Unlike 4G, which is determined by modulation and frequency (i.e., interface-defined), 5G will be the first-ever software-defined wireless standard. And this is a key aspect of the Control User Plane separation of SMF/UPF where LTE CUPS is being reused.

The 5G Core is represented by following network topology:



CHAPTER 2

Prerequisites

For a complete and correct functioning setup, make sure you have downloaded and installed the packages on your test environment:

- **Wireshark** capable to decode PFCP messages and IEs (at least 2.5.2).
This will be used to analyze the traffic captures.
- **AWS account**
The examples presented in this guide were done using a Full Core topology deployed in B2B scenario (no real/external DUT).
- **LoadCore images** (three images: one for Middleware, for Test Agents and one for License Server).

There are few options to get the images (AMI images that Amazon uses):

- Get the AMI images from the support website.
- Get the .ova images from the download section, transform them to AMI and import them in AWS.
<https://support.ixiacom.com/software-downloads/236052>
- Get the shared images from our AWS account. For this, you need to contact the Support Eng. assigned to help with this activity.
- **Valid licenses** for Ixia License server. For deploying full 5G core and run Control Plane and User Plane traffic, the following licenses are required:
 - Control plane licenses:
 - LoadCore interface license simulation (**939-9551** x 11 pcs).
This license will enable Control Plane testing. One license is needed for each simulated interface.
 - 5G Core Performance enabler on VM: 1M UEs and 10k TPS for VM (**939-9552** x 1 pcs).
 - User Plane licenses:
 - User Plane Flow-based license (N3 and N6). Multiple QTY are needed if multiple flows are active simultaneously. It includes three Application Traffic Flows (TCP/UDP) and 10Gbps throughput capacity (**939-9557** x 2 pcs). The recommendation is to use this type of license as this will be suggested for all new customers.
 - As an alternative for the above license you can also use Tier-4 license (**939-9520** or **939-9540** x 2 pcs).

IMPORTANT These license types will enable User Plane traffic and are not needed if only Control Plane traffic is needed for future tests.

Resource requirements in AWS

LoadCore Middleware instance resources

By default, the VM for Middleware will reserve the following compute resources:

- 8 x vCPUs
- At least 12 GB RAM
- 256 GB HDD (in LoadCore 1.3 the HDD space was increased to 256G since the test results are now stored on Middleware and additional space was needed for this)

Recommended instance types: **c4.2xlarge, m4.2xlarge, t2.2xlarge, c4.4xlarge, c5.2xlarge, c5.4xlarge.**

LoadCore Test Agent instance resources

The **Test Agent** will reserve the following compute resources:

- 4 x vCPUs
- 4 GB RAM **out of which 1GB is reserved for HUGE MEM(DPDK)**

IMPORTANT This value is for Control Plane only. If you are running app traffic the recommendation is to allocate minimum 16 GB RAM.

- 20 GB HDD

Recommended instance types: **c4.2xlarge, t2.xlarge, t2.2xlarge, c4.4xlarge, c4.8xlarge, c5.xlarge, c5.2xlarge, c5.4xlarge, c5.9xlarge.**

Licensing server default resources

- 2 x vCPUs
- 4 GB RAM
- 11 GB HDD

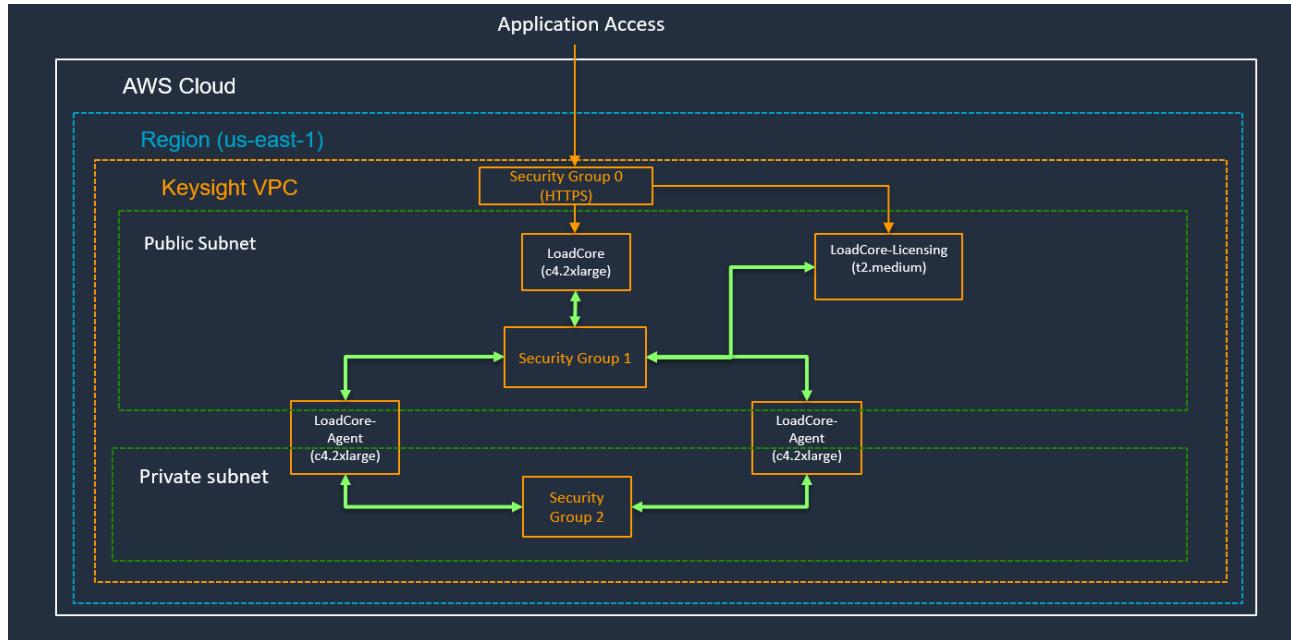
Recommended instance types: **t2.medium, t2.large, t2.xlarge, c4.large, c4.xlarge.**

CHAPTER 3

AWS services and components

Amazon **Virtual Private Cloud** (Amazon VPC) enables you to launch AWS resources into a virtual network that you have defined. Amazon VPC is the networking layer for Amazon EC2 and it is logically isolated from other virtual networks in the AWS Cloud.

The following diagram explains how LoadCore can be deployed in AWS:



For LoadCore deployment, you can reuse an already existing VPC or create a new one.

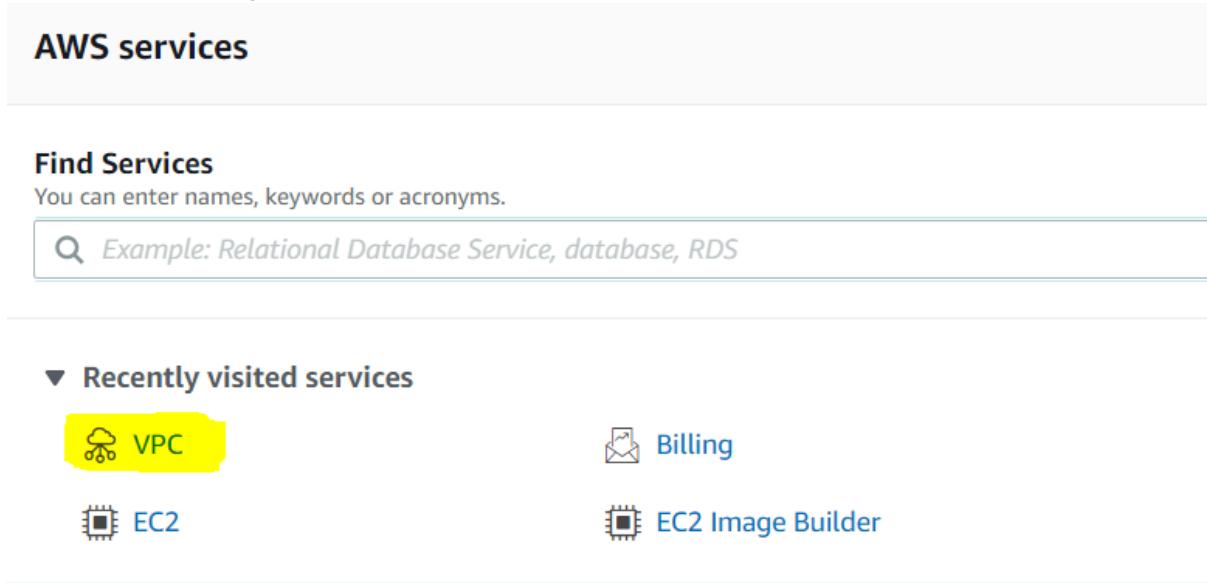
In this guide, a new VPC is created, as presented in the following topics.

Create a Virtual Private Cloud

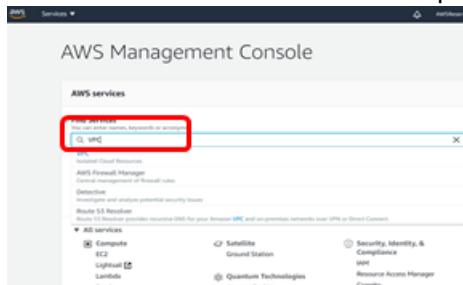
You can create an Amazon Virtual Private Cloud as follows:

1. Select **AWS Management Console** > **Services** > **VPC**.

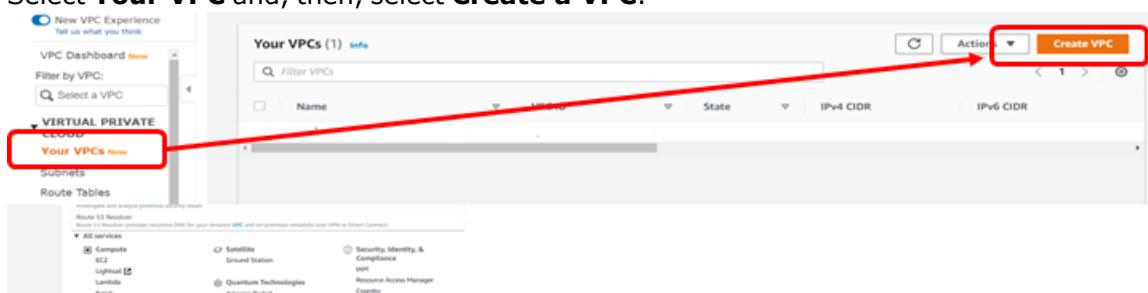
AWS services



You can also use **Find Services** option and search for VPC:



2. Select **Your VPC** and, then, select **Create a VPC**.



3. We will define **loadcore-vpc** with a **10.0.0.0/16** mask network (IPv4 CIDR). Later on, we will define two subnets in this large CIDR block:

Create VPC [Info](#)

A VPC is an isolated portion of the AWS cloud populated by AWS objects, such as Amazon EC2 instances.

VPC settings

Name tag - optional
Creates a tag with a key of 'Name' and a value that you specify.

IPv4 CIDR block [Info](#)

IPv6 CIDR block [Info](#)
 No IPv6 CIDR block
 Amazon-provided IPv6 CIDR block
 IPv6 CIDR owned by me

Tenancy [Info](#)

4. At the end of this operation you should have the following result:

Your VPCs (1/1) [Info](#)

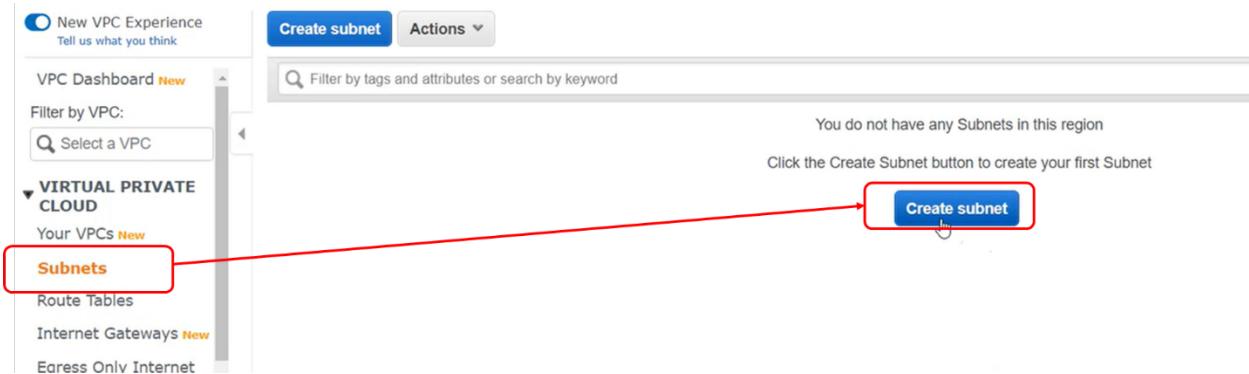
[Actions](#) [Create VPC](#)

<input checked="" type="checkbox"/> Name	VPC ID	State	IPv4 CIDR	IPv6 CIDR
<input checked="" type="checkbox"/> loadcore-vpc	vpc-0f83e58ca0488394d	Available	10.0.0.0/16	-

Create the management and test subnets

You need to create two subnets inside the VPC defined at the previous step, one subnet to be used for management and the other one to be used for test.

A *subnet* is a range of IP addresses in your VPC. You can launch AWS resources into a specified subnet. Use a public subnet for resources that must be connected to the internet, and a private subnet for resources that will not be connected to the internet.



We will use **10.0.0.0/24** for management (with the name **mgmt.-subnet**) and **10.0.10.0/24** for test (with the name **test.-subnet**).

The subnet can be created as follows(in this example, the management subnet):

1. Select the **VPC ID** (there will be only one VPC – the one created at the previous step). If you are reusing an existing VPC, make sure to select the correct VPC ID.
2. Define the subnet TAG (this is the name assigned to the subnet).

3. Define the subnet IP addresses (in this case **10.0.0.0/24**).

4. Select **Create Subnet**.

VPC ID
Create subnets in this VPC.
vpc-0f83e58ca0488394d (loadcore-vpc)

Associated VPC CIDs
IPv4 CIDs
10.0.0.0/16

Subnet settings
Specify the CIDR blocks and Availability Zone for the subnet.

Subnet 1 of 1

Subnet name
Create a tag with a key of 'Name' and a value that you specify.
mgmt-subnet

The name can be up to 256 characters long.

Availability Zone [Info](#)
Choose the zone in which your subnet will reside, or let Amazon choose one for you.
No preference

IPv4 CIDR block [Info](#)
10.0.0.0/24

▼ Tags - optional

Repeat the steps presented above for test subnet also(using **10.0.10.0/24** IP definition).

After creating the two subnets, your console should display the following image:

- The **Subnet ID** is automatically assigned.
- Both subnets should belong to the same VPC.

Subnets (2) [Info](#)

Filter subnets

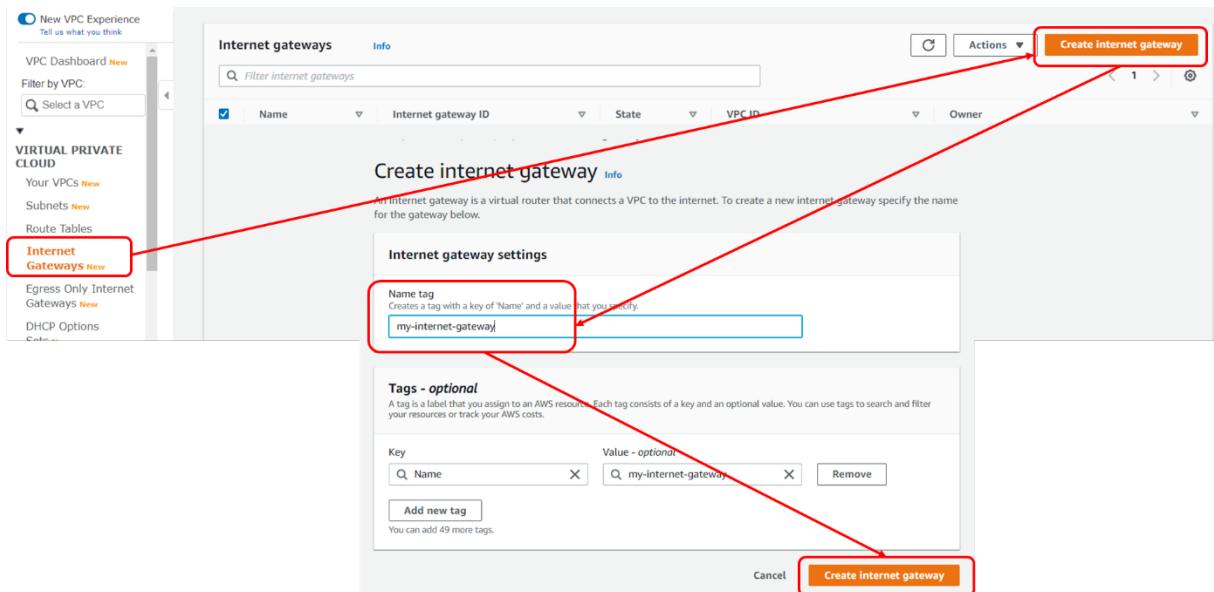
<input type="checkbox"/>	Name	Subnet ID	State	VPC	IPv4 CIDR
<input type="checkbox"/>	mgmt-subnet	subnet-0a87408455ab56c3e	Available	vpc-0f83e58ca0488394d lo...	10.0.0.0/24
<input type="checkbox"/>	test-subnet	subnet-04267cc8ce65eb610	Available	vpc-0f83e58ca0488394d lo...	10.0.10.0/24

Create the Internet Gateway

An internet gateway is a VPC component that enables communication between your VPC and the Internet.

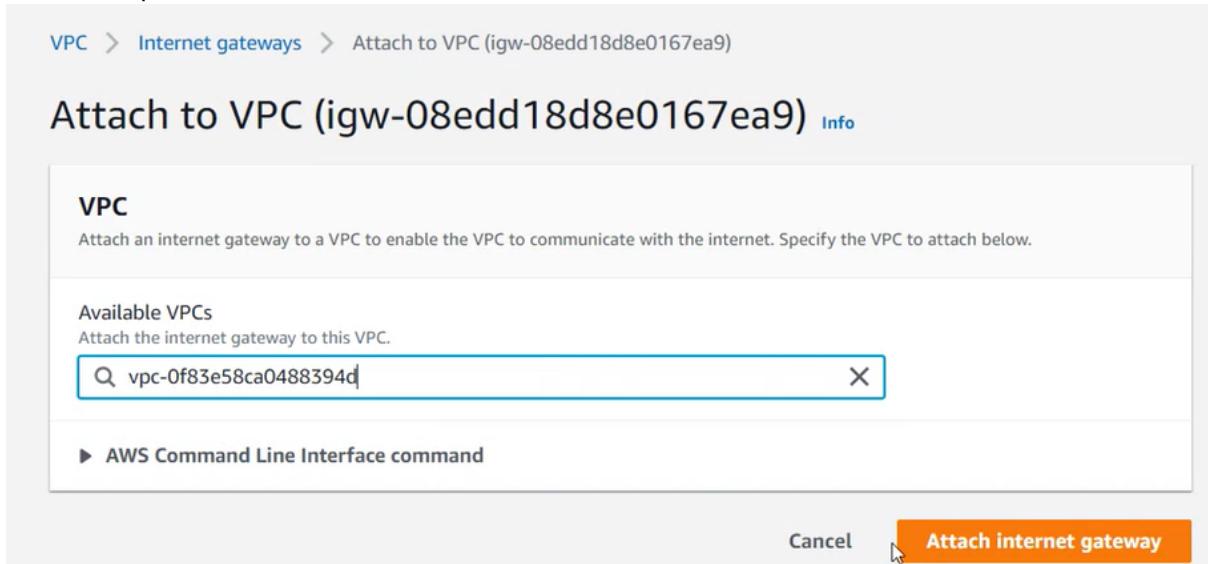
To use an internet gateway, attach it to your VPC and specify it as a target in your subnet route table for internet-routable IPv4 or IPv6 traffic. An internet gateway performs network address translation (NAT) for instances that have been assigned public IPv4 addresses.

We will name it **my-internet-gateway**, after that, we need to attach it to our VPC.



The newly created gateway is in the state **Detached**, with no VPC ID associated. Therefore, we need to attach it to our VPC:

1. Select the gateway.
2. Select **Actions** and, then, select **Attach to VPC**.
3. Select the previous defined VPC.



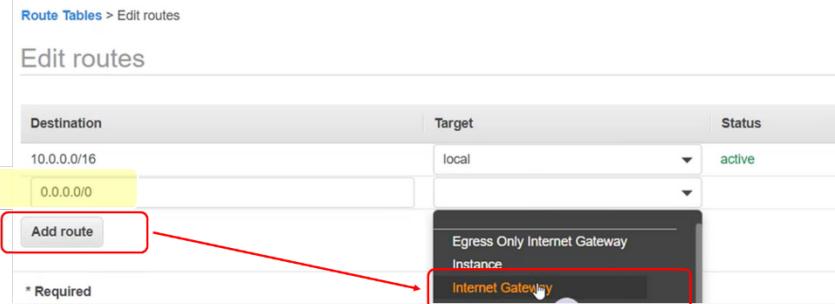
At the end of this step, the following image should be displayed:

Internet gateways (1/1) Info						
<input type="button" value="Actions ▾"/> <input type="button" value="Create internet gateway"/>						
<input type="text" value="Filter internet gateways"/>						
Name	Internet gateway ID	State	VPC ID	Owner		
my-internet-gateway	igw-08edd18d8e0167ea9	Attached	vpc-0f83e58ca0488394d loadcore-vpc	672779868767		

Assign traffic routes

The next step is to assign traffic routes, in order to pass the external traffic through the gateway that we just defined. This can be done as follows:

1. Select the **Route table** menu(a *route table* contains a set of rules, called *routes*, that are used to determine where network traffic from your subnet or gateway is directed).
2. Select **Add Route** and define the default rate: **0.0.0.0/0**.
3. For **Target** select **Internet Gateway** and select the gateway previously defined.
4. Select **Save Routes**.



If you select **Routes**, the following configuration should be displayed:

Name	Route Table ID	Explicit subnet association	Edge associations	Main	VPC ID
	rtb-09038b62a74cab699	-	-	Yes	vpc-0f83e58ca0488394d ...

Route Table: rtb-09038b62a74cab699

Summary **Routes** **Subnet Associations** **Edge Associations** **Route Propagation** **Tags**

Edit routes

View All routes

Destination	Target	Status
10.0.0.0/16	local	active
0.0.0.0/0	igw-08edd18d8e0167ea9	active

Configure Security Groups

To protect the AWS resources in each subnet, you can use multiple layers of security, including security groups and network access control lists (ACL).

A security group acts as a virtual firewall for your instance to control inbound and outbound traffic. When you launch an instance in a VPC, you can assign up to five security groups to the instance. Security groups act at the instance level, not the subnet level. Therefore, each instance in a subnet in your VPC can be assigned to a different set of security groups.

You might set up network ACLs with rules similar to your security groups in order to add an additional layer of security to your VPC.

By default, when the VPC was created, also a Security Group was automatically defined.

We will define a name for it (**loadcore-sg**) and configure the inbound rules:

The screenshot shows the AWS Management Console interface for managing security groups. On the left, there's a sidebar with various AWS services like Spot Requests, Savings Plans, Reserved Instances, etc. The 'Security Groups' section is highlighted. In the main area, a table lists one security group: 'default' (Security group ID: vpc-0f83e58ca0488394d). A modal dialog box is open over the table, titled 'Edit Name'. Inside the dialog, the current name 'default' is shown in a text input field, which is being overwritten by the new name 'loadcore-sg'. Below the input field are 'Cancel' and 'Save' buttons. The 'Save' button is highlighted with a blue border.

Now we need to define Inbound security rules, as follows:

1. Select the security group ID and go on Inbound rules.
2. Select **Add rule**.
 - For security reasons we will allow the traffic only for specific ports used by LoadCore and originated from a single IP address(the one used to access the internet).

The screenshot shows the 'Edit inbound rules' page for a specific security group. The URL in the browser bar is EC2 > Security Groups > sg-0dcc6656aeeb6c9cd - default > Edit inbound rules. The page title is 'Edit inbound rules'. It says 'Inbound rules control the incoming traffic that's allowed to reach the instance.' Below this, there's a table for defining rules. The 'Type' dropdown is set to 'All traffic'. The 'Protocol' dropdown is set to 'All'. The 'Port range' dropdown is set to 'All'. The 'Source' dropdown is set to 'Custom' and has a search bar with 'sg-0dcc6656aeeb6c9cd' typed into it. A red box highlights the 'Add rule' button at the bottom left of the table area.

- We will permit the following:
 - SSH, to access the LoadCore VMs,
 - HTTP, HTTPS, used by LoadCore for configuration, interaction between nodes,
 - Custom: 7443 port, that is used by the LoadCore License Server,
 - For all traffic we will select *My IP*, and the browser will automatically fill it with the outgoing IP address that you have (in this case **188.25.103.79**).

At the end of this step, you should have the following rules in your Security Group:

Inbound rules [Info](#)

Type Info	Protocol Info	Port range Info	Source Info
HTTP	TCP	80	Custom ▼ <input type="text" value="188.25.103.79/32"/> X
SSH	TCP	22	Custom ▼ <input type="text" value="188.25.103.79/32"/> X
HTTPS	TCP	443	Custom ▼ <input type="text" value="188.25.103.79/32"/> X
Custom TCP	TCP	7443	Custom ▼ <input type="text" value="188.25.103.79/32"/> X

[Add rule](#)

Create Key Pairs

The final step is to create the key pair, as presented below.

EC2 > [Key pairs](#) > [Create key pair](#)

Create key pair

Key pair
A key pair, consisting of a private key and a public key, is a set of security credentials that you use to prove your identity when connecting to an instance.

Name The name can include up to 255 ASCII characters. It can't include leading or trailing spaces.

File format **ppk** For use with PuTTY **pem** For use with OpenSSH

Tags (Optional)
No tags associated with the resource.

[Add tag](#) You can add 50 more tags.

[Cancel](#) [Create key pair](#)

CHAPTER 4

LoadCore Components Installation

Until now, we have created the minimum infrastructure required to deploy the LoadCore components.

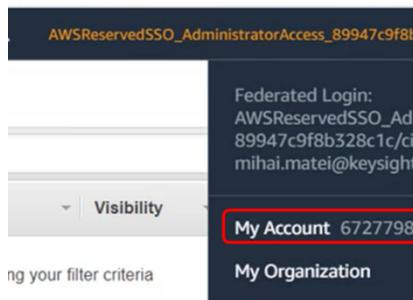
In AWS, the images that we are using are in AMI format.

An Amazon Machine Image (AMI) provides the information required to launch an instance. You must specify an AMI when you launch an instance. You can launch multiple instances from a single AMI when you need multiple instances with the same configuration. You can use different AMIs to launch instances when you need instances with different configurations.

The AMI images can be downloaded from our official website or can be shared from our AWS account.

In this deployment, we will use shared images.

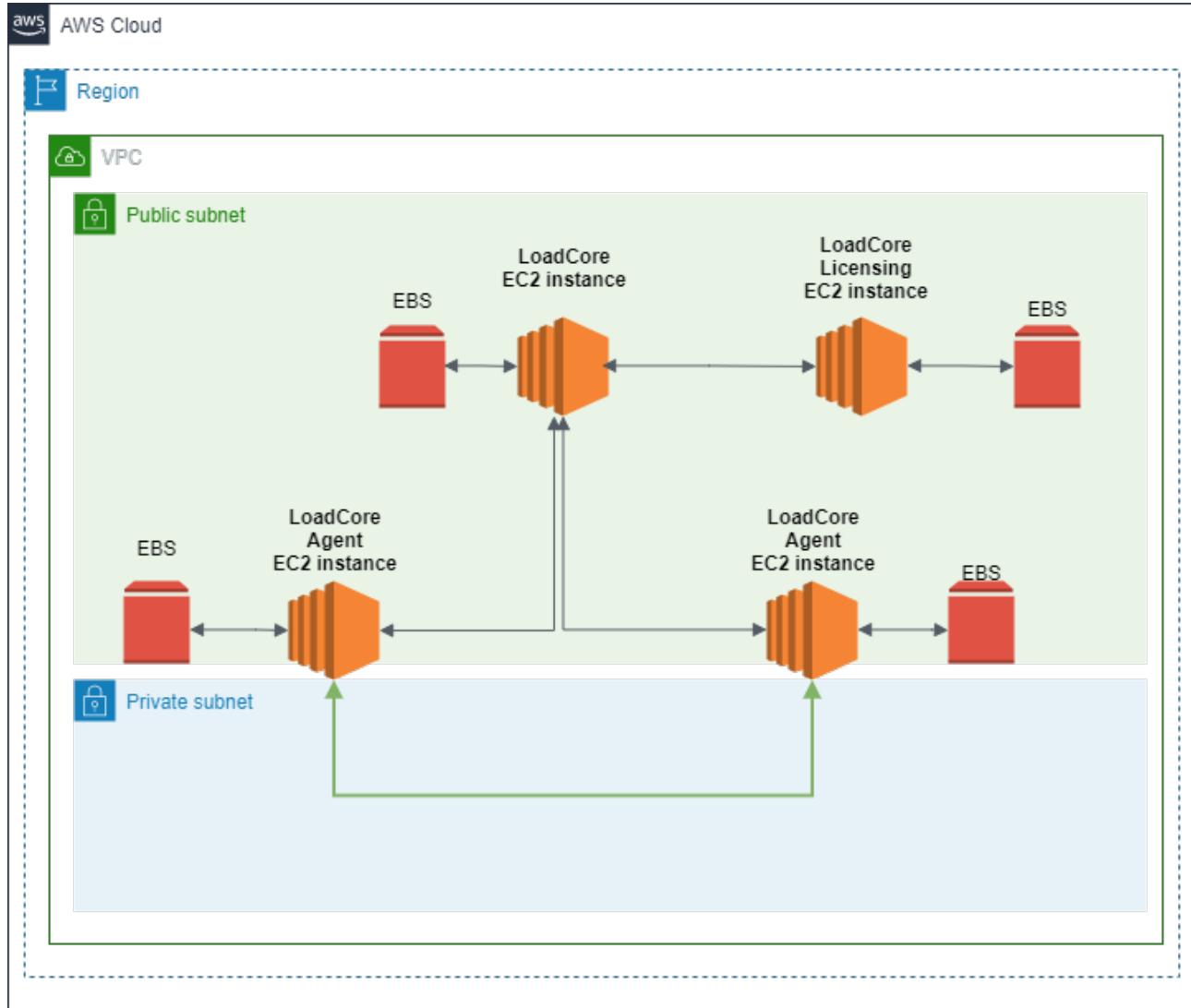
To get access to them, please contact our Support or PM team. You need to provide your AWS account ID to get access to the shared images.



In order to install the LoadCore Middleware, Test Agents and License server, the AMI images should be available for you, in your AWS account.

The installation process basically consists of launching the AMI images.

The following diagram illustrates some of the AWS services used by LoadCore deployment:



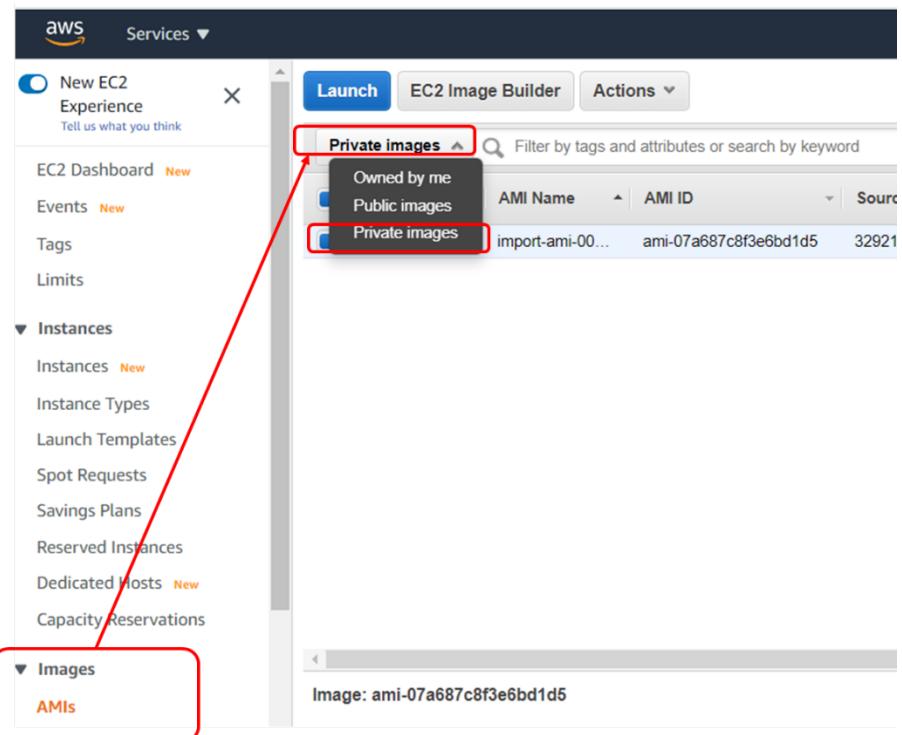
Middleware Installation

The installation procedure of the Middleware requires the following steps:

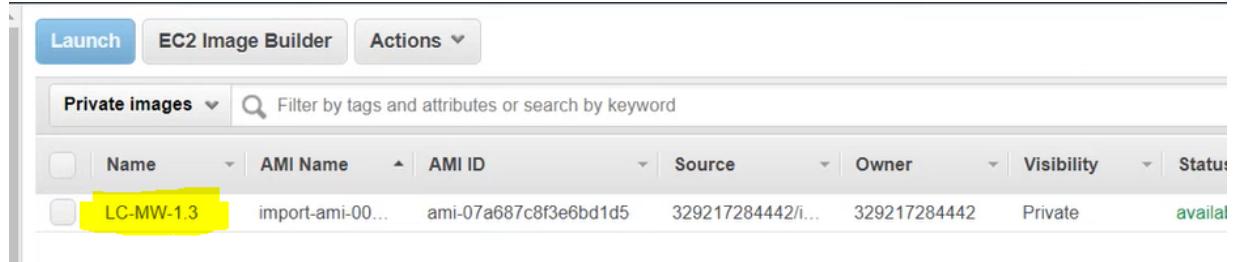
1. From the main console select **Services > EC2 > Images > AMI**.

The browser will automatically display the **images that you own**, therefore, if you do not have other images created, the list will be empty.

Select **Private Image** and you will find the installation images that were shared with you.



You can also give a name to the AMI image, to be easily identified (in this case **LC-MW-1.3**).



Once you have the image available, select it and select **Launch**.

The launch process will request additional info, which is meant to adjust the resources in AWS.

The general advice here is to select the same amount of resources as in the other installation (for example, ESXi):

- Select the Instance type:

- Select **c4.2xlarge**.

Step 2: Choose an Instance Type

<input type="checkbox"/>	t4g	t4g.medium	2	4	EBS only
<input type="checkbox"/>	t4g	t4g.large	2	8	EBS only
<input type="checkbox"/>	t4g	t4g.xlarge	4	16	EBS only
<input type="checkbox"/>	t4g	t4g.2xlarge	8	32	EBS only
<input type="checkbox"/>	c4	c4.large	2	3.75	EBS only
<input type="checkbox"/>	c4	c4.xlarge	4	7.5	EBS only
<input checked="" type="checkbox"/>	c4	c4.2xlarge	8	15	EBS only
<input type="checkbox"/>	c4	c4.4xlarge	16	30	EBS only
<input type="checkbox"/>	c4	c4.8xlarge	36	60	EBS only
<input type="checkbox"/>	c5	c5.large	2	4	EBS only
<input type="checkbox"/>	c5	c5.xlarge	4	8	EBS only
<input type="checkbox"/>	c5	c5.2xlarge	8	16	EBS only

- Configure the Instance Details:

- VPC – select the VPC we defined. In our case there is only one, but if you have multiple VPCs you need to select the one you want to use to deploy LoadCore.
- Select the management subnet.

Step 3: Configure Instance Details

No default VPC found. Select another VPC, or [create a new default VPC](#).

Configure the instance to suit your requirements. You can launch multiple instances from the same AMI, request Spot instances to take advantage of the lowe

Number of Instances	<input type="text" value="1"/>	Launch into Auto Scaling Group
Purchasing option	<input type="checkbox"/> Request Spot instances	
Network	<input type="text" value="vpc-0f83e58ca0488394d loadcore-vpc"/>	Create new VPC
Subnet	<input type="text" value="subnet-0a8740845ab56c3e mgmt-subnet us-east-1"/>	Create new subnet
Auto-assign Public IP	<input type="text" value="Use subnet setting (Disable)"/>	
Placement group	<input type="checkbox"/> Add instance to placement group	

- Select the management subnet.

- Select **Add Storage**.

By default, the **Size** will come with 100GB.

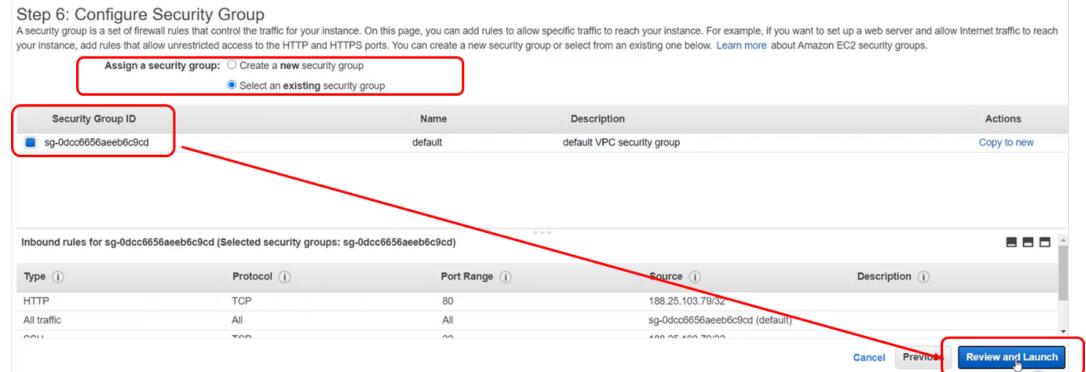
For long duration tests you need to increase the size to 256GB.

Step 4: Add Storage

Your instance will be launched with the following storage device settings. You can attach additional EBS volumes and instance store volumes to yo
edit the settings of the root volume. You can also attach additional EBS volumes after launching an instance, but not instance store volumes. [Learn](#)
storage options in Amazon EC2.

Volume Type	Device	Snapshot	Size (GiB)	Volume Type
Root	/dev/sda1	snap-0a30da8b309439f13	<input type="text" value="100"/>	General Purpose SSD (gp2)
Add New Volume				

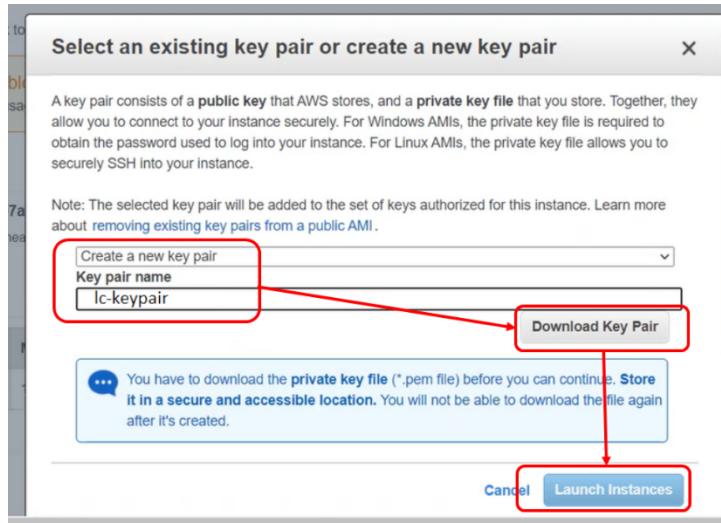
- There is no need to define Tags, select **Configure Security Group**.
 - Select the security group we previously defined.
 - Select **Review and Launch**.



2. Select **Launch**.

This will display a pop-up menu from where you can select/create a key pair. If you already have a key pair (and you downloaded it), you can select that one, otherwise you can create a new one, and download it from here, as shown below:

- Select **Create a new key pair**.
- Define a name for it: **lc-keypair**.
- Select **Download Key Pair**.
- Select **Launch Instances**.



3. At this point, the instance is launched, as shown below.

Launch Status

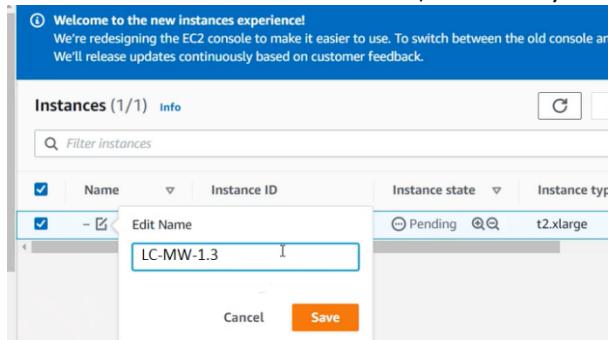
Your instances are now launching
The following instance launches have been initiated: i-0cbcf768f02edab2e [View launch log](#)

i Get notified of estimated charges
Create billing alerts to get an email notification when estimated charges on your AWS bill exceed an amo

How to connect to your instances

Your instances are launching, and it may take a few minutes until they are in the **running** state, when they will be ready to terminate your instances.

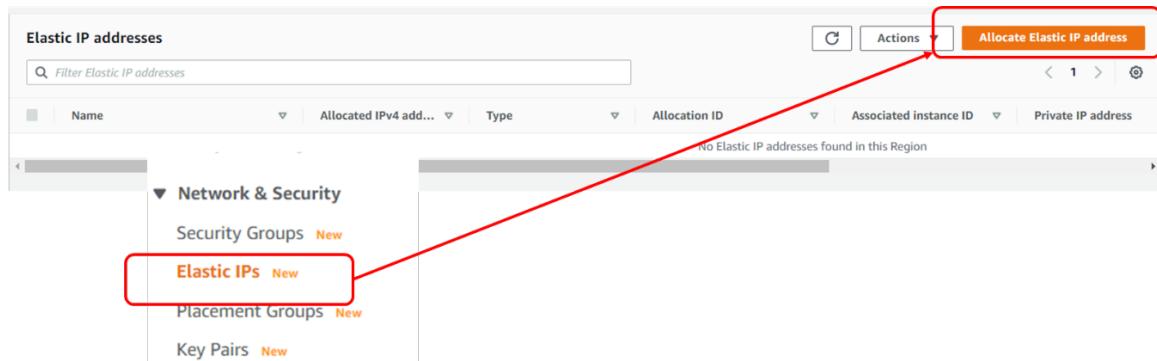
You can also define a name for it, to be easy to identify it(in this case **LC-MW-1.3**).



4. To access the LoadCore Middleware UI, we will need to assign an Elastic IP.

To do this, select the Elastic IP menu:

- Select **Allocate Elastic IP Address**.



Allocate Elastic IP address

Allocate an Elastic IP address from a public IPv4 address pool, or use global IP addresses from AWS Global Accelerator. You can have one Elastic IP associated with a running instance at no charge. You're charged for additional Elastic IPs that are associated with the instance, Elastic IPs that are associated with stopped instances or unattached network interfaces, and unassociated Elastic IPs. [Learn more](#)

Elastic IP address settings

Public IPv4 address pool
Public IP addresses are allocated from Amazon's pool of public IP addresses, from a pool that you own and bring to your account, or from a pool that you own and continue to advertise..

- Amazon's pool of IPv4 addresses
- Public IPv4 address that you bring to your AWS account(option disabled because no pools found) [Learn more](#)
- Customer owned pool of IPv4 addresses(option disabled because no customer owned pools found) [Learn more](#)

Global static IP addresses

AWS Global Accelerator can provide global static IP addresses that are announced worldwide using anycast from AWS edge locations. This can help improve the availability and latency for your user traffic by using the Amazon global network. [Learn more](#)

[Create accelerator](#)

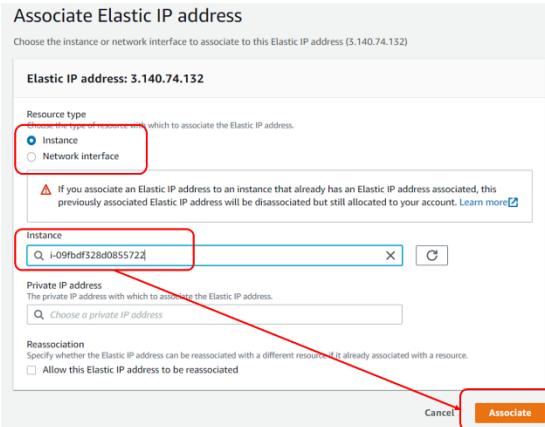
[Cancel](#)
Allocate

- The new IPv4 Public IP address will be allocated from AWS pool.
- Associate this IP address with the Middleware instance.

Elastic IP address allocated successfully.
Elastic IP address 3.140.74.132
[Associate this Elastic IP address](#)

Elastic IP addresses (1/1)					
<input type="text"/> Filter Elastic IP addresses				Actions ▾	
Public IPv4 address: 3.140.74.132 X		Clear filters		Allocate Elastic IP address	
<input checked="" type="checkbox"/>	Name	Allocated IPv4 add...	Type	Allocation ID	Associate Elastic IP address
<input checked="" type="checkbox"/>	-	3.140.74.132	Public IP	eipalloc-09f0e35dabc978f2c	Disassociate Elastic IP address

- Select the Middleware instance id, and then, select **Associate**:

**IMPORTANT**

This is the IP address of the LoadCore UI and you will also use it to install the wireless components.

Using an SSH client we can connect to the middleware using public key authentication:

```
ssh -i <private-key> loadcore@<Elastic_IP_address>
```

Agent(s) Installation

In LoadCore, you can use two different stacks, Linux Stack or IxStack:

- Linux Stack is used for Stateless UDP traffic.
- IxStack is used for Application traffic. This can work with raw sockets or with DPDK.

There are environments where you cannot use DPDK or is not available.

In AWS is not possible to bind the interface to DPDK therefore we will use raw sockets for Application traffic.

In order to use raw sockets, you need to make some changes.

By default, when you create an instance, you assign from AWS some default interfaces, called VIF, but these interfaces cannot be bind, as they do not have a PCI address. With this default interface you can run only Stateless UDP tests (with Linux Stack).

If Application traffic is needed, we will use a different instance that will give you access to two different interfaces/drivers:

- intel sriov, driver ixgbe vf
- ena driver

Enhanced networking support

All [current generation](#) instance types support enhanced networking, except for T2 instances.

You can enable enhanced networking using one of the following mechanisms:

Elastic Network Adapter (ENA)

The Elastic Network Adapter (ENA) supports network speeds of up to 100 Gbps for supported instance types.

The current generation instances use ENA for enhanced networking, except for C4, D2, and M4 instances smaller than m4.16xlarge.

Intel 82599 Virtual Function (VF) interface

The Intel 82599 Virtual Function interface supports network speeds of up to 10 Gbps for supported instance types.

The following instance types use the Intel 82599 VF interface for enhanced networking: C3, C4, D2, I2, M4 (excluding m4.16xlarge), and R3.

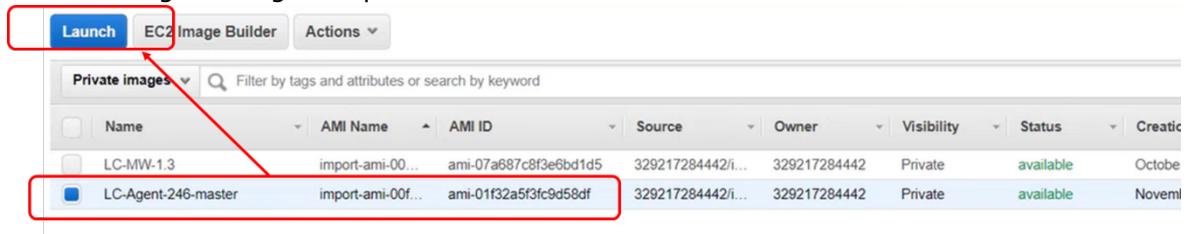
SRIOV support should be enabled from AWS CLI.

The installation procedure of the Agent(s) requires the following steps:

- From the main console select **Services > EC2 > Images > AMI**.

The browser will display the AMI images shared for your account.

Select the Agent image and press **Launch**.



Select **t2.**t** large** for instance type:

<input type="checkbox"/>	t2	t2_medium	2	4	EBS only	-	Low to Moderate
<input type="checkbox"/>	t2	t2_large	2	8	EBS only	-	Low to Moderate
<input checked="" type="checkbox"/>	t2	t2_xlarge	4	16	EBS only	-	Moderate
<input type="checkbox"/>	t2	t2_2xlarge	8	32	EBS only	-	Moderate

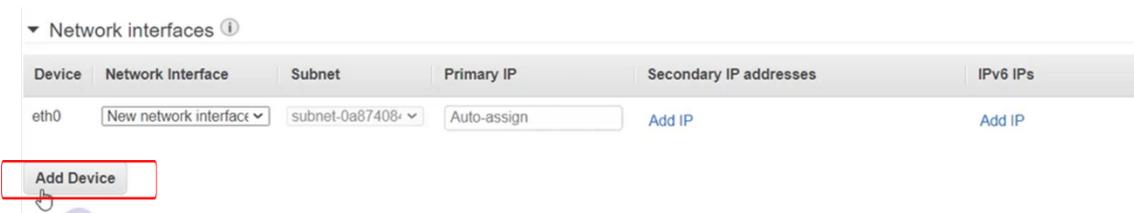
Select **Next**.

- Configure the instance details.

Select the VPC and assign the network interface in the management subnet.

By default, the instance comes with only one interface. For our agent installation we need to add the second interface to be used for test. To do that:

- Scroll down to the network interfaces and select **Add Device**.



- Assign it to the test subnet (previously defined).

Step 3: Configure Instance Details

Device	Network Interface	Subnet	Primary IP	Secondary IP addresses
eth0	New network interface	subnet-0a87408e	Auto-assign	Add IP
eth1	New network interface	subnet-0a87408e	Auto-assign	Add IP
			subnet-0a87408455ab56c3e (mgmt-subnet) 10.0.0.0/24 us-east-2a	
			subnet-04267cc8ce65eb610 (test-subnet) 10.0.10.0/24 us-east-2a	

BV We can no longer assign a public IP address to your instance

- The auto-assign public IP address feature for this instance is disabled because you specified multiple network interfaces for instances with one network interface. To re-enable the auto-assign public IP address feature, please specify only one network interface.

Select **Next**.

3. Add Storage.

By default, the image comes with 17GB assigned. This can be increased if more space is necessary. Simple tests can run with this value, otherwise define 20GB.

Select **Next**.

4. There is no need to add tags. Select **Next**.

5. Define the Security Group by selecting the previously defined security group.

Step 6: Configure Security Group

A security group is a set of firewall rules that control the traffic for your instance. On this page, you can add rules to allow specific traffic to reach your instance. For example, if you want to s allow unrestricted access to the HTTP and HTTPS ports. You can create a new security group or select from an existing one below. [Learn more](#) about Amazon EC2 security groups.

Assign a security group:	<input type="radio"/> Create a new security group	<input checked="" type="radio"/> Select an existing security group				
Security Group ID	<table border="1"> <thead> <tr> <th>Name</th> <th>Description</th> </tr> </thead> <tbody> <tr> <td>default</td> <td>default VPC security group</td> </tr> </tbody> </table>		Name	Description	default	default VPC security group
Name	Description					
default	default VPC security group					
sg-0dcc6656aeeb6c9cd						

6. Select **Review** and **Launch > Launch**.

7. For the key pair, you can reuse the previously generated key pair.

Select an existing key pair or create a new key pair

A key pair consists of a **public key** that AWS stores, and a **private key file** that you store. Together, they allow you to connect to your instance securely. For Windows AMIs, the private key file is required to obtain the password used to log into your instance. For Linux AMIs, the private key file allows you to securely SSH into your instance.

Note: The selected key pair will be added to the set of keys authorized for this instance. Learn more about [removing existing key pairs from a public AMI](#).

Choose an existing key pair

Select a key pair

I acknowledge that I have access to the selected private key file (lc-keypair.pem), and that without this file, I won't be able to log into my instance.

Cancel
Launch Instances

8. Select **Launch Instances**.

Launch Status

Your instances are now launching
The following instance launches have been initiated: i-0cbcf768f02edab2e [View launch log](#)

Get notified of estimated charges
[Create billing alerts](#) to get an email notification when estimated charges on your AWS bill exceed an amo

How to connect to your instances

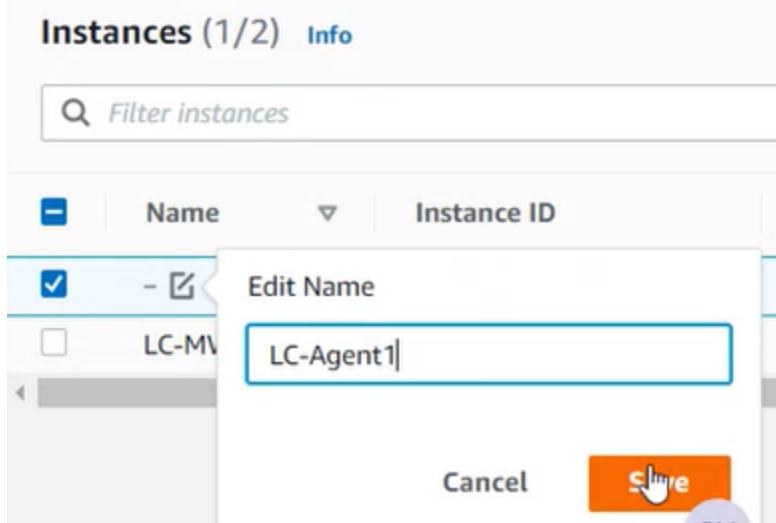
Your instances are launching, and it may take a few minutes until they are in the **running** state, when they will be ready to terminate your instances.

9. On the available instances, you should see two running instances:

- The one containing the Middleware.
- The new one, containing the Agent.

Define a name for the test agent instance (by default there is no name).

In this example we will name it **LC-Agent1**.

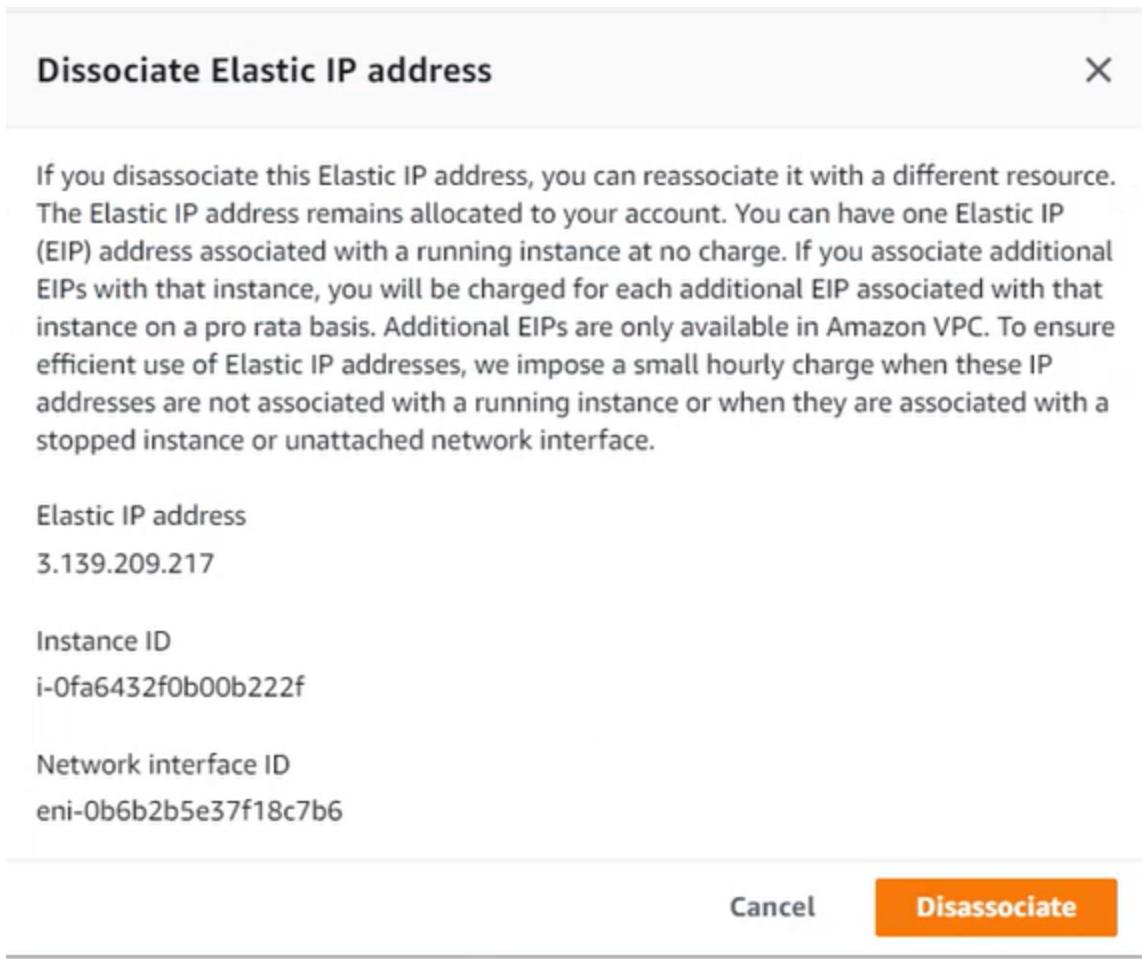


10. In order to access the agent, we need to assign an elastic IP.

There are two options here: assign a new one or reuse the previous one from Middleware. In this example we will reuse the previous one:

- Select **Elastic IP > Action > Disassociate.**

Name	Allocated IPv4 add...	Type	Allocation ID	A	Associate Elastic IP address	Release IP address
3.139.209.217	Public IP	eipalloc-05eb8b223d05e8983			Disassociate Elastic IP address	Release IP address

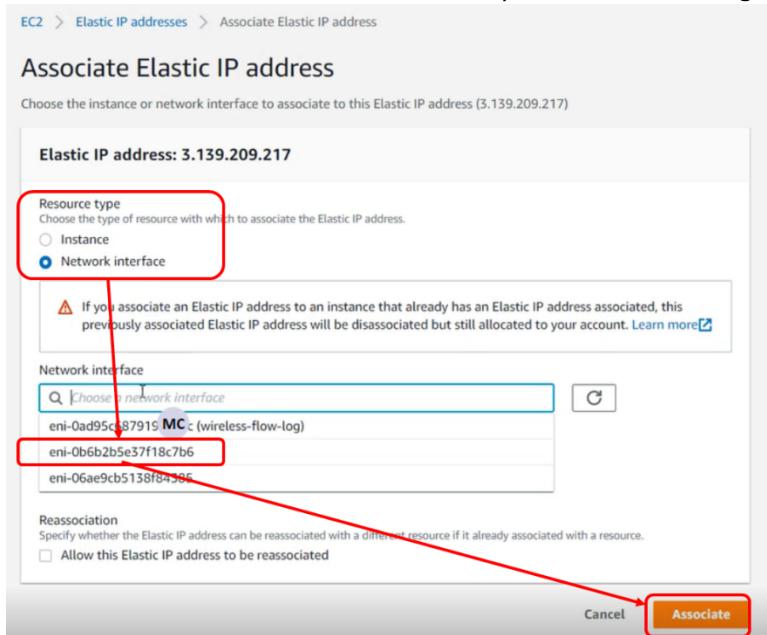


- The Elastic IP was disassociated and now should be reassociation to the Management interface of the test agent.

In the previous image deployment we associated the IP address to the Middleware instance, but here, since we have two network interfaces, we need to associate the Elastic IP address to the management network interface.

Select:

- **Resource type: network interface.**
- **Network interface:** the id that corresponds to the management subnet.



- **Associate.**

Now you can open a web browser and check if the agent Web UI interface is accessible on the elastic IP address:

The screenshot shows a web browser window with the following details:

- Address bar: Not secure | 3.139.209.217/doc/index.html
- Title bar: 5G Core Test Engine REST API OAS3
- Page content: SG Core Test Engine REST API
- Links: License
- Menu: Applications, Traffic, Capture

11. Connect the test Agent to the Middleware.

This process is the standard one, as in standalone deployments:

- Connect to the Agent using SSH.
- Run `agent-setup.sh` script:
 - For Middleware IP address you will specify the private IP address that is assigned for the Middleware instance, from management subnet.
 - For management interface you will select the agent management interface (for example, `eth1`).

12. This completes test Agent deployment procedure.

You can repeat the above steps if multiple Agents should be deployed.

In this moment, the test setup can perform stateless UDP testing.

For application traffic, the agent instance type should be changed, and raw sockets should be configured(this is covered in the next chapter).

Test Agent configuration for Application Traffic

Application traffic in AWS using raw sockets and SRIOV

To do this, the test Agent instance should be one that supports SRIOV.

Enhanced Network Support in AWS will give you access to two types of mechanism, ENA and Intel 82599 VF interface. We will use the Intel one but for that, the Agent Instance type should be one that allows ENA: C3, C4, D2 types.

We will use C4.

Enhanced networking support

All **current generation** instance types support enhanced networking, except for T2 instances.

You can enable enhanced networking using one of the following mechanisms:

Elastic Network Adapter (ENA)

The Elastic Network Adapter (ENA) supports network speeds of up to 100 Gbps for supported instance types.

The current generation instances use ENA for enhanced networking, except for C4, D2, and M4 instances smaller than **m4.16xlarge**.

Intel 82599 Virtual Function (VF) interface

The Intel 82599 Virtual Function interface supports network speeds of up to 10 Gbps for supported instance types.

The following instance types use the Intel 82599 VF interface for enhanced networking: **C3, C4, D2, I2, M4 (excluding m4.16xlarge), and R3.**

Beside this, you will need to configure some parameters that are only available using AWS CLI. Therefore, you will need to install AWS CLI on your computer.

AWS CLI Installation guidelines

The full details can be found on AWS support page:

<https://docs.aws.amazon.com/cli/latest/userguide/install-cliv2-windows.html>

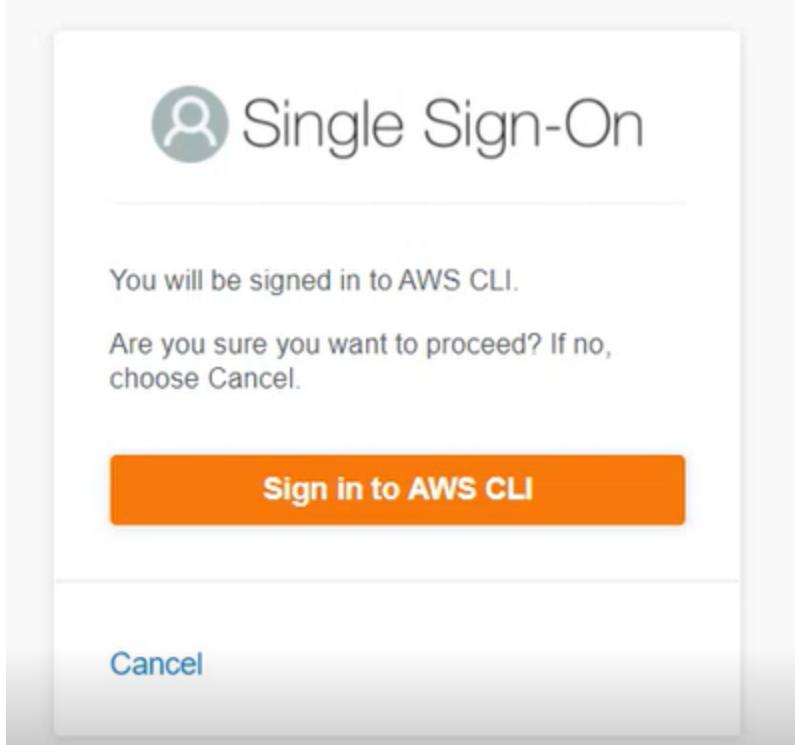
Download and run the MSI installer:

<https://docs.aws.amazon.com/cli/latest/userguide/install-cliv2-windows.html>

You will need admin/elevated right to install it. This is a straight forward process (**Next > Next > ..Finish**).

Open a CLI terminal and configure SSO:

1. **AWS configure SSO.**
2. SSO start URL: **<https://keysight.awsapp.com/start>**.
3. SSO Region: **us-east-1** (you need to check the region where your AWS accounts belong to).
4. Press **Enter**. The browser will automatically open and drives you to AWS SSO:

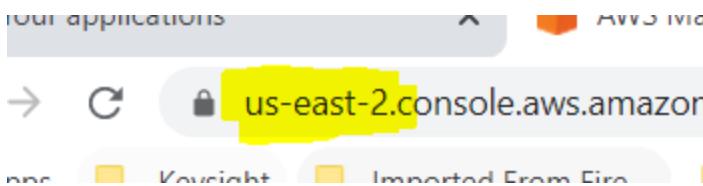


5. Select **Sign to AWS CLI**.
6. On the terminal CLI you will see the available accounts. Select the one you are using:

```
C:\ Command Prompt - aws configure sso
Microsoft Windows [Version 10.0.17763.1577]
(c) 2018 Microsoft Corporation. All rights reserved.

C:\Users\cipmatei>aws configure sso
SSO start URL [None]: https://keysight.awsapps.com/start#/ 
SSO Region [None]: us-east-1
Attempting to automatically open the SSO authorization page in your default browser.
If the browser does not open or you wish to use a different device to authorize this request, open the following URL:
https://device.sso.us-east-1.amazonaws.com/
Then enter the code:
QPBL-QWPQ
There are 2 AWS accounts available to you.
  keysight-aws-sbx-calabasas, aws-sbx-calabasas.pdl-it-cloud@keysight.com (329217284442)
> keysight-aws-demo-loadcore, aws-demo-loadcore.pdl-it-cloud@keysight.com (672779868767)
```

7. Select CLI default client region: **us-east-2** (this can be seen in the browser link):



8. Set the output format to **json**.

9. CLI profile name: press **Enter**.

```
Command Prompt
Microsoft Windows [Version 10.0.17763.1577]
(c) 2018 Microsoft Corporation. All rights reserved.

C:\Users\cipmatei>aws configure sso
SSO start URL [None]: https://keysight.awsapps.com/start#
SSO Region [None]: us-east-1
Attempting to automatically open the SSO authorization page in your default browser.
If the browser does not open or you wish to use a different device to authorize this request, open the following URL:
https://device.sso.us-east-1.amazonaws.com/

Then enter the code:

QPBL-QWPQ
There are 2 AWS accounts available to you.
Using the account ID 672779868767
The only role available to you is: AdministratorAccess
Using the role name "AdministratorAccess"
CLI default client Region [None]: us-east-2
CLI default output format [None]: json
CLI profile name [AdministratorAccess-672779868767]:  

To use this profile, specify the profile name using --profile, as shown:  

aws s3 ls --profile AdministratorAccess-672779868767  

C:\Users\cipmatei>
```

Now you are logged on AWS using your CLI terminal.

Now we will configure the SRIOV support. Multiple details can be found on AWS doc pages:

<https://docs.aws.amazon.com/AWSEC2/latest/UserGuide/sriov-networking.html>

- Check if our test client instance has SRIOV support:

On CLI terminal type:

```
aws ec2 describe-instance-attribute --instance-id instance_id --attribute
sriovNetSupport
```

Replace the **instance_id** parameter with the instance id of the test agent.

Instances (1/3) Info		
	Name	Instance ID
<input checked="" type="checkbox"/>	LC-Agent1	i-0fa6432f0b00b222f

If you have multiple accounts, you'll need to specify the profile id in the above command. If you have only one account this can be skipped:

```
CLI default client region [None]: us-east-2
CLI default output format [None]: json
CLI profile name [AdministratorAccess-672779868767]:  
  
To use this profile, specify the profile name using --profile, as shown:  
  
aws s3 ls --profile AdministratorAccess-672779868767  
  
C:\Users\cipmatei>aws ec2 describe-instance-attribute --profile AdministratorAccess-672779868767 --instance-id i-0fa6432f0b00b222f --attribute sriovNetSupport
```

The output of the above command will display the support for SRIOV. If it is empty (like in the picture below), it means the instance type used for the test agent does not have SRIOV and, in this case, we need to modify the instance attribute or the agent should be redeployed selecting a C4 instance type (or another one that has ENA support).

```
aws s3 ls --profile AdministratorAccess-672779868767

C:\Users\cipmatei>aws ec2 describe-instance-attribute --profile AdministratorAccess-672779868767 --instance-id i-0fa6422f0b00b222f --attribute sriovNetSupport
{
    "InstanceId": "i-0fa6422f0b00b222f",
    "SriovNetSupport": {}
}
```

Currently, the driver is **vif** and we need to do some changes and see **ixgbevf** and a **PCI address** (to be used to bind this to raw sockets).

```
[ec2-user ~]$ ethtool -i eth0
driver: vif
version:
firmware-version:
bus-info: vif-0
supports-statistics: yes
supports-test: no
supports-eeprom-access: no
supports-register-dump: no
supports-priv-flags: no

[ec2-user ~]$ ethtool -i eth0
driver: ixgbbevf
version: 4.0.3
firmware-version: N/A
bus-info: 0000:00:03.0
supports-statistics: yes
supports-test: yes
supports-eeprom-access: no
supports-register-dump: yes
supports-priv-flags: no
```

- We will now modify the instance attribute to support SRIOV.

Stop the test agent instance.

In CLI type the below command:

```
aws ec2 modify-instance-attribute --instance-id instance_id --sriov-net-support simple
```

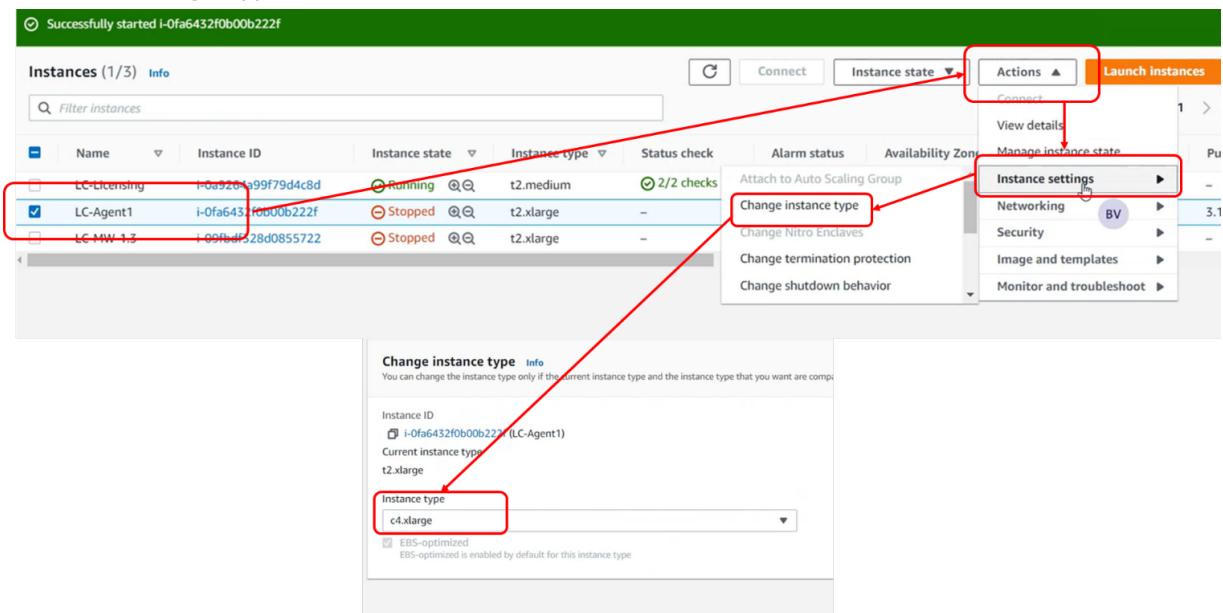
Here you will replace **instance_id** with the test agent instance id (see above). Also, add the profile id in the command (as above).

```
C:\Users\cipmatei>aws ec2 modify-instance-attribute --profile AdministratorAccess-672779868767 --instance-id i-0fa6432f0b00b222f --srivnet-support simple
```

- Make sure you have an Elastic IP associated with the test agent.
 - Stop the test agent instance and change the instance type.



- Select **c4.xlarge** type.



- Start the instance.

Now the test agent instance is properly configured, has SRIOV support.

You can check this using SSH on test agent and type:

- `Ethtool -I eth0` (you should see the ixgbevf driver)

```
ixia@ip-10-0-0-158:~$ ethtool -I eth0
driver: ixgbevf
version: 4.1.0-k
firmware-version:
expansion-rom-version:
bus-info: 0000:00:03.0
supports-statistics: yes
supports-test: yes
supports-eeprom-access: no
supports-register-dump: yes
supports-priv-flags: no
ixia@ip-10-0-0-158:~$
```

- `lspci` (you will see the available interfaces)

```
ixia@ip-10-0-0-158:~$ lspci
00:00.0 Host bridge: Intel Corporation 440FX - 82441FX PMC [Natoma] (rev 02)
00:01.0 ISA bridge: Intel Corporation 82371SB PIIIX3 ISA [Natoma/Triton II]
00:01.1 IDE interface: Intel Corporation 82371SB PIIIX3 IDE [Natoma/Triton II]
00:01.3 Bridge: Intel Corporation 82371AB/EB/MB PIIIX4 ACPI (rev 01)
00:02.0 VGA compatible controller: Cirrus Logic GD 5446
00:03.0 Ethernet controller: Intel Corporation 82599 Ethernet Controller Virtual Function (rev 01)
00:04.0 Ethernet controller: Intel Corporation 82599 Ethernet Controller Virtual Function (rev 01)
00:1f.0 Unassigned class [ff80]: XenSource, Inc. Xen Platform Device (rev 01)
```

Starting with LoadCore 2.1 release, the SRIOV support is enabled per test interface. This can be found in **Agent Assignment > Network Management**. This will activate the usage of the vNIC MAC address for all protocols on that interface.

Agents Assignment		Network Management							
Order	Agent	Tags	Impairment Profile	Agent Interface	Network Stack	SRIOV	Traffic Capture	Entity	
				Name	MAC				
1	10.73.50.65	IxStack: OFF (2) build: 492 (2)	None	ens192	00:0c:29:c0:8b:74	IxStack over Raw Sockets	ON	OFF	RAN
									NRF AUSF UDM/HSS PCF

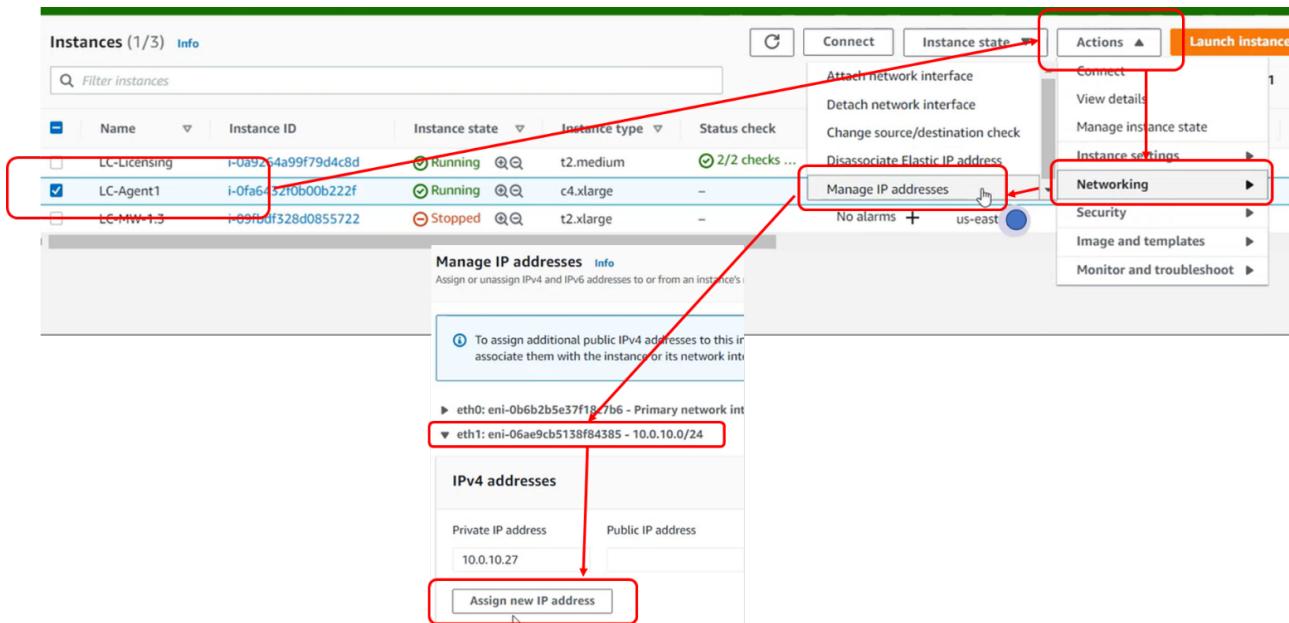
Now the agent is able to run application traffic on eth1.

You can repeat this process for the second agent also you can add multiple interfaces to the test agent.

Add the test IP addresses to the AWS infrastructure

In AWS, in order to allow traffic between test IP addresses, these should be added in AWS infrastructure, on the test agent instance on test interface (s):

1. Go to **Instance > Networking > Manage IP addresses** > select **eth1** > **Assign new IP addresses**.
2. Add all the IP addresses that are used in the test.



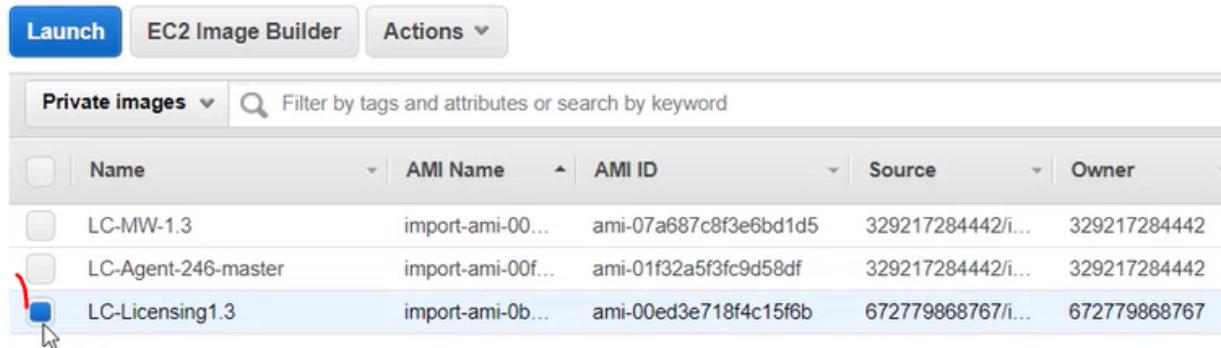
License Server Installation

The installation procedure of the License Server requires the following steps:

1. From the main console select **Services > EC2 > Images > AMI**.

The browser will display the AMI images shared for your account.

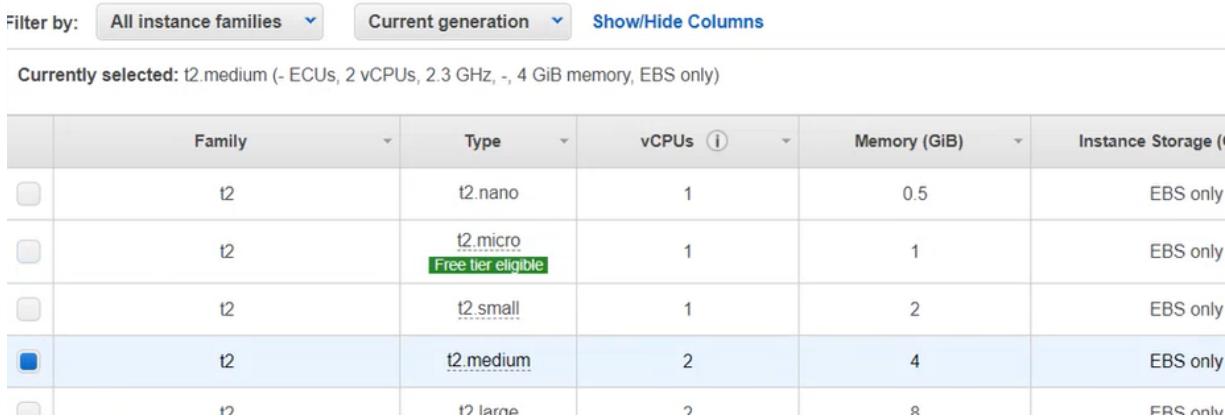
Select the License Server image and select **Launch**.



<input type="checkbox"/>	Name	AMI Name	AMI ID	Source	Owner
<input type="checkbox"/>	LC-MW-1.3	import-ami-00...	ami-07a687c8f3e6bd1d5	329217284442/i...	329217284442
<input type="checkbox"/>	LC-Agent-246-master	import-ami-00f...	ami-01f32a5f3fc9d58df	329217284442/i...	329217284442
<input checked="" type="checkbox"/>	LC-Licensing1.3	import-ami-0b...	ami-00ed3e718f4c15f6b	672779868767/i...	672779868767

2. Select **t2.xt medium** for instance type:

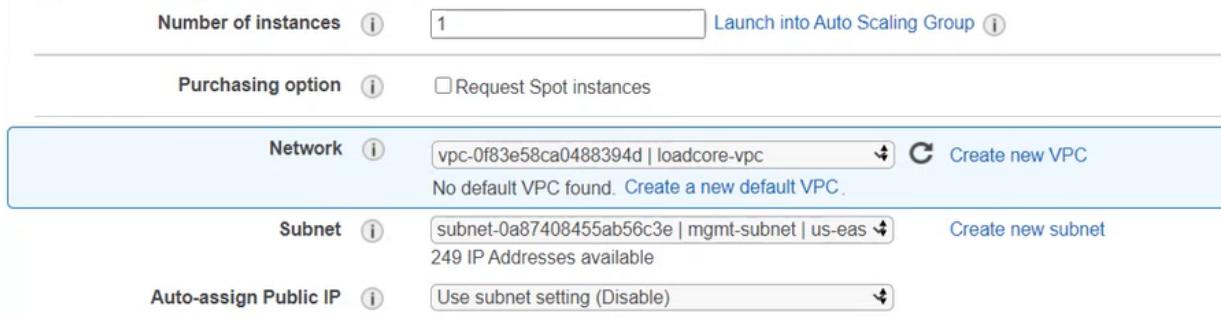
Amazon EC2 provides a wide selection of instance types optimized to fit different use cases. Instances are virtual servers that can run applications. They have the appropriate mix of resources for your applications. [Learn more](#) about instance types and how they can meet your computing needs.



Currently selected: t2.medium (- ECUs, 2 vCPUs, 2.3 GHz, -, 4 GiB memory, EBS only)					
	Family	Type	vCPUs	Memory (GiB)	Instance Storage (EBS only)
<input type="checkbox"/>	t2	t2.nano	1	0.5	EBS only
<input type="checkbox"/>	t2	t2.micro <small>Free tier eligible</small>	1	1	EBS only
<input type="checkbox"/>	t2	t2.small	1	2	EBS only
<input checked="" type="checkbox"/>	t2	t2.medium	2	4	EBS only
<input type="checkbox"/>	t2	t2.large	2	8	EBS only

3. In **Instance details**, the interface should belong to the management network.

Step 3: Configure Instance Details



Number of instances	<input type="text" value="1"/>	Launch into Auto Scaling Group (i)
Purchasing option	(i)	<input type="checkbox"/> Request Spot instances
Network	(i) <input type="text" value="vpc-0f83e58ca0488394d loadcore-vpc"/> (i) Create new VPC	No default VPC found. Create a new default VPC .
Subnet	(i) <input type="text" value="subnet-0a87408455ab56c3e mgmt-subnet us-eas"/> (i) Create new subnet	249 IP Addresses available
Auto-assign Public IP	(i) <input type="text" value="Use subnet setting (Disable)"/>	(i)

4. For Security Group, select the one we previously defined:

Step 6: Configure Security Group

A security group is a set of firewall rules that control the traffic for your instance. On this page, you can allow unrestricted access to the HTTP and HTTPS ports. You can create a new security group or select

- Assign a security group:
- Create a **new** security group
 - Select an **existing** security group

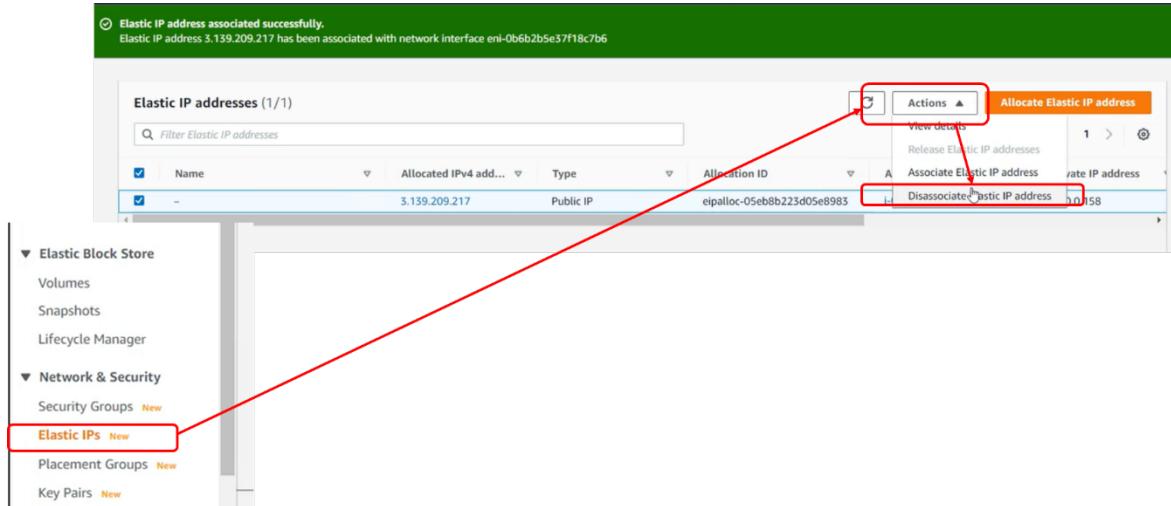


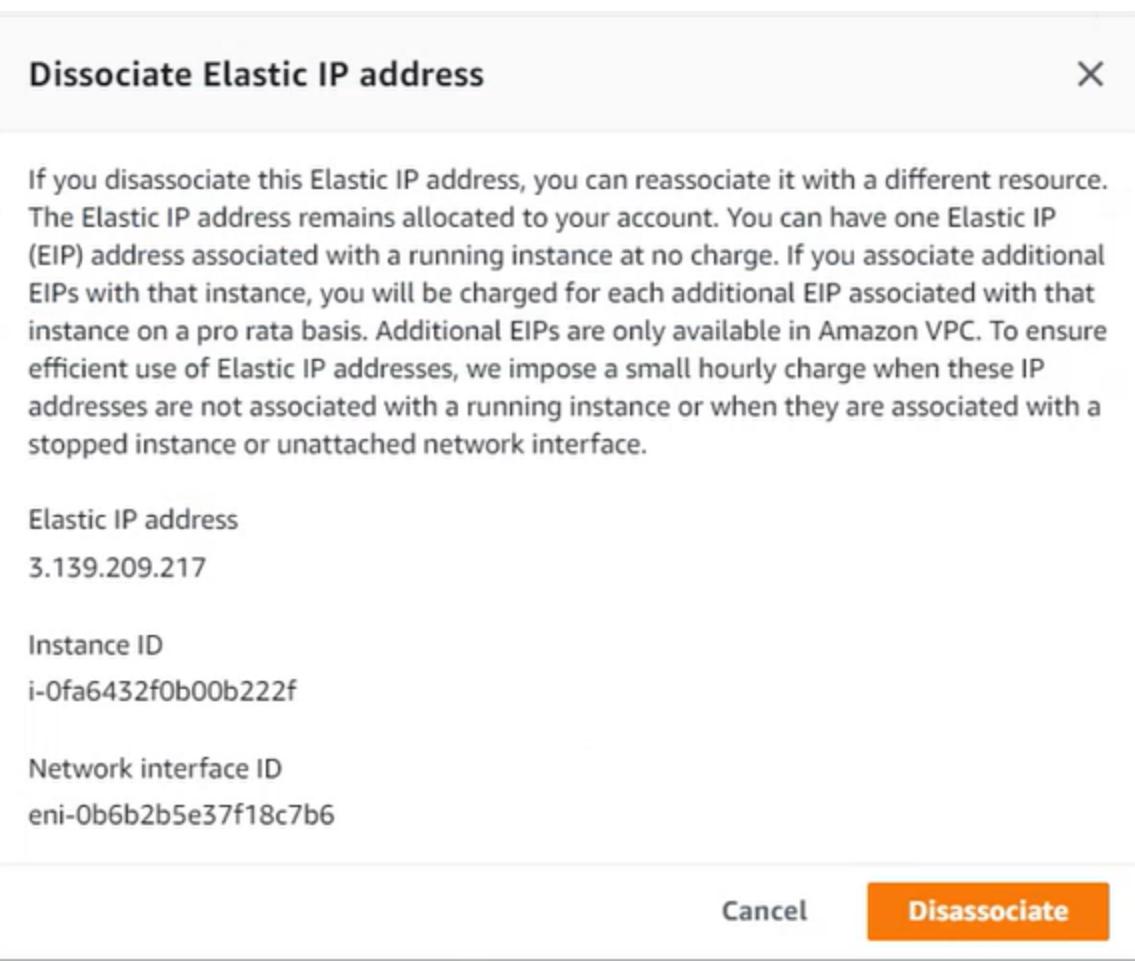
5. Leave the other parameters unchanged and launch the instance.

To install the licenses on the License Server, you need to access it using the Web UI interface on port 7443.

To do this, you need to reassign the Elastic IP address or define a new Elastic IP and assign it to this server:

- Select **Elastic IP > Action > Disassociate**.





- The Elastic IP was disassociated and now should be reassociation to the Instance of the License Server.

Select the following:

- **Resource type: Instance.**
- **Instance id:** select the if of the License server instance.

Associate Elastic IP address

Choose the instance or network interface to associate to this Elastic IP address (3.139.209.217)

Elastic IP address: 3.139.209.217

Resource type
Choose the type of resource with which to associate the Elastic IP address.

Instance
 Network interface

⚠ If you associate an Elastic IP address to an instance that already has an Elastic IP address associated, this previously associated Elastic IP address will be disassociated but still allocated to your account. [Learn more](#)

Instance
 X C

Private IP address
The private IP address with which to associate the Elastic IP address.

- **Select Associate.**

Now you can open a web browser and check if the Web UI interface is accessible on the elastic IP address

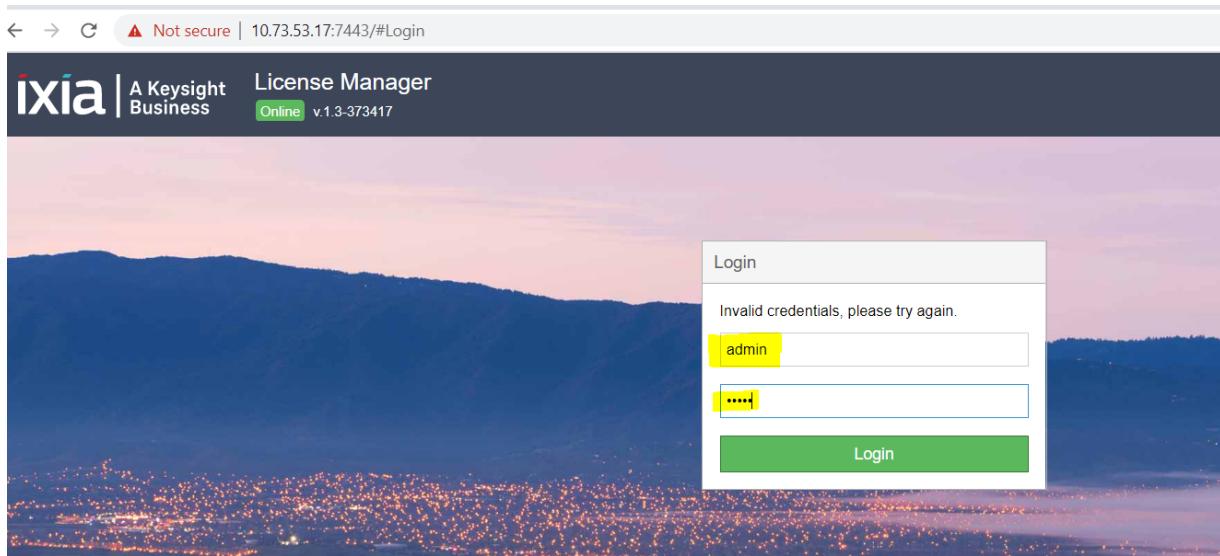
1. On your browser, type the IP address that was assigned for the License Server, using port 7443.

IXIA License Manager
v.1.3-335481

Available licenses

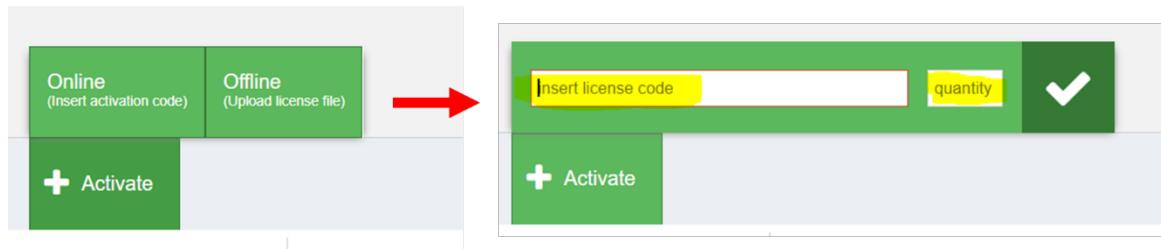
Part number	Product	Description
No available licenses found.		

2. Log in using the default username/password: **admin/admin**.



At this point, there are no licenses available on the newly installed server, therefore you must add the license codes you received (evaluation licenses can be obtained by sending an email to: Software-Eval-Request IX <software-eval-request.ix@keysight.com>.

Select the **+ Activate** button and add the license code and the quantity.



Repeat the activation procedure for all the license codes.

At the end, on the License Server UI, the valid licenses are displayed, as follows:

Available licenses							Host ID: 024ab2-8ef69c-c5290b-9c00
Part number	Product	Description	License expiration	Maintenance expiration	Quantity	Activation code	
939-9551-02	IxLoad	IXIA WRLS 5G Core, FLOATING Perpetual License, Single Interface emulation	08-Jun-2020	08-Jun-2020	20	6910-074A-D776-D1E5	
939-9552-02	IxLoad	IXIA WRLS 5G Core, FLOATING Perpetual Licenses, Performance enabler (UEs and Procedures per Sec)	08-Jun-2020	08-Jun-2020	1	E292-A5E4-4652-FECA	
939-9540-08	IxVMIxLoad	IXIA IxLoad VE Tier-4 10G Floating PERPETUAL License	08-Jun-2020	08-Jun-2020	10	FBA0-A3BC-75BC-DD...	

Software Upgrades

Middleware Upgrade

You can upgrade the Middleware software as follows:

1. After connecting to the LoadCore 2.1 setup, open the gear icon in the upper right to display the gear menu.
2. Select **Administration > Software Updates**.

3. Select **Browse** and use the opened window to find the LoadCore 2.1.1 upgrade .tar file on the disk.
4. Select **Start Update** to apply the patch and wait for the procedure to end.
5. Access the same menu and check the version of the setup, to make sure that the patch has been applied successfully.

Agent(s) Upgrade

You can upgrade the Agent(s) software as follows:

1. Connect to one of the LoadCore 2.1 agents.
2. Copy LoadCore-Agent-Update- < version >.tgz to /home/ixia.
3. Run the command:

```
curl -kX PUT https://< agent IP address > /api/v1/update --upload-file /home/ixia/LoadCore-Agent-Update- < version >.tgz
```
4. Using this agent, you will be able to upgrade all agents including the agent that you are connected from.
5. Make sure that the upgrade was successful:

```
curl -kX GET http://< agent IP address > /api/v1/version
```

Expected response:

```
{"revision": "b02c33cb", "tag": "jenkins-lizard-dist-249", "timestamp": "2020-03-20T21:02:13Z"}
```

Optionally, the agents can also be upgraded from Insomnia or any REST agent.

Repeat the steps presented above to deploy as many agents as required.

Troubleshooting

How to recover configuration files when LoadCore UI becomes unresponsive

1. Open a SSH connection to LoadCore Middleware instance using public key authentication.
2. `kubectl exec -it -n keysight-wap wap-db[TAB] /bin/bash [ENTER]`
3. `psql wapdb -U user`
4. `\dt+`
5. `\c wapdb`
6. `SELECT * FROM wireless_sessionconfigs;`
7. `SELECT session_id FROM wireless_sessionconfigs;`
8. `SELECT raw_config FROM wireless_sessionconfigs WHERE session_id='<session-id>';`

How to recover a session that got stuck in starting/stopping/running state

1. Open the REST API Browser from LoadCore UI gear wheel menu (the upper right corner of the LoadCore UI).
2. Go to **Sessions**.
3. Identify your session and click on **Sessions** button (Instance column).
4. Select **test** under selected session on the left side of the view.

5. Select **Edit** and go to status attribute. Change the status to **STOPPED** and select the commit button.
6. Return to LoadCore UI and check the session status.

How to recover a LoadCore Agent that does not respond when trying to run a test from LoadCore UI

1. Reboot the LoadCore Agent.
2. Connect to the LoadCore Agent using SSH.
3. Run the `agent-setup.sh` script: `sudo ./agent_setup.sh`.
4. Provide the required information regarding the interfaces used in the testbed:
 - a. The IP address of the LoadCore Middleware.
 - b. The management interface.
5. Allow the agent to be rebooted from the LoadCore UI : [y].

CHAPTER 5

AWS Security Best Practices

IAM Service

AWS provides a set of security guidelines to help secure your resources. For more details, please refer to:

- <https://docs.aws.amazon.com/IAM/latest/UserGuide/best-practices.html>

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