CS 455 – Computer Security Fundamentals

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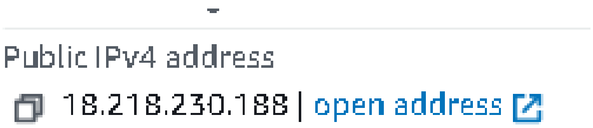
Computer Security Fundamentals

- Amazon EC2 instances with Security Groups and Session Manager
- AWS Network Access Control List (TBD)
- AWS Web Application Firewall (WAF) (TBD)
  - **AWS WAF Bot Control Explained and Demonstrated**

Amazon EC2 instances with Security Groups and Session Manager

- First thing of all, let’s examine the vulnerabilities of our EC2 instance
- Assuming that, my Kali Linux @ VirtualBox is the hacker’s machine
- The instance’s public IP address which I get from the AWS EC2 console is:



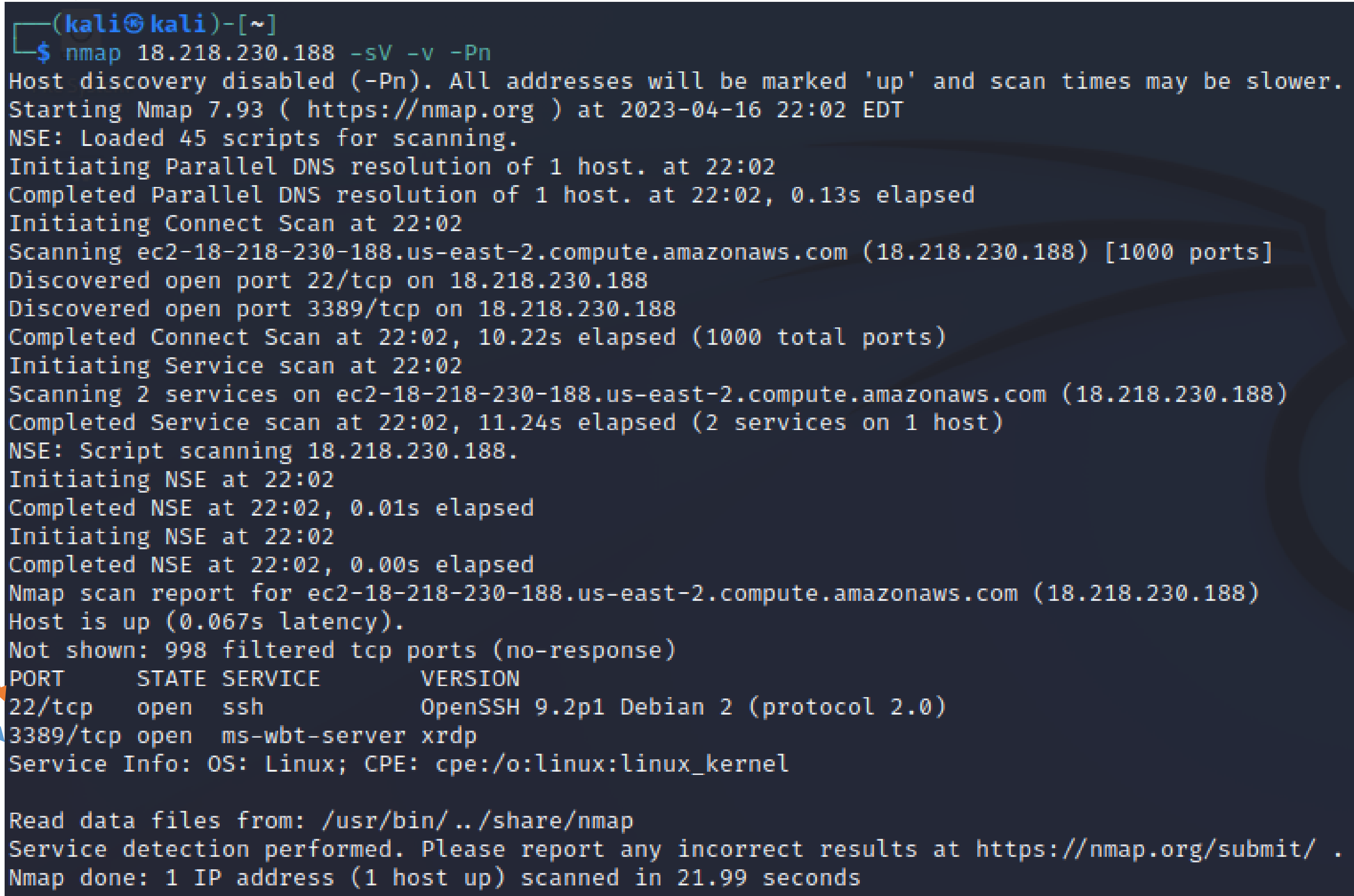
Public IPv4 address

18.218.230.188 | open address

- Let’s do some nmap scans (check the next page)

Amazon EC2 instances with Security Groups and Session Manager

- I only have port 22 for SSH is open, and
- Port 3389 for RDP is open
- This is the same as our expectations. Remember the inbound traffic?

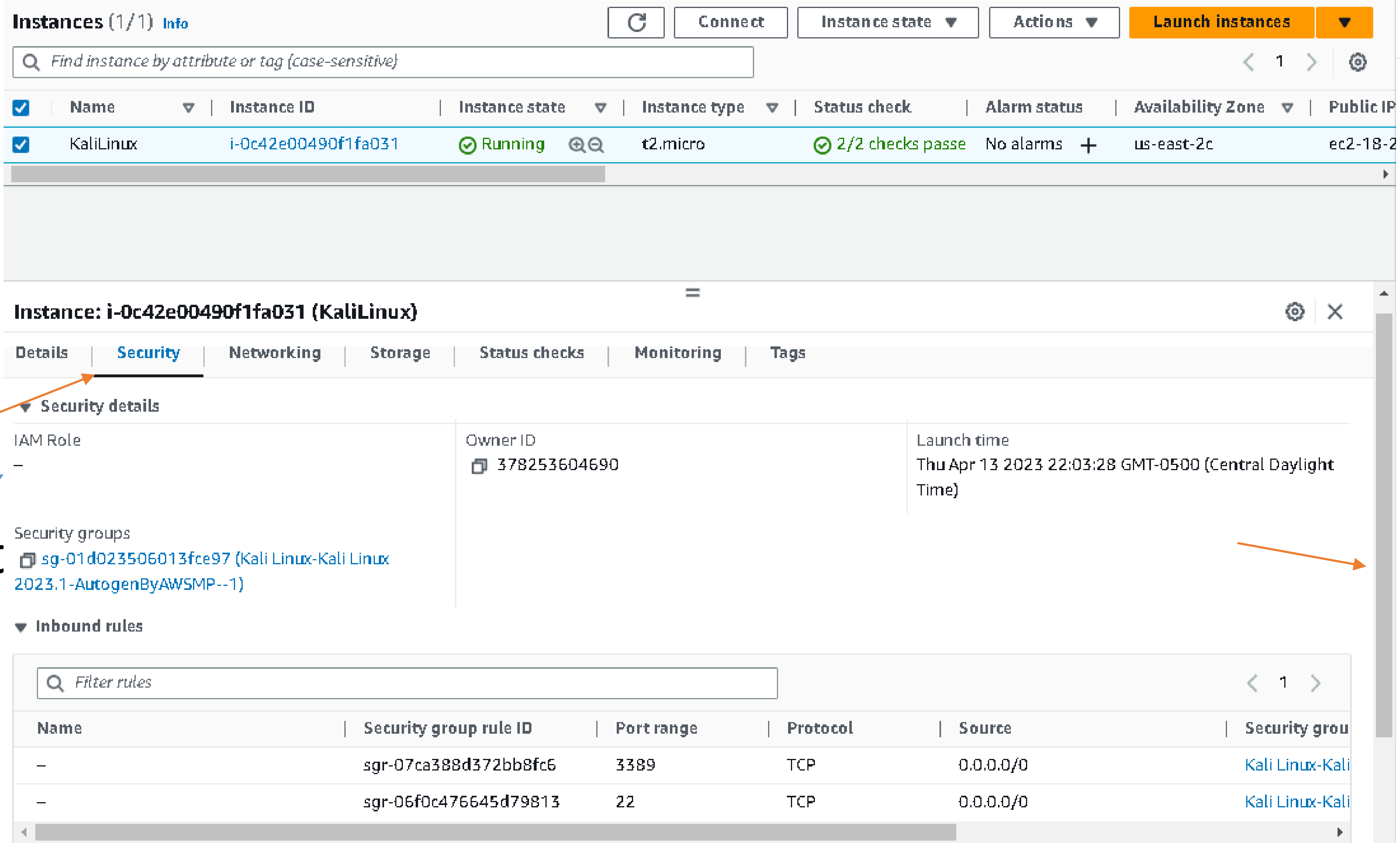


```
┌──(kali㉿kali)-[~]
└─$ nmap 18.218.230.188 -sV -v -Pn
Host discovery disabled (-Pn). All addresses will be marked 'up' and scan times may be slower.
Starting Nmap 7.93 ( https://nmap.org ) at 2023-04-16 22:02 EDT
NSE: Loaded 45 scripts for scanning.
Initiating Parallel DNS resolution of 1 host. at 22:02
Completed Parallel DNS resolution of 1 host. at 22:02, 0.13s elapsed
Initiating Connect Scan at 22:02
Scanning ec2-18-218-230-188.us-east-2.compute.amazonaws.com (18.218.230.188) [1000 ports]
Discovered open port 22/tcp on 18.218.230.188
Discovered open port 3389/tcp on 18.218.230.188
Completed Connect Scan at 22:02, 10.22s elapsed (1000 total ports)
Initiating Service scan at 22:02
Scanning 2 services on ec2-18-218-230-188.us-east-2.compute.amazonaws.com (18.218.230.188)
Completed Service scan at 22:02, 11.24s elapsed (2 services on 1 host)
NSE: Script scanning 18.218.230.188.
Initiating NSE at 22:02
Completed NSE at 22:02, 0.01s elapsed
Initiating NSE at 22:02
Completed NSE at 22:02, 0.00s elapsed
Nmap scan report for ec2-18-218-230-188.us-east-2.compute.amazonaws.com (18.218.230.188)
Host is up (0.067s latency).
Not shown: 998 filtered tcp ports (no-response)
PORT     STATE SERVICE       VERSION
22/tcp   open  ssh           OpenSSH 9.2p1 Debian 2 (protocol 2.0)
3389/tcp open  ms-wbt-server xrdp
Service Info: OS: Linux; CPE: cpe:/o:linux:linux_kernel

Read data files from: /usr/bin/../share/nmap
Service detection performed. Please report any incorrect results at https://nmap.org/submit/ .
Nmap done: 1 IP address (1 host up) scanned in 21.99 seconds
```

Amazon EC2 instances with Security Groups and Session Manager

- Let’s go back to our EC2 instance.
- Go ahead check the instance, and click the [Security] tab
- It seems we do not have IAM setup yet



☑	Name	Instance ID	Instance state	Instance type	Status check	Alarm status	Availability Zone	Public IP
☑	KaliLinux	i-0c42e00490f1fa031	Running	t2.micro	2/2 checks passe	No alarms +	us-east-2c	ec2-18-2

Instance: i-0c42e00490f1fa031 (KaliLinux)

▼ Security details

IAM Role
–

Owner ID
378253604690

Launch time
Thu Apr 13 2023 22:03:28 GMT-0500 (Central Daylight Time)

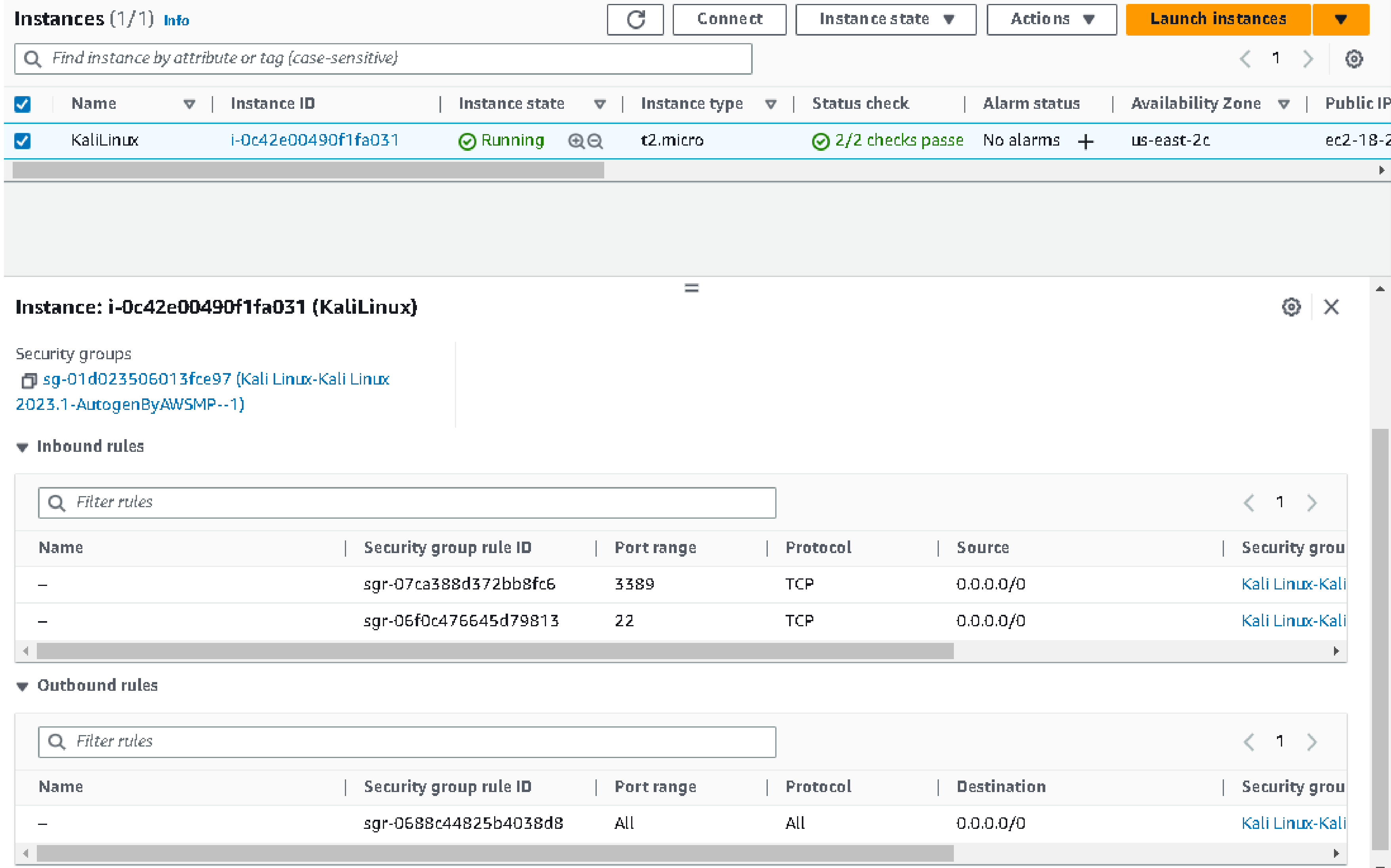
Security groups
sg-01d023506013fce97 (Kali Linux-Kali Linux 2023.1-AutogenByAWSMP--1)

▼ Inbound rules

Name	Security group rule ID	Port range	Protocol	Source	Security grou
–	sgr-07ca388d372bb8fc6	3389	TCP	0.0.0.0/0	Kali Linux-Kali
–	sgr-06f0c476645d79813	22	TCP	0.0.0.0/0	Kali Linux-Kali

Amazon EC2 instances with Security Groups and Session Manager

- Scroll down little bit more, you can see the details for "Security Group"
- Inbound and Outbound rules



Instances (1/1) Info

☑	Name	Instance ID	Instance state	Instance type	Status check	Alarm status	Availability Zone	Public IP
☑	KaliLinux	i-0c42e00490f1fa031	Running	t2.micro	2/2 checks passe	No alarms +	us-east-2c	ec2-18-2

Instance: i-0c42e00490f1fa031 (KaliLinux)

Security groups
sg-01d023506013fce97 (Kali Linux-Kali Linux 2023.1-AutogenByAWSMP--1)

▼ Inbound rules

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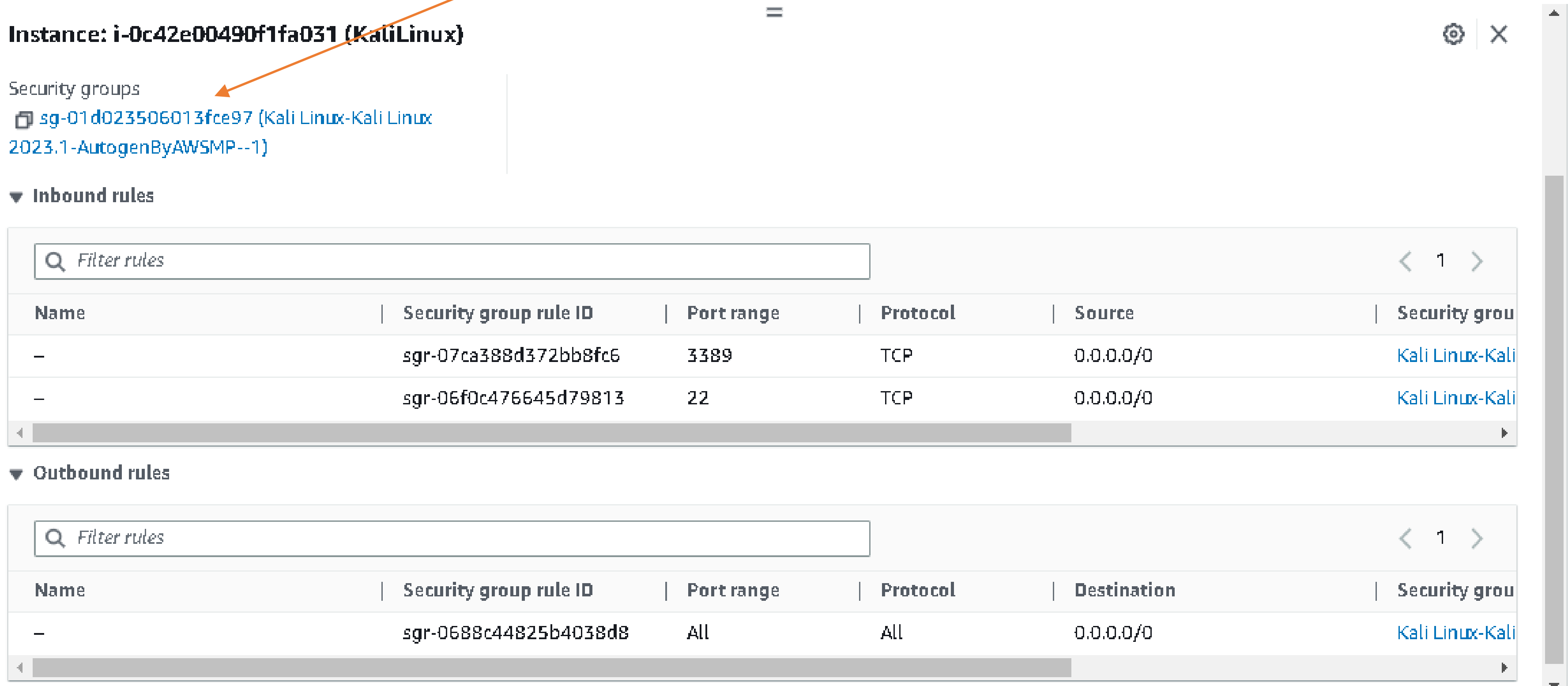
–	sgr-07ca388d372bb8fc6	3389	TCP	0.0.0.0/0	Kali Linux-Kali
–	sgr-06f0c476645d79813	22	TCP	0.0.0.0/0	Kali Linux-Kali

▼ Outbound rules

Name	Security group rule ID	Port range	Protocol	Destination	Security grou
–	sgr-0688c44825b4038d8	All	All	0.0.0.0/0	Kali Linux-Kali

Amazon EC2 instances with Security Groups and Session Manager

- Going to the [Security Groups] is easy.
- We can directly go to the security group by using the shortcut, which means the one you are using. Or, go to the link on your LHS



Instance: i-0c42e00490f1fa031 (KaliLinux)

Security groups

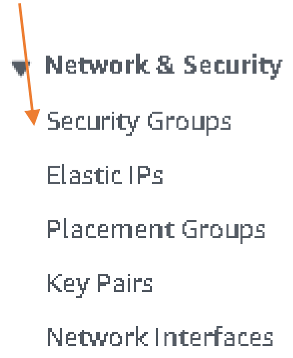
sg-01d023506013fce97 (Kali Linux-Kali Linux 2023.1-AutogenByAWSMP--1)

Inbound rules

Name	Security group rule ID	Port range	Protocol	Source	Security grou
–	sgr-07ca388d372bb8fc6	3389	TCP	0.0.0.0/0	Kali Linux-Kali
–	sgr-06f0c476645d79813	22	TCP	0.0.0.0/0	Kali Linux-Kali

Outbound rules

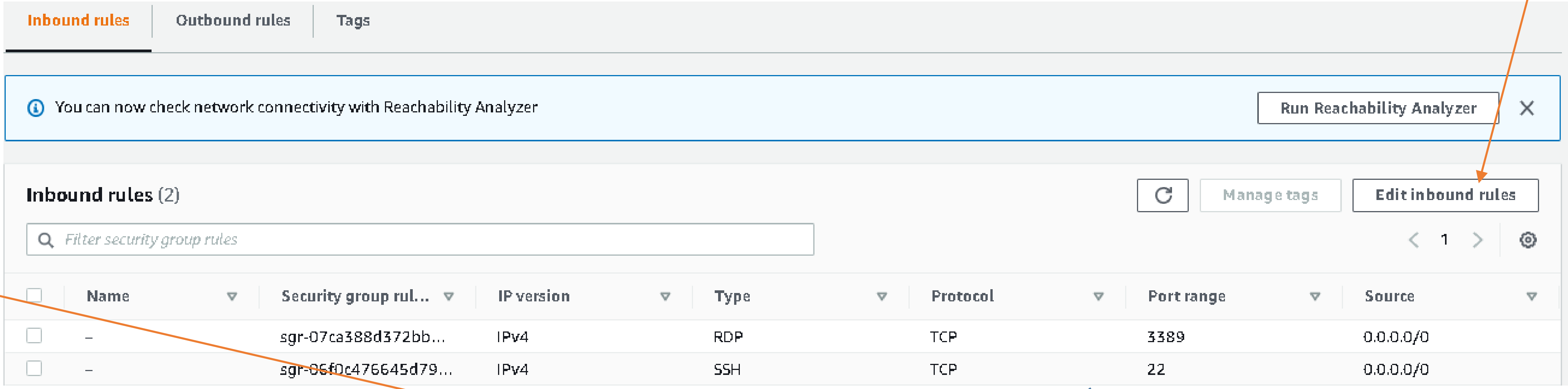
Name	Security group rule ID	Port range	Protocol	Destination	Security grou
–	sgr-0688c44825b4038d8	All	All	0.0.0.0/0	Kali Linux-Kali



Amazon EC2 instances with Security Groups and Session Manager

After a click on the [Security Groups], we can “tighten” the access rights

In this case, you can delete the whole SSH. That means, no more connection is allowed from SSH. Or change the current setting

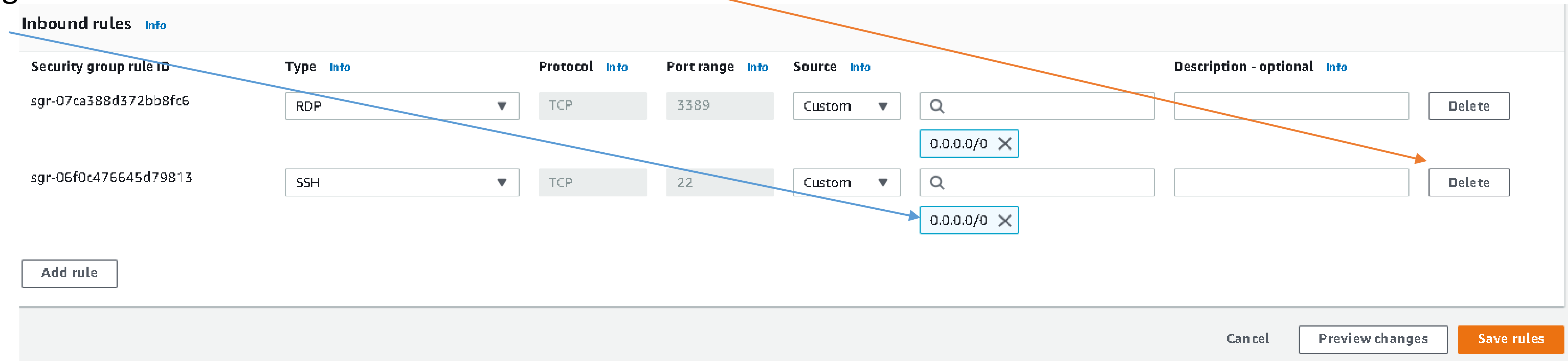


Inbound rules | Outbound rules | Tags

You can now check network connectivity with Reachability Analyzer

Inbound rules (2)

Name	Security group rul...	IP version	Type	Protocol	Port range	Source
–	sgr-07ca388d372bb...	IPv4	RDP	TCP	3389	0.0.0.0/0
–	sgr-06f0c476645d79...	IPv4	SSH	TCP	22	0.0.0.0/0

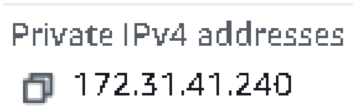


Inbound rules Info

Security group rule ID	Type Info	Protocol Info	Port range Info	Source Info		Description - optional Info	
sgr-07ca388d372bb8fc6	RDP	TCP	3389	Custom	0.0.0.0/0		Delete
sgr-06f0c476645d79813	SSH	TCP	22	Custom	0.0.0.0/0		Delete

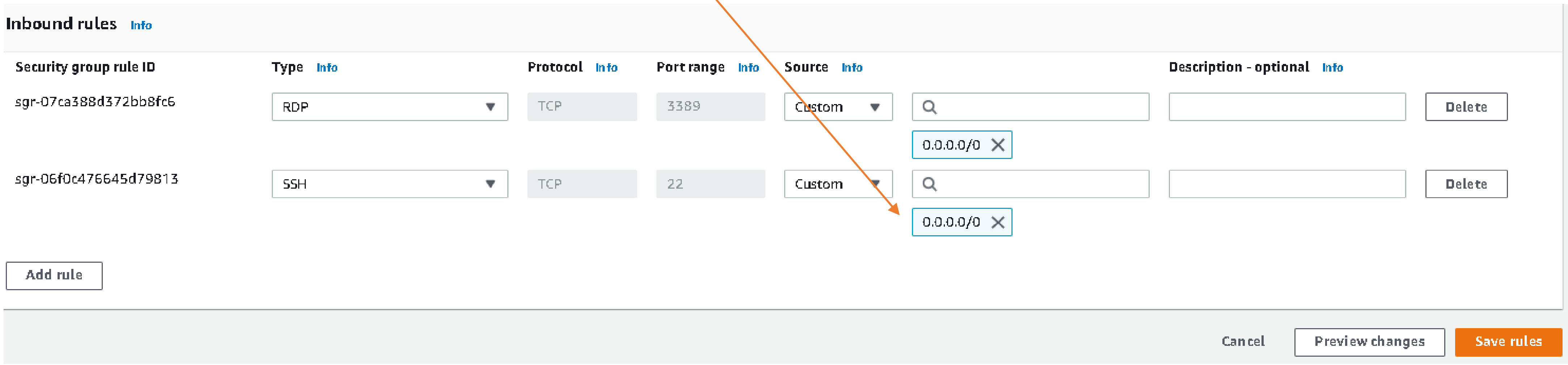
Amazon EC2 instances with Security Groups and Session Manager

- What if we only allow local (private) IP addresses to be able to access this EC2 instance? (Allowing connections within AWS!)
  - Step1. Delete the current “setting” for SSH (0.0.0.0/0) We took SSH for example
  - Step2. Go back to the EC2 instance and check its Private IPv4 addresses in the [Networking] tab. Then, we get the following: 172.31.41.240



Private IPv4 addresses

172.31.41.240

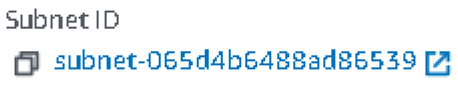


Inbound rules Info

Security group rule ID	Type Info	Protocol Info	Port range Info	Source Info		Description - optional Info	
sgr-07ca388d372bb8fc6	RDP	TCP	3389	Custom	0.0.0.0/0		Delete
sgr-06f0c476645d79813	SSH	TCP	22	Custom	0.0.0.0/0		Delete

Amazon EC2 instances with Security Groups and Session Manager

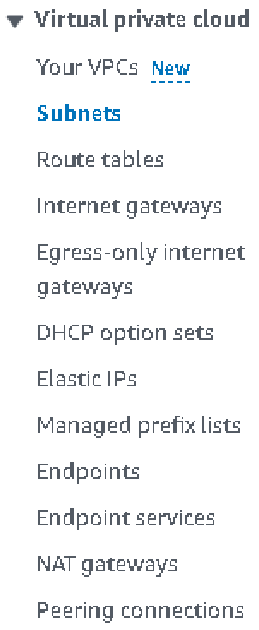
- Step3. Click the Subnet ID



Subnet ID

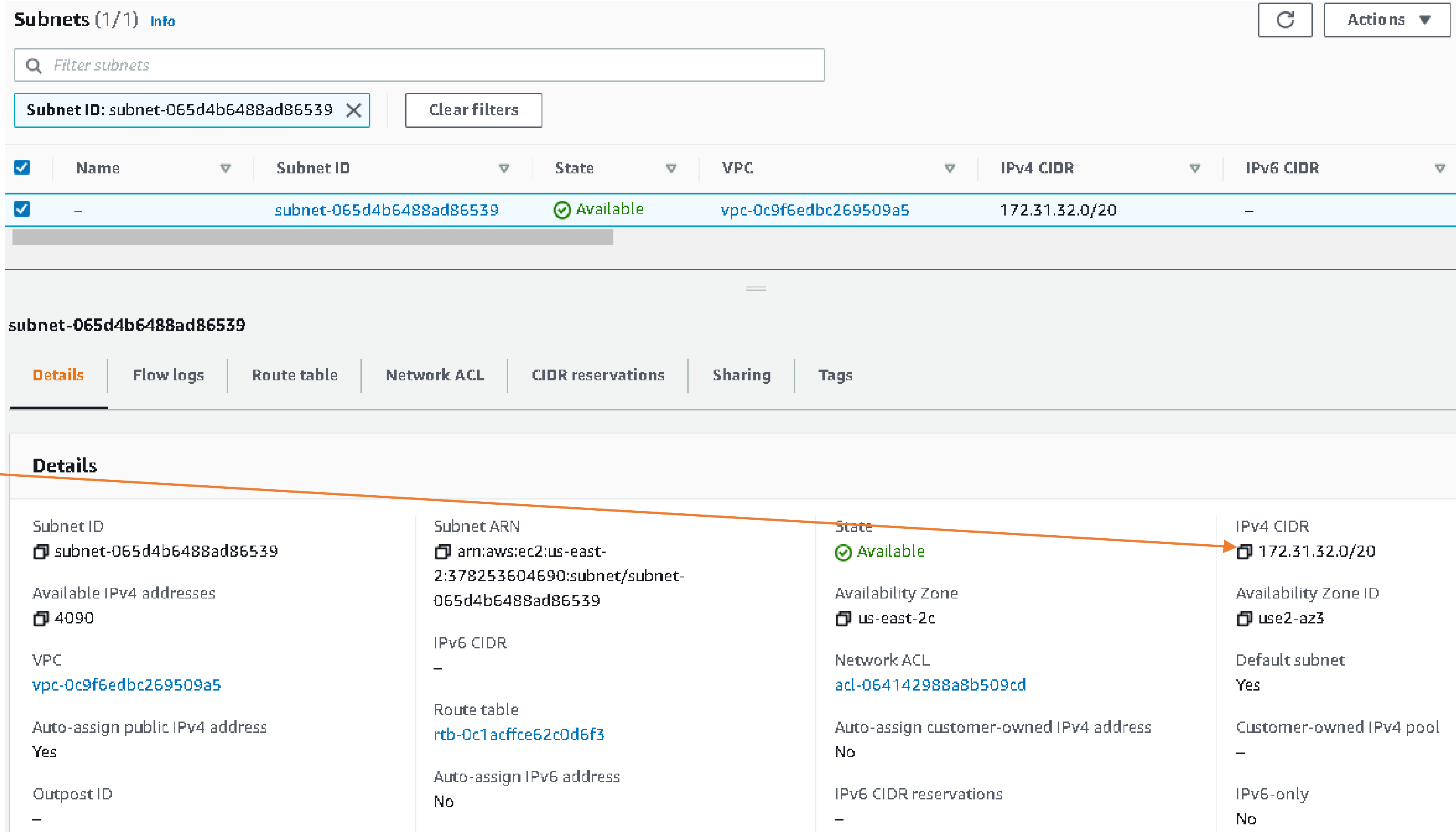
subnet-065d4b6488ad86539

- It will guide you to this setting, the [Subnets]
- Here we go! This is what I want!
- Copy this!



Virtual private cloud

- Your VPCs New
- Subnets
- Route tables
- Internet gateways
- Egress-only internet gateways
- DHCP option sets
- Elastic IPs
- Managed prefix lists
- Endpoints
- Endpoint services
- NAT gateways
- Peering connections



Subnets (1/1) Info

☑	Name	Subnet ID	State	VPC	IPv4 CIDR	IPv6 CIDR
☑	–	subnet-065d4b6488ad86539	✓ Available	vpc-0c9f6edbc269509a5	172.31.32.0/20	–

subnet-065d4b6488ad86539

Details

Subnet ID
subnet-065d4b6488ad86539

Available IPv4 addresses
4090

VPC
vpc-0c9f6edbc269509a5

Auto-assign public IPv4 address
Yes

Outpost ID
–

Subnet ARN
arn:aws:ec2:us-east-2:378253604690:subnet/subnet-065d4b6488ad86539

IPv6 CIDR
–

Route table
rtb-0c1acffce62c0d6f3

Auto-assign IPv6 address
No

State
✓ Available

Availability Zone
us-east-2c

Network ACL
acl-064142988a8b509cd

Auto-assign customer-owned IPv4 address
No

IPv6 CIDR reservations
–

IPv4 CIDR
172.31.32.0/20

Availability Zone ID
use2-az3

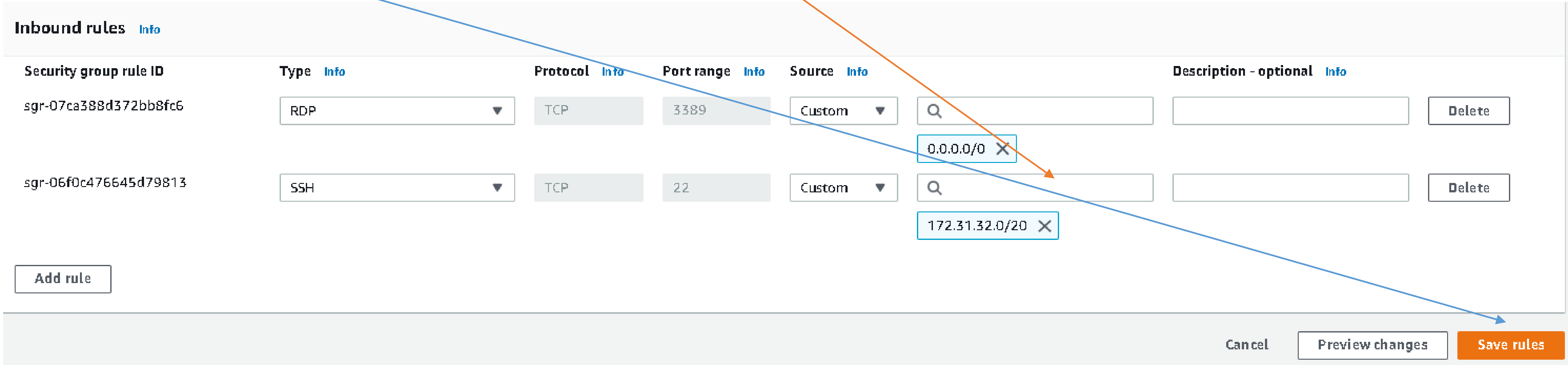
Default subnet
Yes

Customer-owned IPv4 pool
–

IPv6-only
No

Amazon EC2 instances with Security Groups and Session Manager

- Step4. We can head back to the EC2, inbound rules.
- Paste it to this field
- So, in this way, the IP addresses coming in from this subnet (in the private / local area network) are allowed to use SSH into this EC2 instance. In other words, the IP addresses must be in the AWS as well.
- Step5. Save rules. Then, enjoy your “basic” and “fundamental” protections!

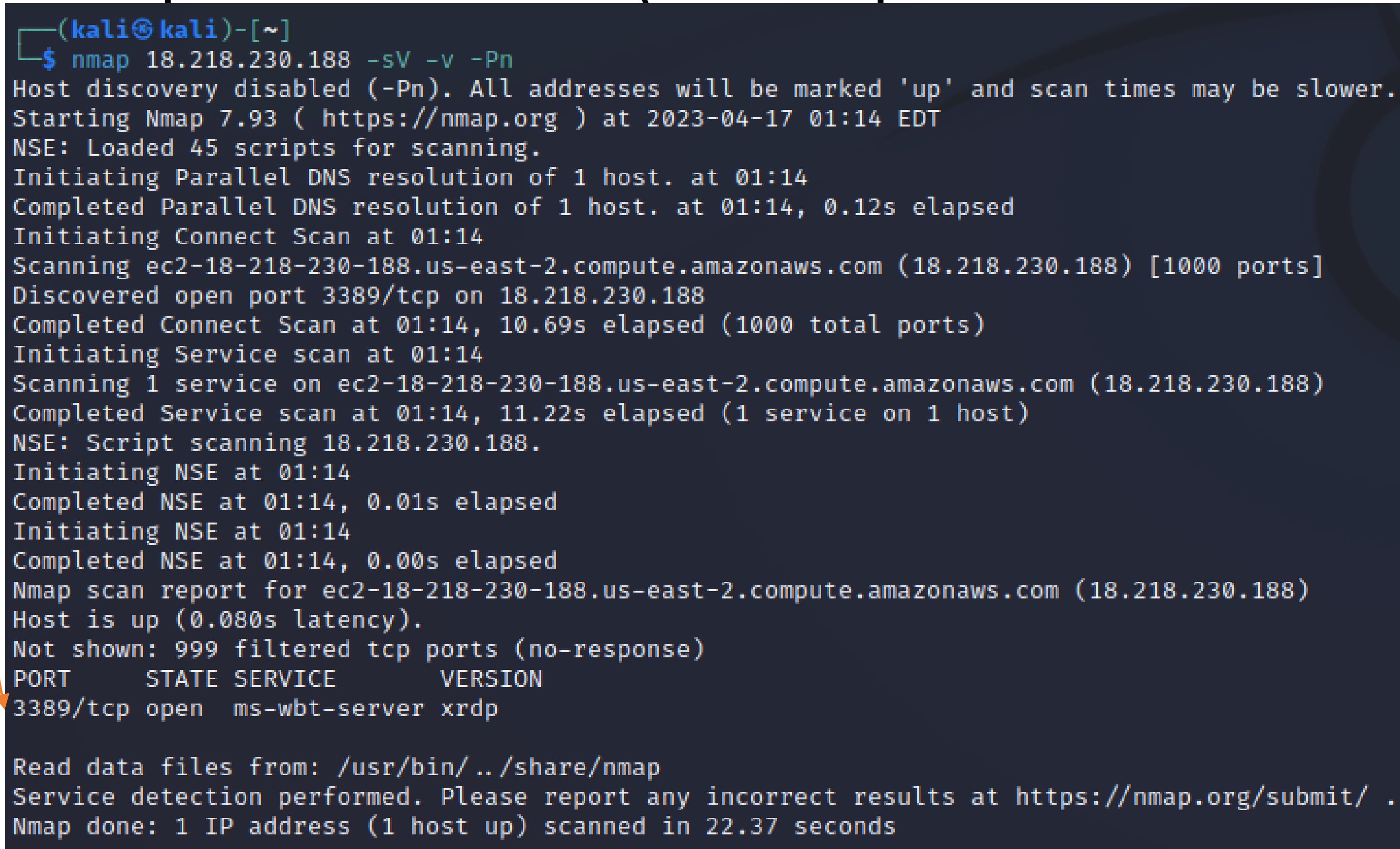


Inbound rules Info

Security group rule ID	Type Info	Protocol Info	Port range Info	Source Info		Description - optional Info	
sgr-07ca388d372bb8fc6	RDP	TCP	3389	Custom	0.0.0.0/0		Delete
sgr-06f0c476645d79813	SSH	TCP	22	Custom	172.31.32.0/20		Delete

Amazon EC2 instances with Security Groups and Session Manager

- If I go back to the Kali Linux (VirtualBox) and run the exact same scan?
- See? The SSH port is closed to the public internet! (But is open to AWS internal devices!)

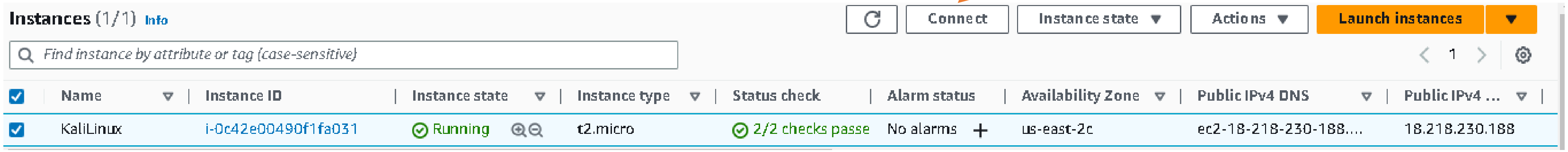


```
┌──(kali㉿kali)-[~]
└─$ nmap 18.218.230.188 -sV -v -Pn
Host discovery disabled (-Pn). All addresses will be marked 'up' and scan times may be slower.
Starting Nmap 7.93 ( https://nmap.org ) at 2023-04-17 01:14 EDT
NSE: Loaded 45 scripts for scanning.
Initiating Parallel DNS resolution of 1 host. at 01:14
Completed Parallel DNS resolution of 1 host. at 01:14, 0.12s elapsed
Initiating Connect Scan at 01:14
Scanning ec2-18-218-230-188.us-east-2.compute.amazonaws.com (18.218.230.188) [1000 ports]
Discovered open port 3389/tcp on 18.218.230.188
Completed Connect Scan at 01:14, 10.69s elapsed (1000 total ports)
Initiating Service scan at 01:14
Scanning 1 service on ec2-18-218-230-188.us-east-2.compute.amazonaws.com (18.218.230.188)
Completed Service scan at 01:14, 11.22s elapsed (1 service on 1 host)
NSE: Script scanning 18.218.230.188.
Initiating NSE at 01:14
Completed NSE at 01:14, 0.01s elapsed
Initiating NSE at 01:14
Completed NSE at 01:14, 0.00s elapsed
Nmap scan report for ec2-18-218-230-188.us-east-2.compute.amazonaws.com (18.218.230.188)
Host is up (0.080s latency).
Not shown: 999 filtered tcp ports (no-response)
PORT      STATE SERVICE       VERSION
3389/tcp open  ms-wbt-server xrdp

Read data files from: /usr/bin/../share/nmap
Service detection performed. Please report any incorrect results at https://nmap.org/submit/ .
Nmap done: 1 IP address (1 host up) scanned in 22.37 seconds
```

Amazon EC2 instances with Security Groups and Session Manager

- In the beginning, go to the EC2 instance. Check the instance → Connect.
- You may find the “session manager” is not working

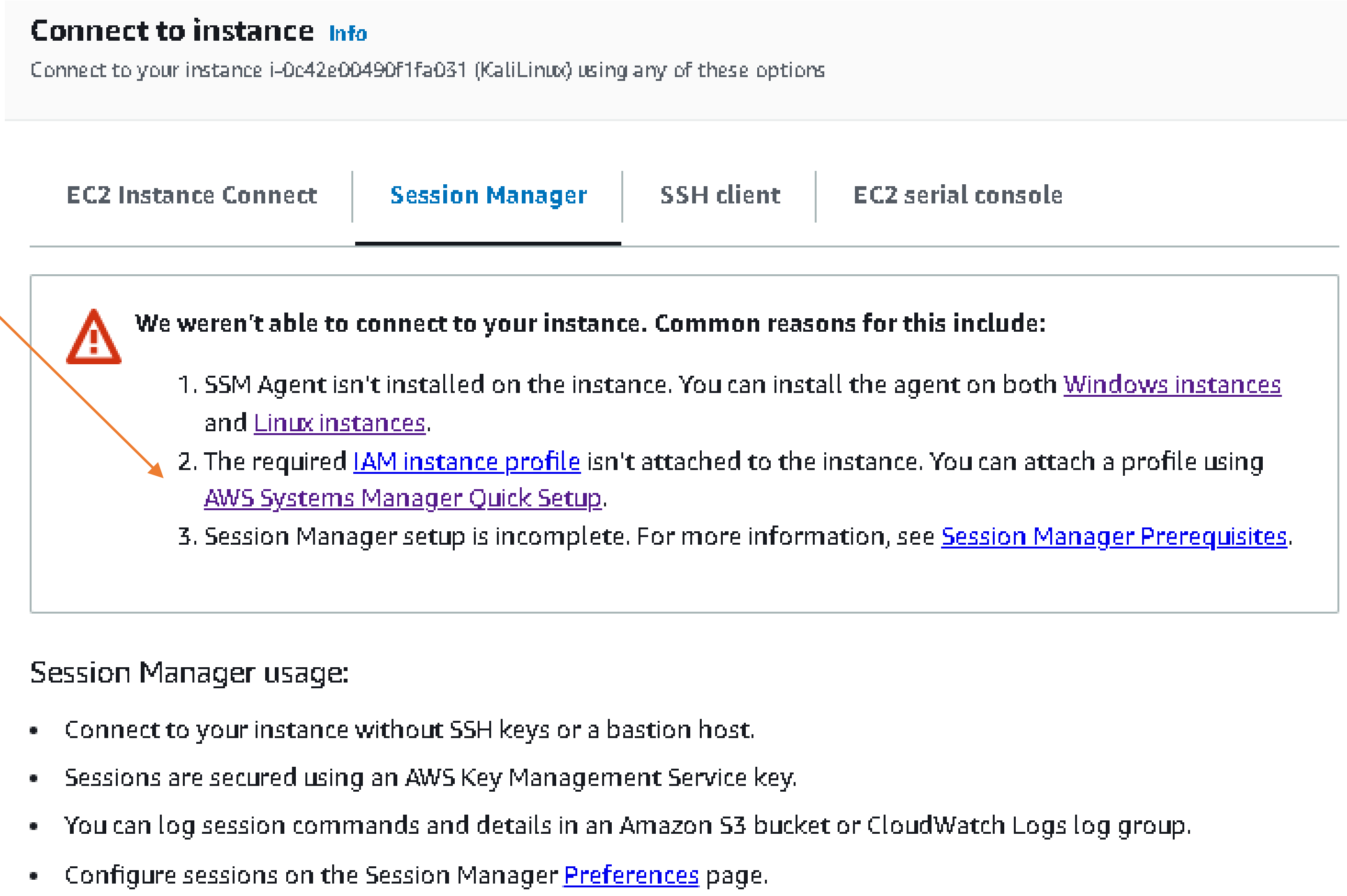


☑	Name	Instance ID	Instance state	Instance type	Status check	Alarm status	Availability Zone	Public IPv4 DNS	Public IPv4 ...
☑	KaliLinux	i-0c42e00490f1fa031	✓ Running	t2.micro	✓ 2/2 checks passe	No alarms	us-east-2c	ec2-18-218-230-188....	18.218.230.188

- Check the next page

Amazon EC2 instances with Security Groups and Session Manager

- It is not working!
- It seems like we haven’t finish the IAM setup (check slide #5)
- Step1: Click the “AWS Systems Manager Quick Setup”



Connect to instance Info

Connect to your instance i-0c42e00490f1fa031 (KaliLinux) using any of these options

We weren't able to connect to your instance. Common reasons for this include:

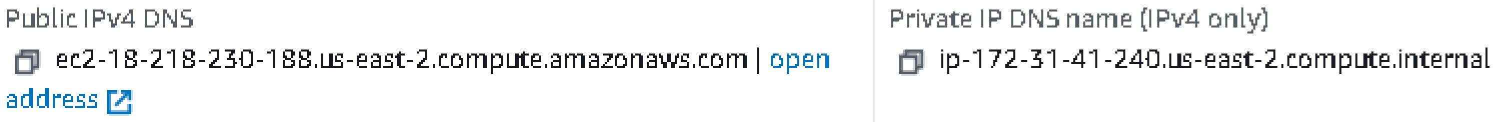
1. SSM Agent isn't installed on the instance. You can install the agent on both Windows instances and Linux instances.
2. The required IAM instance profile isn't attached to the instance. You can attach a profile using AWS Systems Manager Quick Setup.
3. Session Manager setup is incomplete. For more information, see Session Manager Prerequisites.

Session Manager usage:

- Connect to your instance without SSH keys or a bastion host.
- Sessions are secured using an AWS Key Management Service key.
- You can log session commands and details in an Amazon S3 bucket or CloudWatch Logs log group.
- Configure sessions on the Session Manager Preferences page.

Amazon EC2 instances with Security Groups and Session Manager

- Check your instance info. I know my instance is in us-east-2 as region



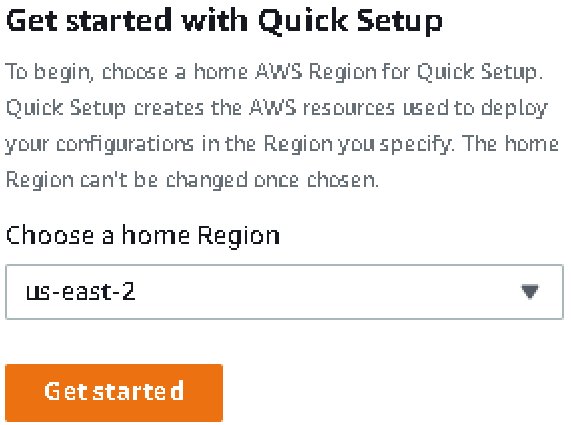
Public IPv4 DNS

ec2-18-218-230-188.us-east-2.compute.amazonaws.com | open address

Private IP DNS name (IPv4 only)

ip-172-31-41-240.us-east-2.compute.internal

- Finish the following setups, click the [Create].
- Bring you to the next screen

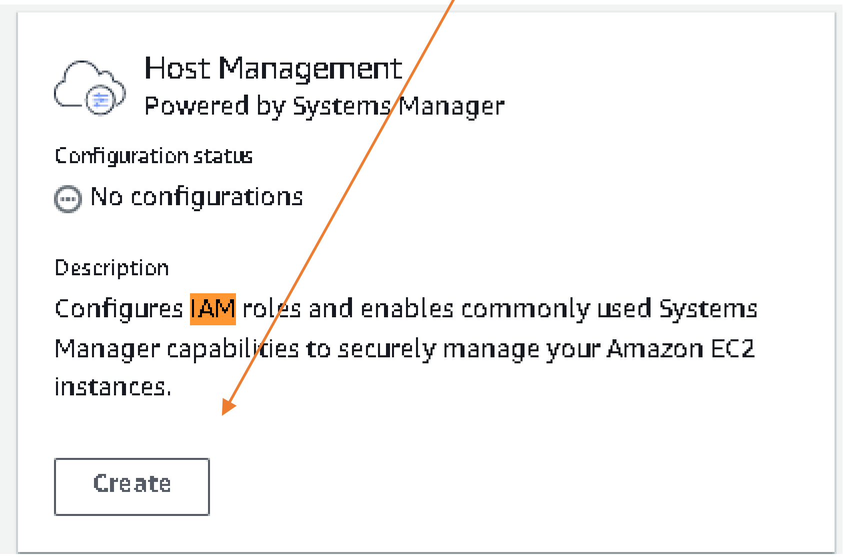


Get started with Quick Setup

To begin, choose a home AWS Region for Quick Setup. Quick Setup creates the AWS resources used to deploy your configurations in the Region you specify. The home Region can't be changed once chosen.

Choose a home Region

us-east-2



Host Management

Powered by Systems Manager

Configuration status

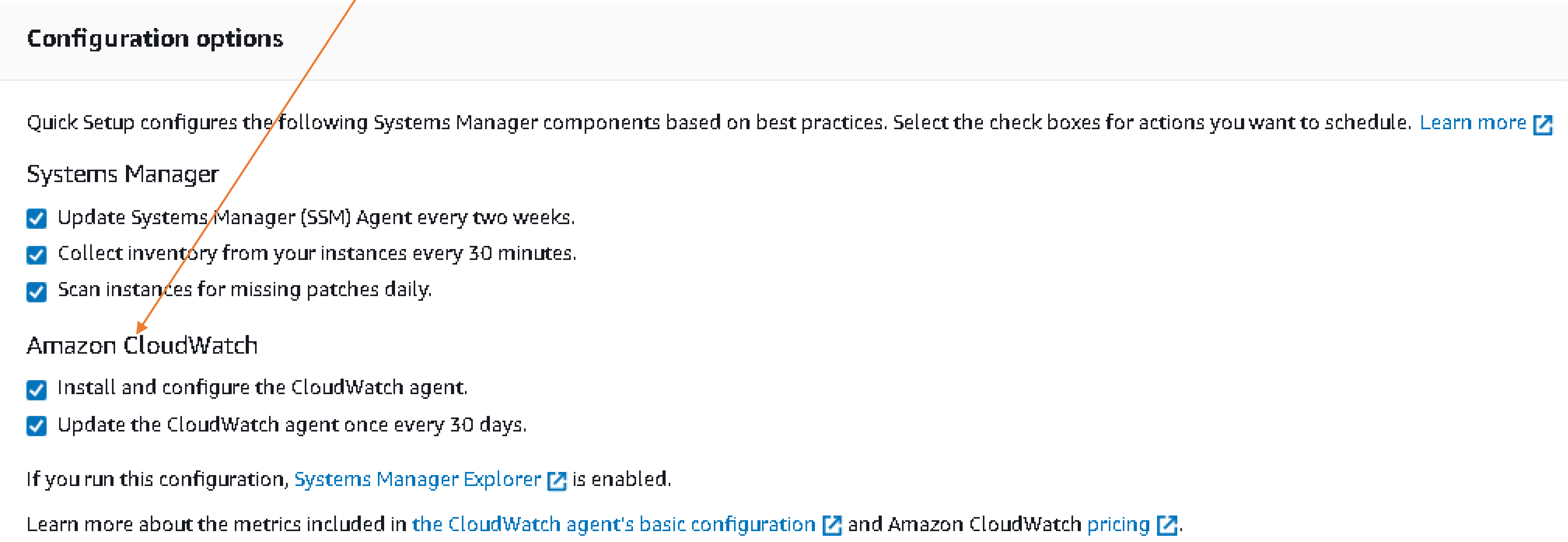
No configurations

Description

Configures IAM roles and enables commonly used Systems Manager capabilities to securely manage your Amazon EC2 instances.

Amazon EC2 instances with Security Groups and Session Manager

- Check the 2 options in Amazon Cloudwatch



Configuration options

Quick Setup configures the following Systems Manager components based on best practices. Select the check boxes for actions you want to schedule. Learn more

Systems Manager

☑ Update Systems Manager (SSM) Agent every two weeks.

☑ Collect inventory from your instances every 30 minutes.

☑ Scan instances for missing patches daily.

Amazon CloudWatch

☑ Install and configure the CloudWatch agent.

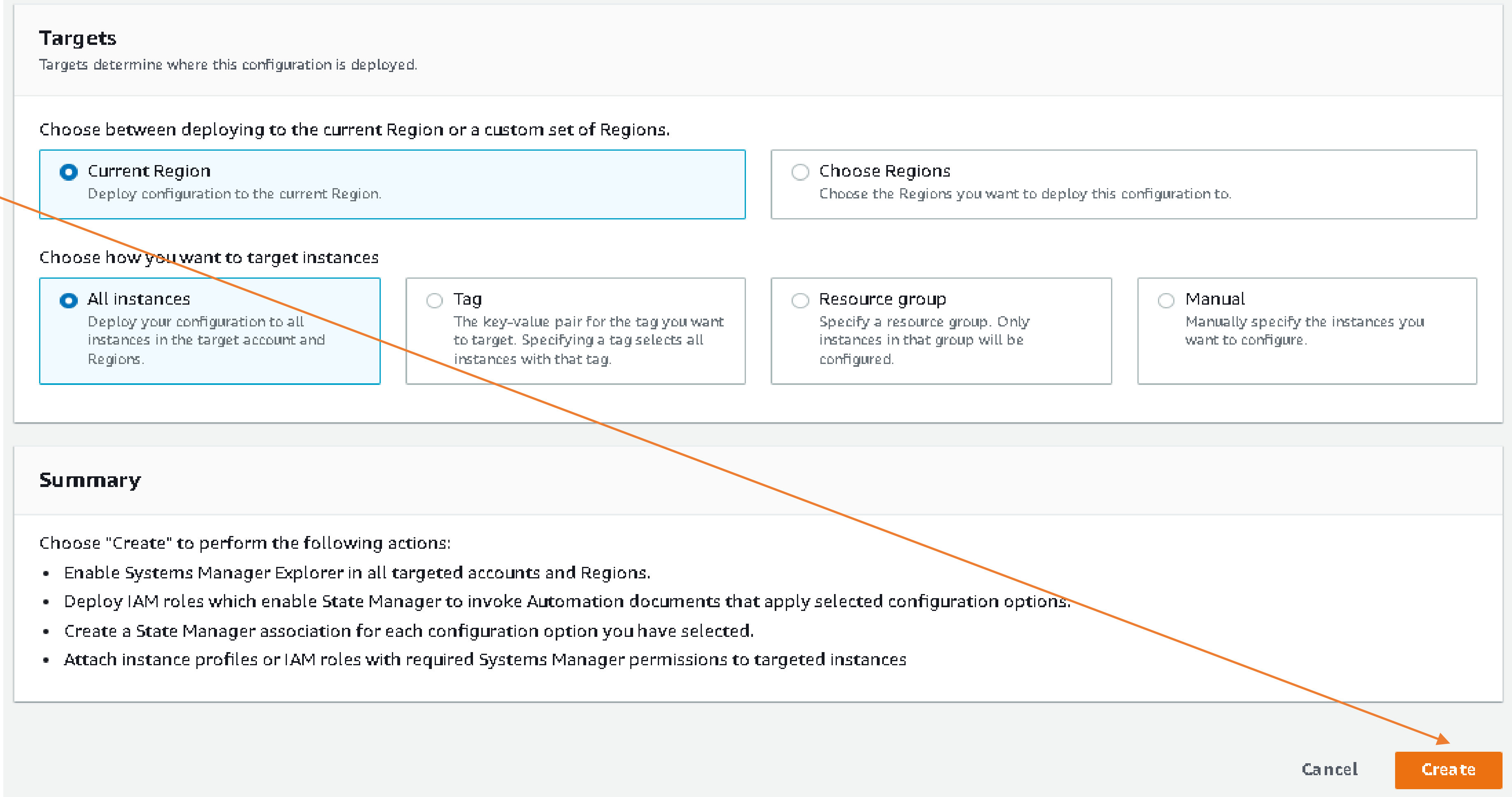
☑ Update the CloudWatch agent once every 30 days.

If you run this configuration, Systems Manager Explorer is enabled.

Learn more about the metrics included in the CloudWatch agent's basic configuration and Amazon CloudWatch pricing.

Amazon EC2 instances with Security Groups and Session Manager

- Scroll down on the same page and keep everything in the "Targets" to default settings
- Create!



Targets

Targets determine where this configuration is deployed.

Choose between deploying to the current Region or a custom set of Regions.

● Current Region
Deploy configuration to the current Region.

○ Choose Regions
Choose the Regions you want to deploy this configuration to.

Choose how you want to target instances

● All instances
Deploy your configuration to all instances in the target account and Regions.

○ Tag
The key-value pair for the tag you want to target. Specifying a tag selects all instances with that tag.

○ Resource group
Specify a resource group. Only instances in that group will be configured.

○ Manual
Manually specify the instances you want to configure.

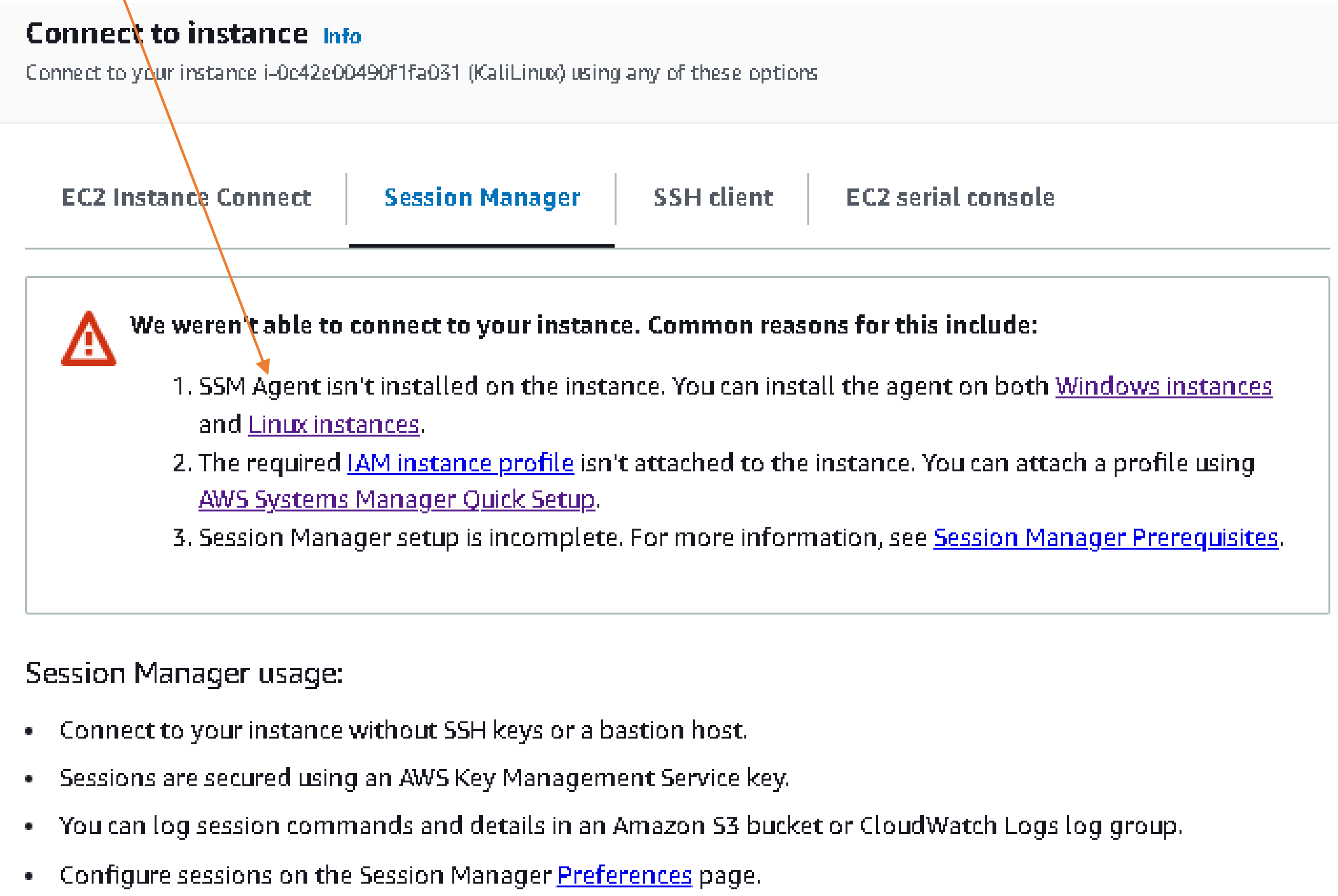
Summary

Choose "Create" to perform the following actions:

- Enable Systems Manager Explorer in all targeted accounts and Regions.
- Deploy IAM roles which enable State Manager to invoke Automation documents that apply selected configuration options.
- Create a State Manager association for each configuration option you have selected.
- Attach instance profiles or IAM roles with required Systems Manager permissions to targeted instances

Amazon EC2 instances with Security Groups and Session Manager

- Step2: Install the AWS SSM Agent



Connect to instance Info

Connect to your instance i-0c42e00490f1fa031 (KaliLinux) using any of these options

We weren't able to connect to your instance. Common reasons for this include:

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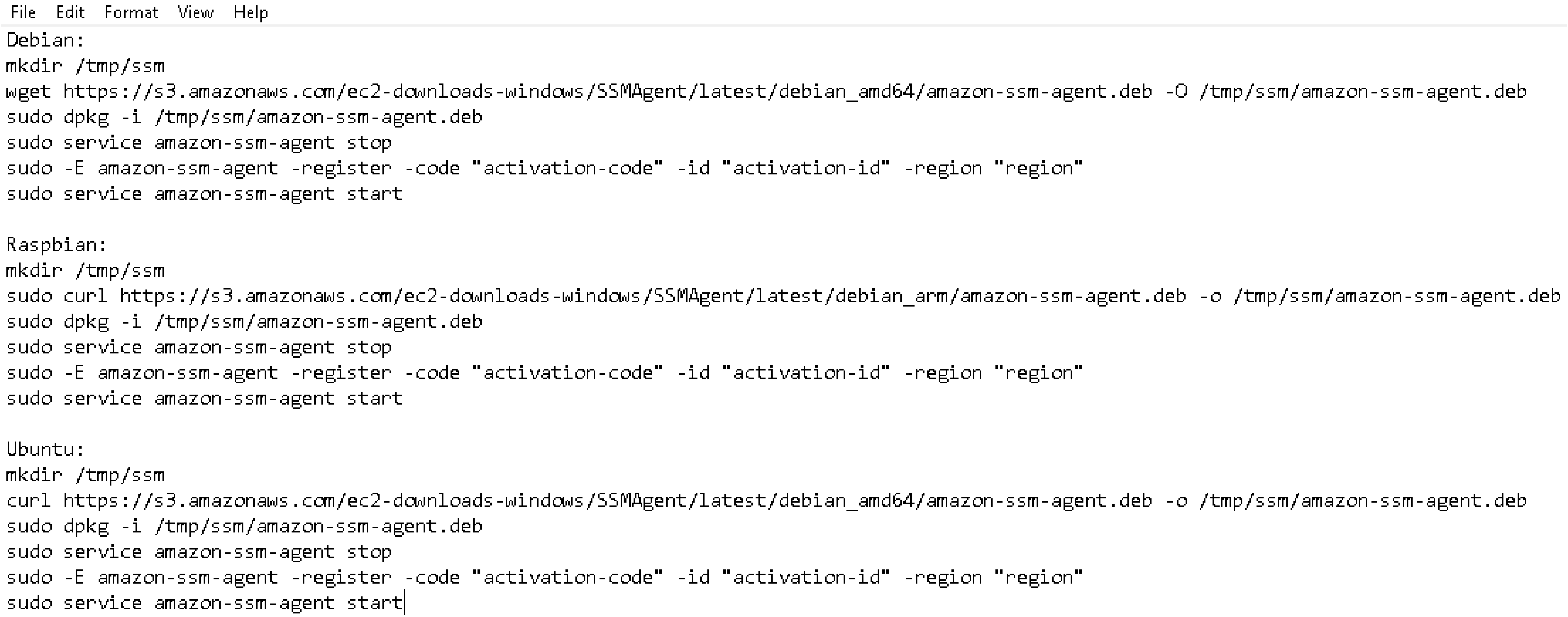
- You can log session commands and details in an Amazon S3 bucket or CloudWatch Logs log group.
- Configure sessions on the Session Manager Preferences page.

Amazon EC2 instances with Security Groups and Session Manager

- By following some tutorial in the internet, make sure the “amazon-ssm-agent” service starts (This is for Debian family)



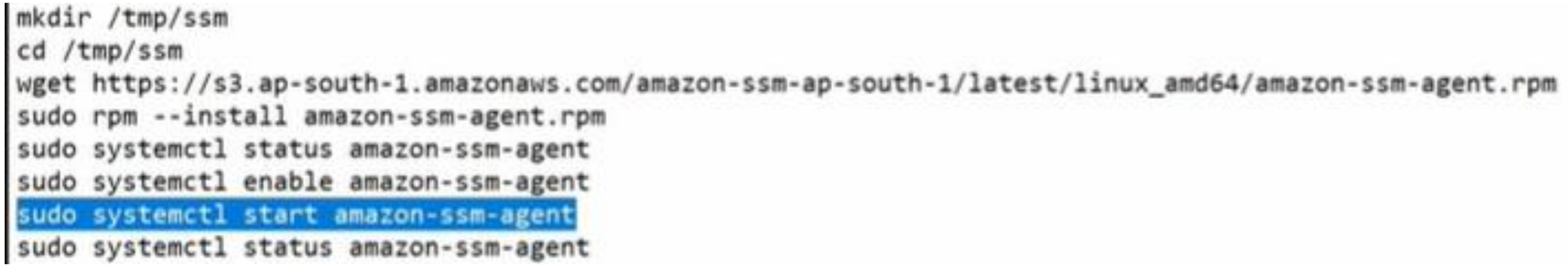
```
Debian:
mkdir /tmp/ssm
wget https://s3.amazonaws.com/ec2-downloads-windows/SSMAgent/latest/debian_amd64/amazon-ssm-agent.deb -O /tmp/ssm/amazon-ssm-agent.deb
sudo dpkg -i /tmp/ssm/amazon-ssm-agent.deb
sudo service amazon-ssm-agent stop
sudo -E amazon-ssm-agent -register -code "activation-code" -id "activation-id" -region "region"
sudo service amazon-ssm-agent start

Raspbian:
mkdir /tmp/ssm
sudo curl https://s3.amazonaws.com/ec2-downloads-windows/SSMAgent/latest/debian_arm/amazon-ssm-agent.deb -o /tmp/ssm/amazon-ssm-agent.deb
sudo dpkg -i /tmp/ssm/amazon-ssm-agent.deb
sudo service amazon-ssm-agent stop
sudo -E amazon-ssm-agent -register -code "activation-code" -id "activation-id" -region "region"
sudo service amazon-ssm-agent start

Ubuntu:
mkdir /tmp/ssm
curl https://s3.amazonaws.com/ec2-downloads-windows/SSMAgent/latest/debian_amd64/amazon-ssm-agent.deb -o /tmp/ssm/amazon-ssm-agent.deb
sudo dpkg -i /tmp/ssm/amazon-ssm-agent.deb
sudo service amazon-ssm-agent stop
sudo -E amazon-ssm-agent -register -code "activation-code" -id "activation-id" -region "region"
sudo service amazon-ssm-agent start
```

Amazon EC2 instances with Security Groups and Session Manager

- This is for CentOS (RedHat) family

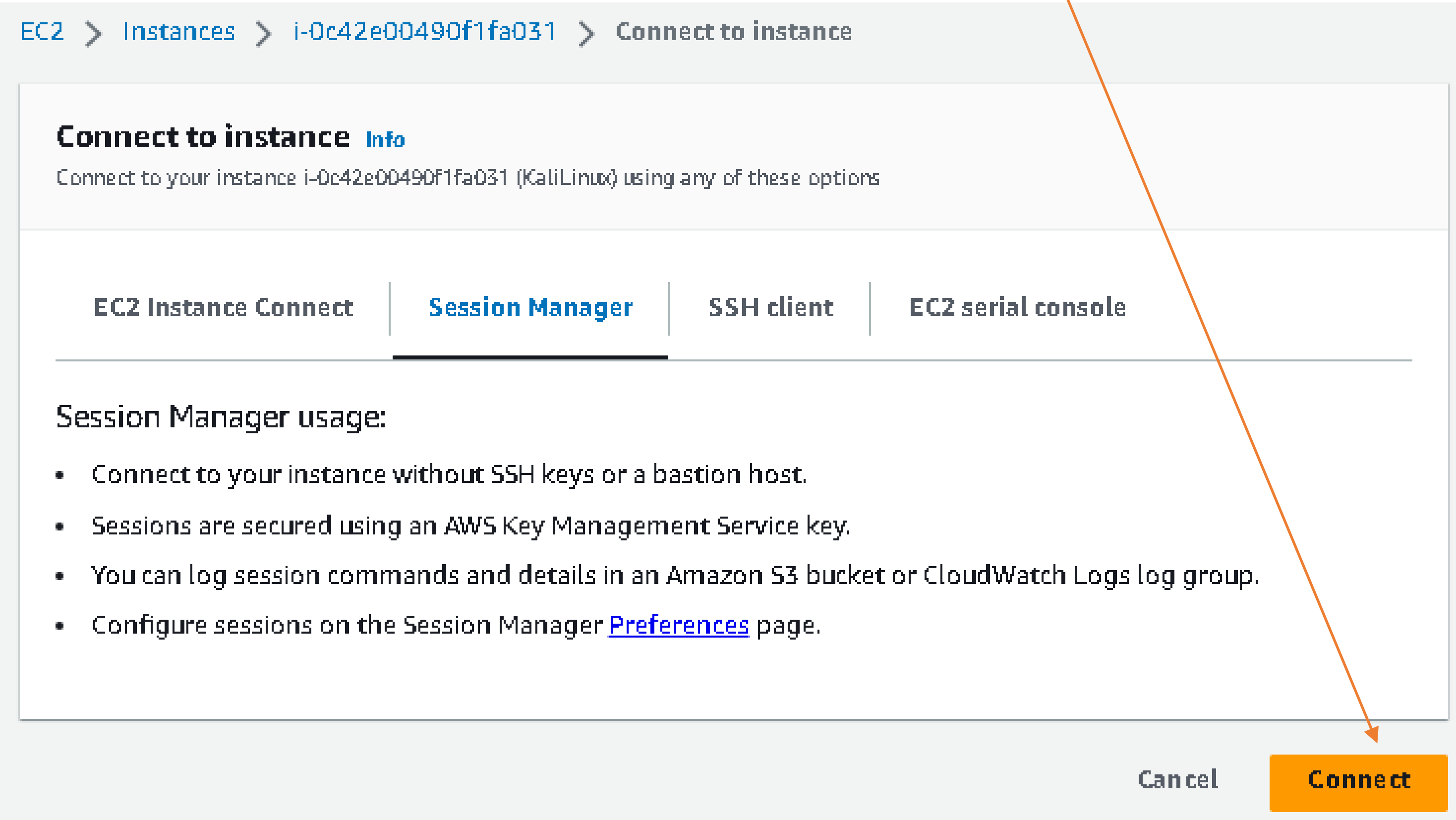


```
mkdir /tmp/ssm
cd /tmp/ssm
wget https://s3.ap-south-1.amazonaws.com/amazon-ssm-ap-south-1/latest/linux_amd64/amazon-ssm-agent.rpm
sudo rpm --install amazon-ssm-agent.rpm
sudo systemctl status amazon-ssm-agent
sudo systemctl enable amazon-ssm-agent
sudo systemctl start amazon-ssm-agent
sudo systemctl status amazon-ssm-agent
```

- Of course, our Kali Linux is the Debian family.
- Once you make sure your SSM agent is running, go back to the EC2 instance → [Connect]

Amazon EC2 instances with Security Groups and Session Manager

- You will see this! Hit the [Connect]



Connect to instance Info

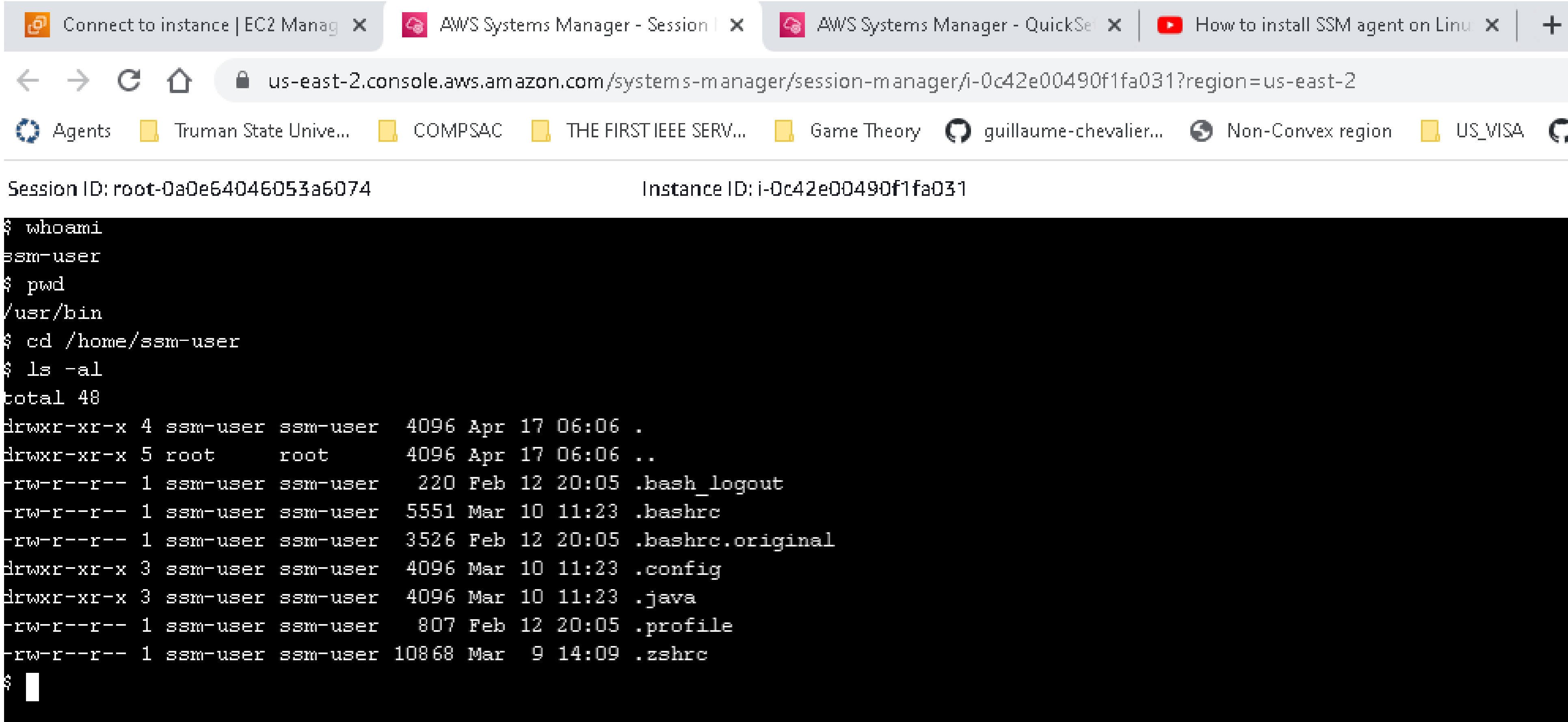
Connect to your instance i-0c42e00490f1fa031 (KaliLinux) using any of these options

Session Manager usage:

- Connect to your instance without SSH keys or a bastion host.
- Sessions are secured using an AWS Key Management Service key.
- You can log session commands and details in an Amazon S3 bucket or CloudWatch Logs log group.
- Configure sessions on the Session Manager Preferences page.

Amazon EC2 instances with Security Groups and Session Manager

- Here we go! I can access my EC2 instance from the browser!
- SSM Agent!



Connect to instance | EC2 Manag
AWS Systems Manager - Session
AWS Systems Manager - QuickSe
How to install SSM agent on Linu
us-east-2.console.aws.amazon.com/systems-manager/session-manager/i-0c42e00490f1fa031?region=us-east-2
Agents
Truman State Unive...
COMPSAC
THE FIRST IEEE SERV...
Game Theory
guillaume-chevalier...
Non-Convex region
US_VISA

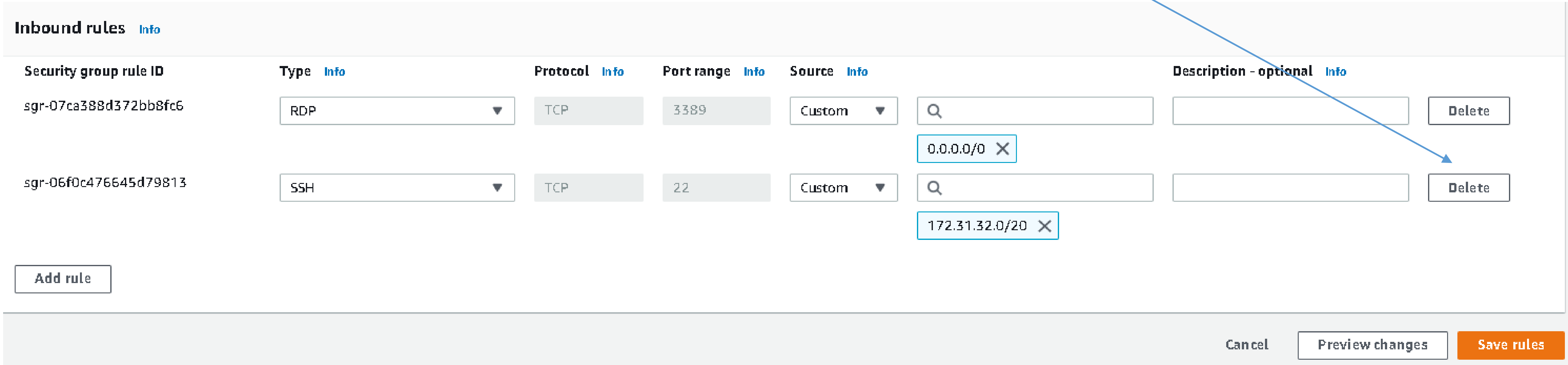
Session ID: root-0a0e64046053a6074

Instance ID: i-0c42e00490f1fa031

```
$ whoami
ssm-user
$ pwd
/usr/bin
$ cd /home/ssm-user
$ ls -al
total 48
drwxr-xr-x 4 ssm-user ssm-user  4096 Apr 17 06:06 .
drwxr-xr-x 5 root     root      4096 Apr 17 06:06 ..
-rw-r--r-- 1 ssm-user ssm-user   220 Feb 12 20:05 .bash_logout
-rw-r--r-- 1 ssm-user ssm-user  5551 Mar 10 11:23 .bashrc
-rw-r--r-- 1 ssm-user ssm-user  3526 Feb 12 20:05 .bashrc.original
drwxr-xr-x 3 ssm-user ssm-user  4096 Mar 10 11:23 .config
drwxr-xr-x 3 ssm-user ssm-user  4096 Mar 10 11:23 .java
-rw-r--r-- 1 ssm-user ssm-user   807 Feb 12 20:05 .profile
-rw-r--r-- 1 ssm-user ssm-user 10868 Mar  9 14:09 .zshrc
$
```

Amazon EC2 instances with Security Groups and Session Manager

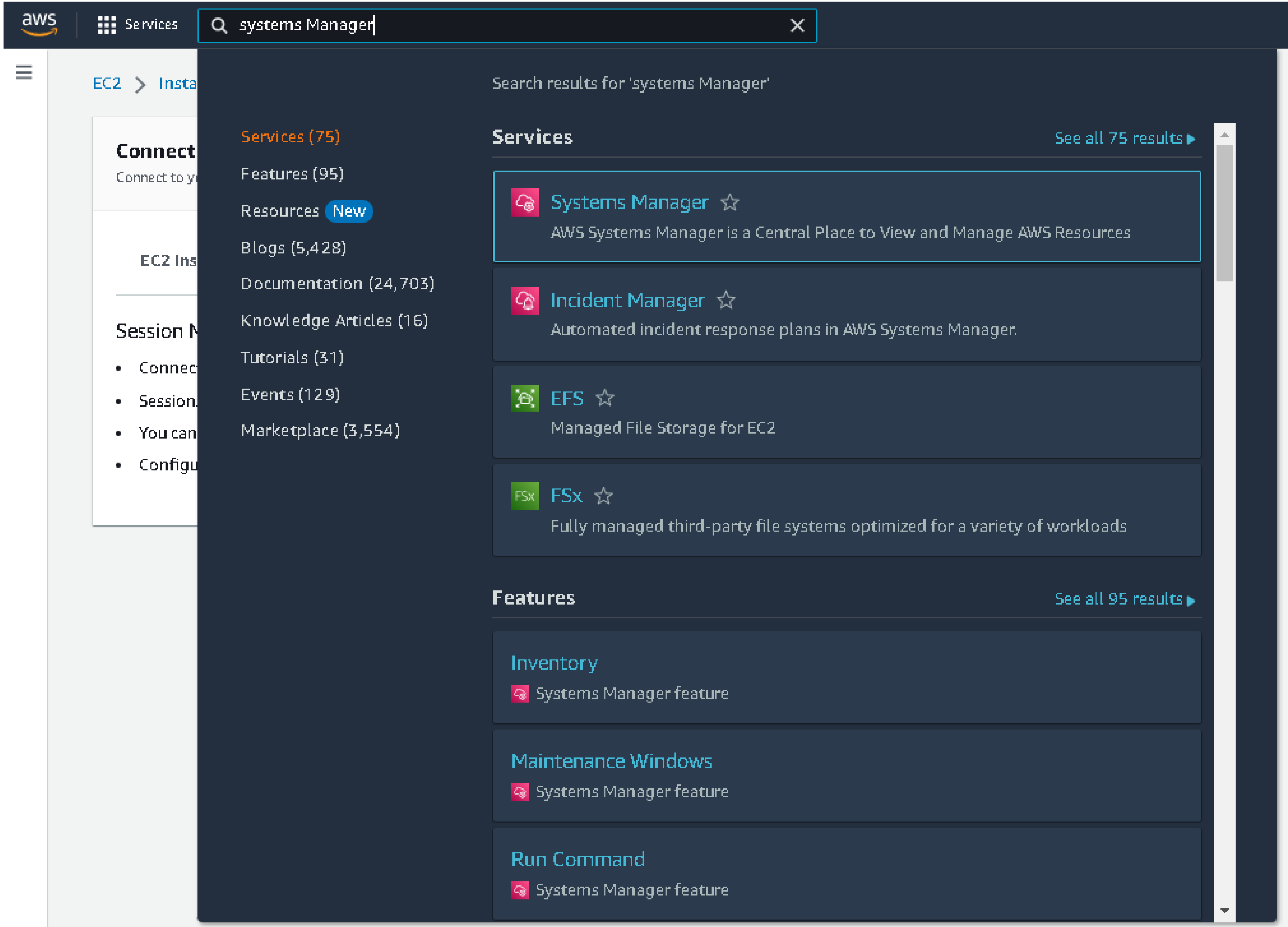
- Now, we can actually delete the SSH form inbound and use the [Session Manager] to manage our system connections.



Inbound rules Info

Security group rule ID	Type Info	Protocol Info	Port range Info	Source Info		Description - optional Info	
sgr-07ca388d372bb8fc6	RDP	TCP	3389	Custom	0.0.0.0/0		Delete
sgr-06f0c476645d79813	SSH	TCP	22	Custom	172.31.32.0/20		Delete

- Now we can search the Systems Manager



systems Manager

Search results for 'systems Manager'

Services See all 75 results

Systems Manager
AWS Systems Manager is a Central Place to View and Manage AWS Resources

Incident Manager
Automated incident response plans in AWS Systems Manager.

EFS
Managed File Storage for EC2

FSx
Fully managed third-party file systems optimized for a variety of workloads

Features See all 95 results

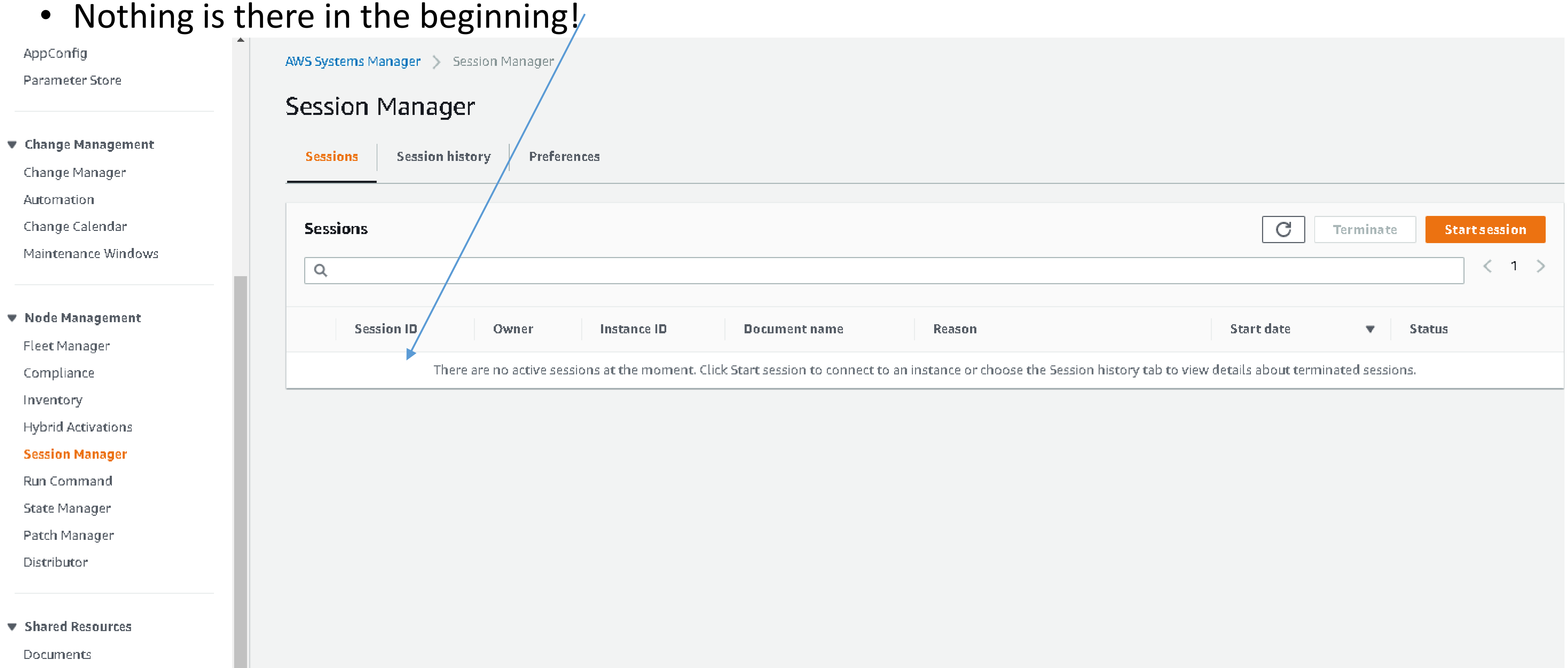
Inventory
Systems Manager feature

Maintenance Windows
Systems Manager feature

Run Command
Systems Manager feature

Amazon EC2 instances with Security Groups and Session Manager

- You can see right at the bottom left, the session manager
- Nothing is there in the beginning!

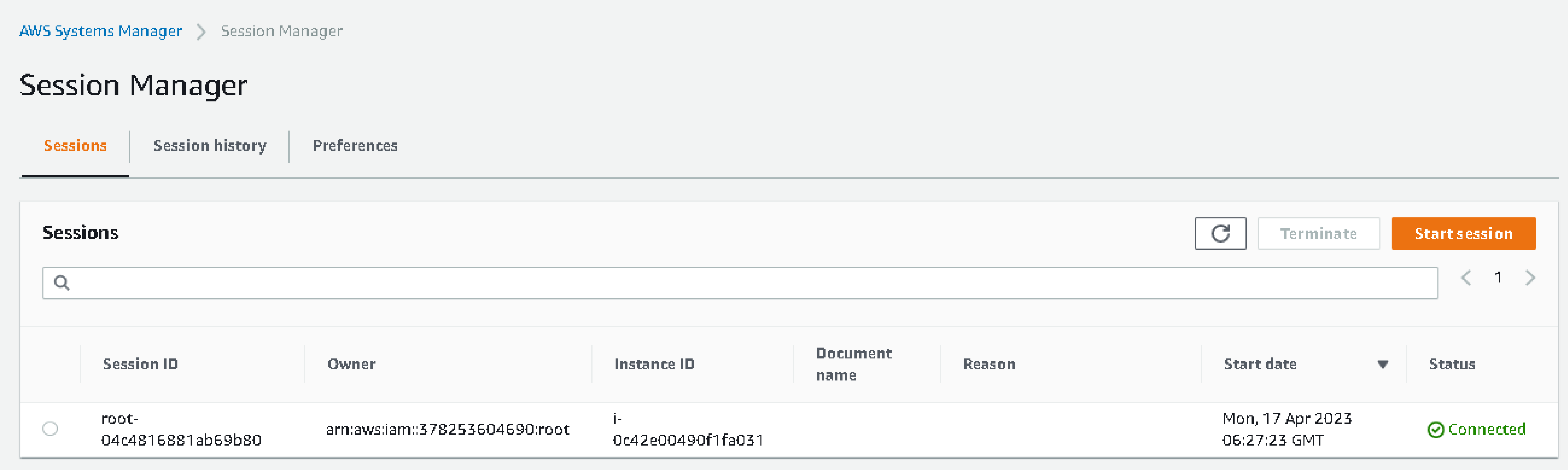


Session ID	Owner	Instance ID	Document name	Reason	Start date	Status

There are no active sessions at the moment. Click Start session to connect to an instance or choose the Session history tab to view details about terminated sessions.

Amazon EC2 instances with Security Groups and Session Manager

- If we go back to use the SSM Agent to [Connect] again? So you can do some management jobs over there. You can also check the session and terminate it, if it looks suspicious!



	Session ID	Owner	Instance ID	Document name	Reason	Start date ▼	Status
○	root-04c4816881ab69b80	arn:aws:iam::378253604690:root	i-0c42e00490f1fa031			Mon, 17 Apr 2023 06:27:23 GMT	✓ Connected