

How to Implement SAS 9.4 on an Amazon Web Services Cloud Server Instance

Jeff Lehmann, Slalom Consulting, LLC

ABSTRACT

This paper demonstrates a tactical scenario where a SAS® 9.4 test environment is installed and configured on an Amazon Web Services (AWS) Elastic Compute Cloud (EC2) instance running Linux Red Hat version 7.1. The best practice actions to complete this SAS® 9.4 implementation are based upon successful implementation techniques as well as existing customer installations.

INTRODUCTION

The process to install SAS® 9.4 on an Amazon EC2 instance can be divided into the following steps:

1. Create an AWS EC2 instance using virtual private cloud (VPC)
2. Connect to the EC2 instance
3. Download a SAS® 9.4 software depot with SAS download manager
4. Perform SAS® 9.4 pre-installation tasks
5. Install SAS® 9.4 software with SAS Deployment Manager
6. Complete SAS® 9.4 post-installation tasks and configuration

While the majority of these installation actions are similar, even agnostic to the target operating system, the steps to complete a Windows or UNIX implementation may vary with what is proposed in this paper. Moreover, properly sizing an EC2 instance to replace an existing SAS® 9.4 data center installation is beyond the scope of this paper, as are discussions of potential issues and pitfalls to watch out for. Additionally, this paper assumes that the administrator has some familiarity with the AWS Management Console and its various networking, storage, database and security offerings.

SAS administrators and users who are interested in investigating solutions outside of the traditional data center environment will benefit from understanding this paper's installation and configuration exercise. As more enterprises using SAS® search for ways to experiment with new software, they will find that cloud service providers such as Amazon can help them reach their implementation goals at a faster pace and at a lower cost. Alleviating the SAS® enterprise of some labor and capacity planning constraints while allowing staff to refocus on more productive or innovative uses of SAS® will lead to notably higher ROI on new SAS® software investments.

CREATE AWS EC2 INSTANCE USING A VPC

What follows is a series of steps to guide the SAS® administrator through the AWS Management Console VPC Wizard and EC2 Launch Instance interface.

1. Log into AWS Management Console and click the VPC icon. Then, click “Start VPC Wizard” and finally, click “VPC with Public and Private Subnets”:



Display 1. “Select a VPC Configuration” ties in with “VPC with Public and Private Subnets” interface

Next, Specify: “IP CIDR block”, “VPC Name”, “Public subnet/name”, “Private subnet/name”, “Instance type”, “Key pair name”, S3 “Subnet/Policy” and then, click the “Create VPC” button.

Step 2: VPC with Public and Private Subnets

IP CIDR block* (65531 IP addresses available)

VPC name:

Public subnet* (251 IP addresses available)

Availability Zone*

Public subnet name:

Private subnet* (251 IP addresses available)

Availability Zone*

Private subnet name:

You can add more subnets after AWS creates the VPC.

Specify the details of your NAT instance.

Instance type*

Key pair name:

Note: Instance rates apply. [View Rates](#)

Add endpoints for S3 to your subnets

Subnet:

Policy: ☒ Full Access - Allow access by any user or service within the VPC using credentials from any AWS accounts to any S3 resources ☐ Custom

Enable DNS hostnames* ☒ Yes ☐ No

Hardware tenancy*

Enable ClassicLink* ☐ Yes ☒ No

[Cancel and Exit](#) [Back](#) [Create VPC](#)

Display 2. “Create VPC with Public and Private Subnets” details

The above step created a VPC instance ID, *vpc-466c6b23*, along with 2 subnets, a routing table, *rtb-83d137e7*, an internet gateway, *igw-362e5153*, an endpoint, *vpce-db2bcfb2*, a network ACL, *acl-0f0e096a* and most prominently, a new EC2 instance, *i-d057df79*.

2. The next step is to launch a new EC2 instance into the VPC already created. Back in the AWS Management Console, click the EC2 icon. Choose "Launch instance". Then, select "Red Hat Enterprise Linux 7.1 (HVM) - ami-12663b7a (64-bit)"

1. Choose AMI 2. Choose Instance Type 3. Configure Instance 4. Add Storage 5. Tag Instance 6. Configure Security Group 7. Review

Step 1: Choose an Amazon Machine Image (AMI)

An AMI is a template that contains the software configuration (operating system, application server, and applications) required to launch your instance. You can select an AMI provided by AWS, our user community, or the AWS Marketplace; or you can select one of your own AMIs.

Quick Start

My AMIs

AWS Marketplace

Community AMIs

☐ Free tier only (1)

Amazon Linux AMI 2015.03 (HVM), SSD Volume Type - ami-1ecae776

The Amazon Linux AMI is an EBS-backed, AWS-supported image. The default image includes AWS command line tools, Python, Ruby, Perl, and Java. The repositories include Docker, PHP, MySQL, PostgreSQL, and other packages.

Root device type: ebs Virtualization type: hvm

Red Hat Enterprise Linux 7.1 (HVM), SSD Volume Type - ami-12663b7a

Red Hat Enterprise Linux version 7.1 (HVM), EBS General Purpose (SSD) Volume Type

Root device type: ebs Virtualization type: hvm

[Select](#) 64-bit

[Select](#) 64-bit

Display 3. Amazon Machine Image (AMI) selection list prompted by the EC2 Launch Instance action

*The compatible version of SAS® 9.4 for Red Hat 7.1 must be SAS 9.4 TS1M0 or later.

- Select the following instance specifications for a SAS® test environment that will handle from 25 to 50 concurrent users and click “Next: Configure Instance Details”:

Family: Compute optimized family
 Type: c3.4xlarge
 vCPUs: 16vCPUs
 Memory: 30GB memory
 Instance Storage: 2x160GB
 EBS-Optimized Available: Yes
 Network Performance: High

<input checked="" type="checkbox"/>	Compute optimized	c3.4xlarge	16	30	2 x 160 (SSD)	Yes	High
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[Cancel](#)
[Previous](#)
[Review and Launch](#)
[Next: Configure Instance Details](#)

Display 4. EC2 Launch Instance Type specification page

- In the “Configure Instance Details” screen Network field, select the newly created VPC. This will also populate the Subnet field. Then, for the Auto-assign Public IP field, select “Enable”. Finally, in the Enable termination protection field, click the box to “Protect against accidental termination”. Click “Next: Add Storage”:

1. Choose AMI 2. Choose Instance Type 3. Configure Instance 4. Add Storage 5. Tag Instance 6. Configure Security Group 7. Review

Step 3: Configure Instance Details

Configure the instance to suit your requirements. You can launch multiple instances from the same AMI, request Spot Instances to take advantage of the lower pricing, assign an access management role to the instance, and more.

Number of instances

Purchasing option ☐ Request Spot Instances

Network [Create new VPC](#)

Subnet [Create new subnet](#)

Auto-assign Public IP

Placement group

IAM role [Create new IAM role](#)

Shutdown behavior

Enable termination protection ☒ Protect against accidental termination

Monitoring ☐ Enable CloudWatch detailed monitoring
Additional charges apply.

EBS optimized instance ☐ Launch as EBS-optimized instance
Additional charges apply.

Tenancy Additional charges will apply for dedicated tenancy.

Network interfaces

Device	Network Interface	Subnet	Primary IP	Secondary IP addresses
eth0	New network interface	subnet-aab02d81	Auto-assign	Add IP

[Add Device](#)

[Cancel](#)
[Previous](#)
[Review and Launch](#)
[Next: Add Storage](#)

Display 5. “Configure Instance Details” details

- Click “Next: Add Storage” and it is recommended to type in a larger size than the 10GB default. Below, 300GB was chosen to start. In any event, if required, storage can be added later without stopping the instance:

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 your instance, or edit the settings of the root volume. You can also attach additional EBS volumes after launching an instance, but not instance store volumes. [Learn more](#) about storage options in Amazon EC2.

Type <input type="text"/>	Device <input type="text"/>	Snapshot <input type="text"/>	Size (GiB) <input type="text"/>	Volume Type <input type="text"/>	IOPS <input type="text"/>	Delete on Termination <input type="text"/>
Root	/dev/sda1	snap-7d0526da	<input type="text" value="300"/>	General Purpose (SSD)	30 / 3000	<input checked="" type="checkbox"/>

Display 6. “Add Storage” details include customizable size and volume type

6. Click “Next: Tag Instance” and enter in a unique key-value pair

Step 5: Tag Instance

A tag consists of a case-sensitive key-value pair. For example, you could define a tag with key = Name and value = Webserver. [Learn more](#) about tagging your Amazon EC2 resources.

Key (127 characters maximum)	Value (255 characters maximum)
Name	SAS 9.4 9C4VEX RHEL

Create Tag (Up to 10 tags maximum)

Display 7. “Tag Instance” useful key-value pairs can be the SAS® version, the SAS® order number or the OS

7. Click “Next: Configure Security Group” and enter in the firewall rules for your VPC. Refer to the [SAS® 9.4 pre-installation checklist for ports](#) [1] for inbound/outbound traffic instructions. NOTE: The below list of SAS ports is open only to the specified port. It is NEVER recommended to have the source be set to “Anywhere” at any port 0.0.0.0. Consider setting strict, specific IP address source origins, such as a VPN gateway IP address. Contact your network admin to confirm IP address(s).

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 set up a web server and allow Internet traffic to reach your instance, add rules that 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: ☒ Create a new security group ☐ Select an existing security group

Security group name: secgrp-SAS-9.4-Linux-RHEL

Description: secgrp-SAS-9.4-Linux-RHEL created 2015-06-10T18:44:32.918-04:00

Type	Protocol	Port Range	Source
SSH	TCP	22	My IP 72.28.157.179/32
Custom TCP Rule	TCP	7980	My IP 72.28.157.179/32
Custom TCP Rule	TCP	21050	My IP 72.28.157.179/32
Custom TCP Rule	TCP	8111	My IP 72.28.157.179/32
Custom TCP Rule	TCP	41415	My IP 72.28.157.179/32
Custom TCP Rule	TCP	9380-9384	My IP 72.28.157.179/32
Custom TCP Rule	TCP	8581	My IP 72.28.157.179/32
HTTPS	TCP	443	My IP 72.28.157.179/32
Custom TCP Rule	TCP	11099	My IP 72.28.157.179/32
Custom TCP Rule	TCP	8811	My IP 72.28.157.179/32
Custom TCP Rule	TCP	7080	My IP 72.28.157.179/32
Custom TCP Rule	TCP	8701	My IP 72.28.157.179/32
Custom TCP Rule	TCP	8631	My IP 72.28.157.179/32
Custom TCP Rule	TCP	10651	My IP 72.28.157.179/32
Custom TCP Rule	TCP	7541	My IP 72.28.157.179/32
Custom TCP Rule	TCP	8801	My IP 72.28.157.179/32
Custom TCP Rule	TCP	9452	My IP 72.28.157.179/32
Custom TCP Rule	TCP	7551	My IP 72.28.157.179/32
Custom TCP Rule	TCP	5451	My IP 72.28.157.179/32
Custom TCP Rule	TCP	8591	My IP 72.28.157.179/32

Cancel Previous Review and Launch

Display 8. “Configure Security Group” details containing a list of firewall rules for required SAS® ports

Above, the listed ports are accessible from any source, anywhere. Select the “Review and Launch” button. The following warning message appears:

 Your instance configuration is not eligible for the free usage tier

To launch an instance that's eligible for the free usage tier, check your AMI selection, instance type, configuration options, or storage devices. [Learn more about free usage tier eligibility and usage restrictions.](#)

[Don't show me this again](#)

Display 9. Warning message at “Review and Launch” time for the EC2 instance

Another less administratively intensive best practice would be to attach a virtual private gateway to the VPC, creating a custom route table and updating the security rules. The result would be a VPN connection between the VPC and an external corporate network. Setting up this VPN connection is beyond the scope of this paper, but the details can be found at this [AWS VPC user guide web page](#) [2].

8. Click the “Launch” button. Next, a popup requests to “Choose an existing key pair” or “create new key pair”. AWS uses public-key cryptography to encrypt and a private key to decrypt login information. Together, they are known as a [key pair](#) [3]. If no key pair exists, it must be created. Below, an existing key pair was selected. Then, the “Launch Instances” button was clicked.

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

test1

☒ I acknowledge that I have access to the selected private key file (test1.pem), and that without this file, I won't be able to log into my instance.

Cancel Launch Instances

Display 10. Key pair selection/creation screen

Launch Status

✓ Your instances are now launching
The following instance launches have been initiated: [i-7dab20d4](#) [View launch log](#)

Display 11. Launch status message details

9. Select VPC off the AWS Management Console menu and then select "Internet Gateways". An [internet gateway](#) [4] allows communication between a VPC instance and the internet. Review the previously created internet gateway attached to the earlier created VPC.

igw-362e5153 attached vpc-466c6b23 (10.0.0.0/16) | vpc_S...

<

igw-362e5153

Summary Tags

ID: igw-362e5153 Attached VPC ID: vpc-466c6b23 (10.0.0.0/16) | vpc_SAS_9_4_9B6PXC_RHEL2

State: attached Attachment state: available

Display 12. Internet gateway attached to a VPC

10. The steps leading up to now created a secure connectivity method to the internet, connecting from a Private Network EC2 residing in a Public Network [NAT \(Network Address Translation\) instance](#) [18]. A NAT instance can be enabled to receive Internet-bound traffic from instances in a private subnet (e.g. 10.0.1.0/24), as well as SSH traffic from your network. To review the connectivity to the internet, check the Routes tab on the Route Table *rtb-83d137e7*.

rtb-83d137e7 0 Subnets Yes vpc-466c6b23 (10.0.0.0/16) | vpc_S...

<

rtb-83d137e7

Summary Routes Subnet Associations Route Propagation Tags

Edit

Destination	Target	Status	Propagated
10.0.0.0/16	local	Active	No
pl-63a5400a (com.amazonaws.us-east-1.s3)	vpce-db2bcfb2	Active	No
0.0.0.0/0	eni-f831f7d7 / i-d057df79	Active	No

Display 13. Route table association with the internet gateway for the public subnet

11. Return to the AWS Management Console and select Elastic IP off the VPC menu. Click “Allocate New Address” and then “Yes, Allocate” to make it assignable to a VPC. Once allocated, the IP address can then be assigned back to the newly created EC2 instance ID. [Elastic IP](#) [5] addresses are very useful to provide users with a consistent IP address to use regardless of what dynamic cloud resource is implemented.

The image shows two AWS console dialog boxes. The top box, titled "Allocate New Address", asks "Are you sure you want to allocate a new IP address?". It has a dropdown menu for "EIP used in:" set to "VPC", and two buttons: "Cancel" and "Yes, Allocate". The bottom box, titled "Associate Address", prompts the user to "Select the instance OR network interface to which you wish to associate this IP address (52.6.249.250)". It has fields for "Instance" (i-7dab20d4) and "Network Interface" (with a search prompt). Below these is a "Private IP Address" dropdown set to "10.0.0.34* - 52.0.174.145" and a checkbox for "Reassociation". A yellow warning box states: "Warning: If you associate an Elastic IP address with your instance, your current public IP address is released. Learn more about public IP addresses." At the bottom are "Cancel" and "Associate" buttons.

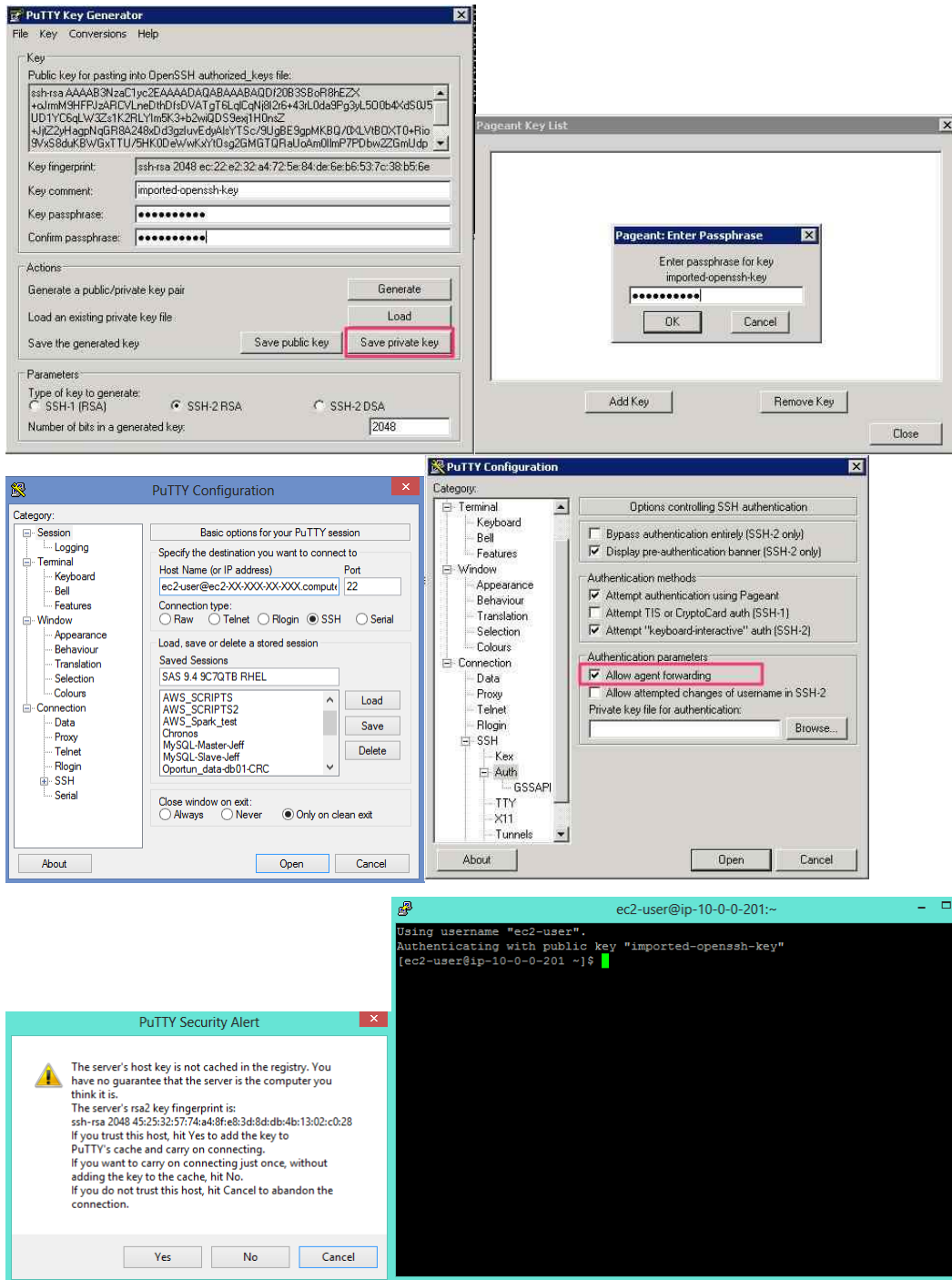
Display 14. Dialogue boxes for Elastic IP allocation and association

12. Select EC2 off the AWS Management Console and select the newly created EC2. Take note of the associated Public DNS: : **ec2-XX-XXX-XX-XXX.compute-1.amazonaws.com** (XX-XXX-XX-XXX is a mask for an IP Address. Your installation will have its own unique IP address)

CONNECT TO THE EC2 INSTANCE

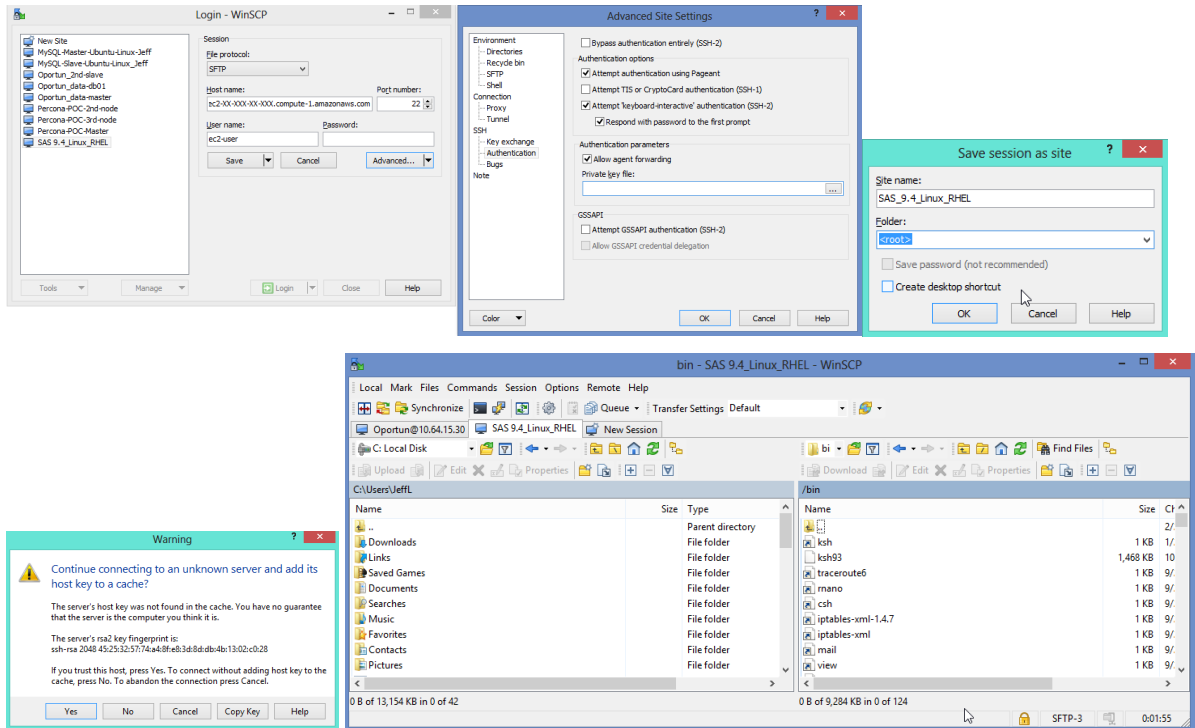
Now that an AWS EC2 instance has been launched in a VPC, permitting access to the internet as well as providing external access to specified SAS® 9.4 ports, the next step is to set up client connections using ssh, FTP and VNC as well as a Firefox web browser running on the EC2 instance.

13. Download and configure a new ssh client connection to the instance using [putty](#) [6]. Next, download Pageant and install from the same [page](#) in order to get the most secure SSH agent functionality. First, convert your AWS .pem credentials file to a .ppk file using [PuttyGen](#). Next, open Pageant (running as a Windows service), click the “Add Key” button and enter in the AWS Passphrase. Close the Pageant window and then configure putty as shown below and check the “Allow agent forwarding” box. As long as the matching private key for the instance is loaded into Pageant, the connection will be successful. The NAT scenario described up to now where the SAS 9.4 instance resides in a private subnet also requires setting up a [reverse ssh tunnel](#) [19].



Display 15. Putty configuration details using private key file

14. Configure [WinSCP](#) [7], an FTP client, to connect to the EC2 instance in a similar way, clicking the same "Allow agent forwarding" box. Click "OK" to confirm "Advanced Site Settings", "OK" to save the session site name and "Yes" to the unknown server warning:



Display 16. WinSCP configuration details using private key file

15. Return to the putty session to run the Red Hat Linux OS update (It may discover no new updates):

```
[ec2-user@ip-10-0-0-201 ~]$ sudo yum install update
Loaded plugins: amazon-id, rhui-lb, security
rhui-REGION-client-config-server-6                | 2.9 kB   00:00
rhui-REGION-client-config-server-6/primary_db      | 4.0 kB   00:00
rhui-REGION-rhel-server-releases                  | 3.7 kB   00:00
rhui-REGION-rhel-server-releases/primary_db       | 28 MB    00:00
rhui-REGION-rhel-server-releases-optional          | 3.5 kB   00:00
rhui-REGION-rhel-server-releases-optional/primary_db | 2.8 MB   00:00
rhui-REGION-rhel-server-rh-common                  | 2.9 kB   00:00
rhui-REGION-rhel-server-rh-common/primary_db       | 33 kB    00:00
rhui-REGION-rhel-server-rhsc1                      | 3.1 kB   00:00
rhui-REGION-rhel-server-rhsc1/primary_db           | 584 kB   00:00
Setting up Install Process
No package update available.
Error: Nothing to do
```

16. [Install Tiger VNC Server](#) [8], on the EC2 instance. In putty, type the following commands separately:

```
sudo yum groupinstall "Desktop" (It will prompt: Is this ok [y/N]: y; At the end, it shows: Complete!)
sudo yum install pixman pixman-devel libXfont
sudo yum install tigervnc-server
vncpasswd (Set VNC Password)
```


sudo vi /etc/sysconfig/vncservers (Edit VNC configuration file: add the following 2 lines at the end)

VNCSERVERS="1:ec2-user"

VNCSERVERARGS[1]="-geometry 1024x768"

vncserver (Start the VNC server instance. The following lines show typical response entries)

xauth: creating new authority file /home/ec2-user/.Xauthority

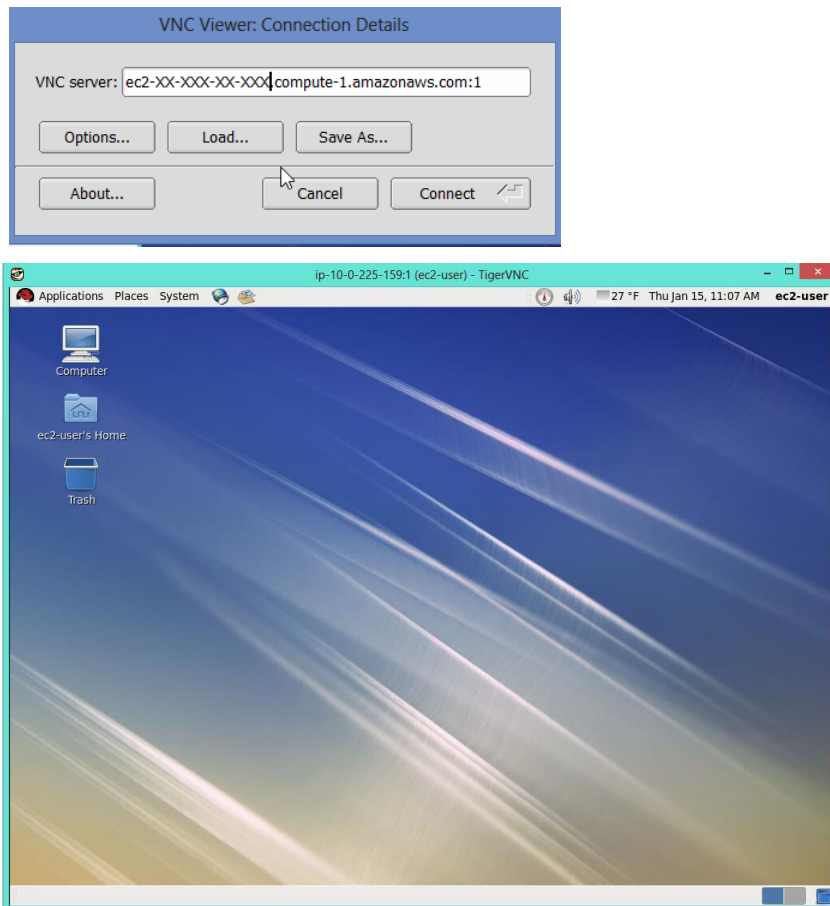
New 'ip-10-0-0-201:1 (ec2-user)' desktop is ip-10-0-0-201:1

Creating default startup script /home/ec2-user/.vnc/xstartup

Starting applications specified in /home/ec2-user/.vnc/xstartup

Log file is /home/ec2-user/.vnc/ip-10-0-0-201:1.log

17. Use the [TigerVNC viewer](#) [9] client to connect to your EC2 instance:

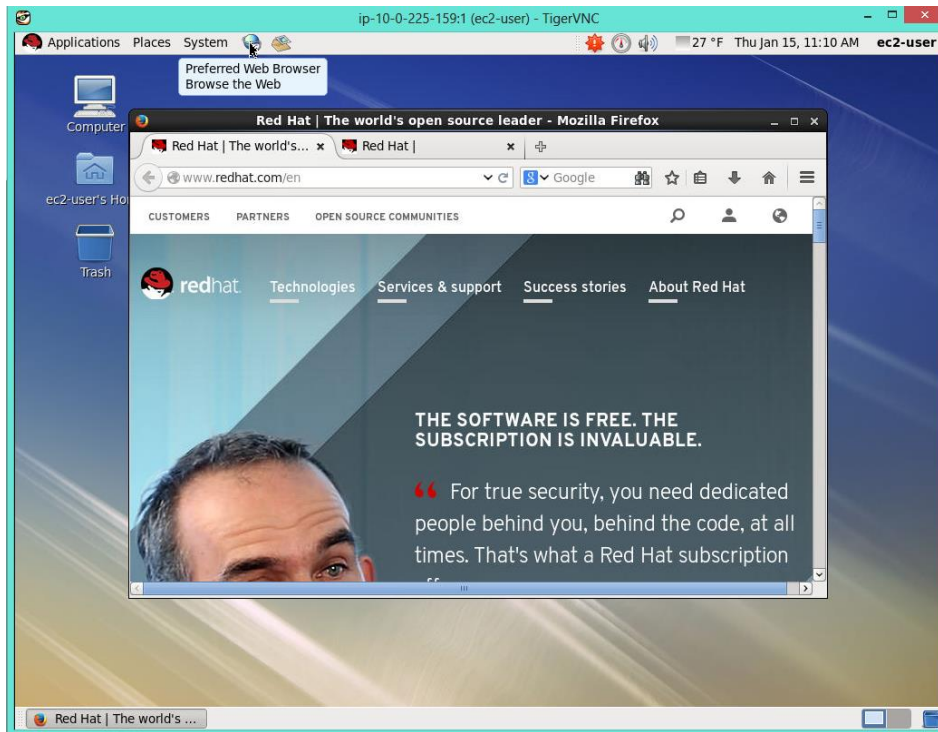


Display 17. TigerVNC Viewer's connection details and successful login to GUI interface

18. Download and install Firefox web browser on the EC2 instance:

sudo yum install firefox

Start Firefox by clicking on the icon to the right of the System drop down menu:



Display 18. [Firefox](#) [10] web browser launched in EC2 instance GUI interface

DOWNLOAD A SAS® 9.4 SOFTWARE DEPOT

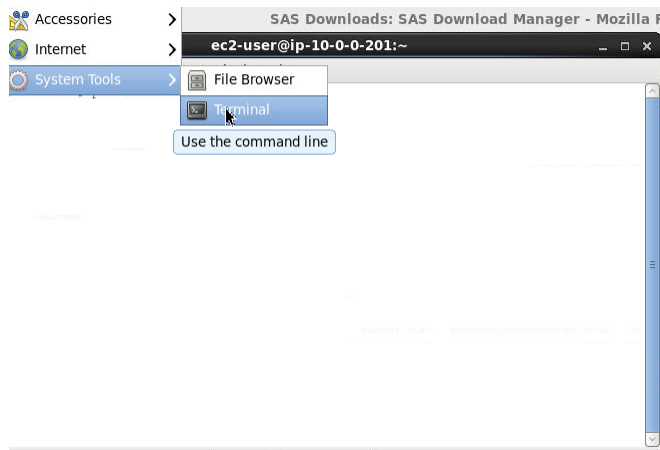
Since there now is a GUI interface available running the Firefox web browser, a SAS software depot can be downloaded to the EC2 instance.

19. Browse to the [SAS Download Manager download page](#) [11]. Log into a SAS profile. First click on the Release 1.61 link and then click on the link for Linux for x64 and begin the download process:

SAS Download Manager					
Platform	Description	Request Download	Size	Uncompressed	Release Date
64-bit enabled AIX	SAS Download Manager	esdclient_94250_r64_xx_web_1	117MB	534MB	2014-09
64-bit enabled Solaris	SAS Download Manager	esdclient_94250_s64_xx_web_1	88MB	534MB	2014-09
HP-UX IPF	SAS Download Manager	esdclient_94250_h6i_xx_web_1	109MB	534MB	2014-09
Linux for x64	SAS Download Manager	esdclient_94250_lax_xx_web_1	67MB	534MB	2014-09
Macintosh	SAS Download Manager	esdclient_94250_mac_xx_web_1.dmg	15MB	534MB	2014-09
Microsoft® Windows® for x64	SAS Download Manager	esdclient_94250_wx6_xx_web_1.exe	42MB	534MB	2014-09
Solaris for x64	SAS Download Manager	esdclient_94250_sax_xx_web_1	83MB	534MB	2014-09
Windows	SAS Download Manager	esdclient_94250_win_xx_web_1.exe	42MB	534MB	2014-09
z/OS	SAS Download Manager	esdclient_94250_mvs_xx_web_1.zos	17MB	534MB	2014-09

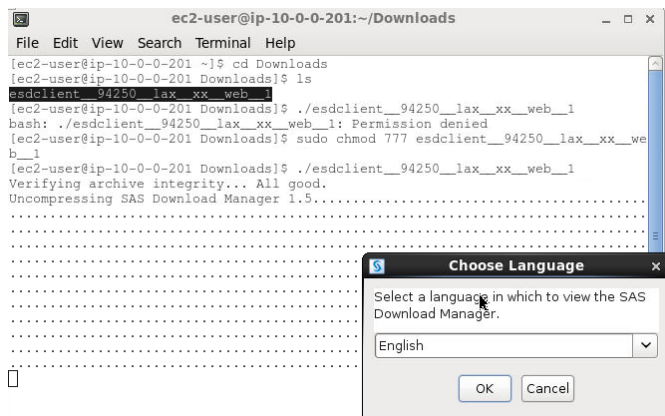
Display 19. SAS Download Manager download by platform

20. Start a terminal session. Create a new SAS software depot directory. Open up permissions on the depot directory and with the SAS download executable. Then, start SAS download manager to download SAS® 9.4 software with the commands below..



Display 20. Select System Tools drop down menu to start the “Terminal” (ssh) session

```
sudo mkdir /SAS_9.4_Software_Depot
sudo chmod 777 /SAS_9.4_Software_Depot
cd /home/ec2-user/Downloads
sudo chmod 777 esdclient_94250_lax_xx_web_1
./esdclient_94250_lax_xx_web_1
```



Display 21. Start SAS® Download Manager

21. After clicking OK for English on the Language prompt, obtain the SAS® 9.4 order information from the SAS orders ESD e-mail sent to the SAS site representative and type in the Order Number and SAS Installation Key on the Order Information dialogue box. Click the “Next” button and confirm the order details on the next screen. Click “Next” and opt to include the entire order or a subset. Click “Next” and select the depot directory. Click “Next” and confirm that disk space requirements are met and click “Download” to start the process. If the process is interrupted, the administrator has the opportunity to restart the download where it left off or to start again.



Display 22. The SAS Download Manager progress bar

At the end of the download process, if successful, a “Download Complete” confirmation dialogue box appears. Click “Finish”.

PERFORM SAS® 9.4 PRE-INSTALLATION TASKS

In order to complete a successful deployment of SAS® 9.4, the [pre-installation tasks](#) [12] must be completed:

22. In the instance's Firefox browser, point to the following [SAS® 9.4 QuickStart guide](#) [13] URL :

file:///SAS_9.4_Software_Depot/install_doc/9B6PXC/quickstart.html

This web page contains useful URLs for SAS pre-installation and migration/installation/configuration documentation.

23. Run the following commands to install SAS® 9.4-required Linux packages:

```
sudo yum install libXp
```

```
sudo yum install numactl
```

```
sudo yum install glibc
```

```
sudo yum install compat-glibc (required [14] for SAS® 9.4 to run on Linux Redhat 7.1)
```

24. Create the following required local users for the SAS® 9.4 installation and assign them to the new SAS user groups sas_user and sas:

```
sudo groupadd sas_user
```

```
sudo useradd sas
```

```
sudo passwd sas
```

```
sudo usermod -G sas_user sas
```

id sas (verify success of user sas creation and assignment to group sas_user)

Perform the next 5 commands again, substituting sassrv with lsadmin, lsuser and sasdmo)

sudo useradd sassrv

sudo passwd sassrv

sudo usermod -G sas_user sassrv

sudo usermod -g sas sassrv

id sassrv

25. Verify the install SAS software depot. Substitute the name of your software depot directory below:

sudo chmod 755 /your_software_depot_directory/*.*

sudo chmod 755 /your_software_depot_directory/hot_fix/*.xml

sudo chmod 755 /your_software_depot_directory/hot_fix/*.zip

sudo chmod 755 /your_software_depot_directory/order_data/9B6PXC/*.xml

sudo chmod 755 /your_software_depot_directory/download_data/*.xml

cd /your_software_depot_directory/utilities/depotchecker

./SASDepotCheck.sh

26. Create and provide the appropriate write access to the following directory /etc/opt/vmware/vfabric:

cd /etc/opt

sudo mkdir vmware

cd vmware

sudo mkdir vfabric

sudo chgrp -R sas /etc/opt/vmware/

sudo chown sas /etc/opt/vmware/

sudo chgrp -R sas /etc/opt/vmware/vfabric

sudo chown sas /etc/opt/vmware/vfabric

27. [Increase open files limit](#) [15] for all processes. Check **ulimit** and increase open file descriptors to **20480** and number of processes (RHEL) to **10240**:

ulimit -a

core file size (blocks, -c) 0

data seg size (kbytes, -d) unlimited

scheduling priority (-e) 0

file size (blocks, -f) unlimited

pending signals (-i) 239355

max locked memory (kbytes, -l) 64

max memory size (kbytes, -m) unlimited

open files (-n) **1024**
pipe size (512 bytes, -p) 8
POSIX message queues (bytes, -q) 819200
real-time priority (-r) 0
stack size (kbytes, -s) 10240
cpu time (seconds, -t) unlimited
max user processes (-u) **1024**
virtual memory (kbytes, -v) unlimited
file locks (-x) unlimited

sudo vi /etc/security/limits.conf (Add the following to the end of the file):

*** soft nproc 10240**
*** hard nproc 10240**
*** soft nofile 20480**
*** hard nofile 20480**

sudo vi /etc/security/limits.d/91-nofile.conf (Add the following to the end of the file):

*** - nofile 20480**

sudo vi /etc/security/limits.d/90-nproc.conf (Add the following to the end of the file):

*** soft nofile 20480**
*** hard nofile 20480**

Exit out of the user session in putty, etc. to view the changes. Log back in and type the following:

```
[ec2-user@ip-10-0-0-98 ~]$ ulimit -a
```

core file size (blocks, -c) 0
data seg size (kbytes, -d) unlimited
scheduling priority (-e) 0
file size (blocks, -f) unlimited
pending signals (-i) 239355
max locked memory (kbytes, -l) 64
max memory size (kbytes, -m) unlimited
open files (-n) **20480**
pipe size (512 bytes, -p) 8
POSIX message queues (bytes, -q) 819200
real-time priority (-r) 0

stack size (kbytes, -s) 10240
cpu time (seconds, -t) unlimited
max user processes (-u) **10240**
virtual memory (kbytes, -v) unlimited
file locks (-x) unlimited

28. Create SAS 9.4 install home and configuration home: (e.g. **/sas_install/9.4 /sas_config/9.4**)

```
sudo mkdir /sas_install  
sudo mkdir /sas_install/9.4  
sudo mkdir /sas_config  
sudo mkdir /sas_config/9.4  
sudo chgrp -R sas /sas_install  
sudo chown -R sas /sas_install  
sudo chgrp -R sas /sas_config  
sudo chown -R sas /sas_config  
sudo chmod -R 777 /sas_install  
sudo chmod -R 777 /sas_config
```

29. Download [junit](#) [16] and copy to the SAS install directory (e.g. **/sas_install**) directory using WinSCP FTP

30. Download and install C compiler and python:

```
sudo yum install gcc  
sudo yum install python (python may already be installed)
```

Find where python is already installed:

```
sudo find . -name "python*" -print  
(e.g. /usr/lib64/python2.6, /usr/lib/python2.6, /usr/bin/python)
```

31. The following components are required to be installed to run **./sasbatch.sh** (SAS base):

```
sudo yum install ksh (Korn shell)  
sudo yum install libXp.so.6
```

32. In order to avoid a setuid permissions error later on in the installation process, run these commands:

```
cd /sas_install/9.4/SASFoundation/9.4/utilities/bin  
sudo ./setuid.sh
```

INSTALL SAS® 9.4 SOFTWARE WITH SAS DEPLOYMENT MANAGER

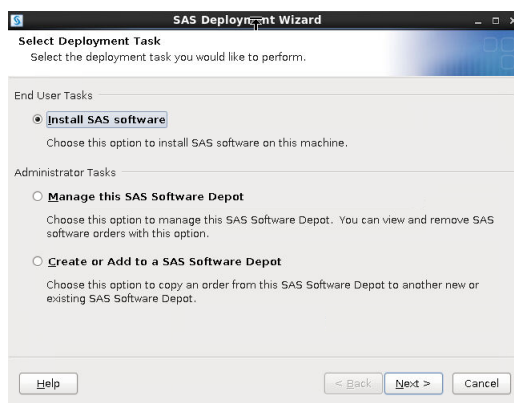
Now that the Linux RedHat 7.1 environment has been properly prepared, SAS® 9.4 software can be installed. What follows is a series of approximate steps showing via screen prints the SAS® 9.4 Deployment Wizard installation process in its entirety. These steps vary considerably based upon the SAS® 9.4 software order and as well as on requirements for additional configuration (authentication, migration, third-party software, etc.).

33. Start the SAS® 9.4 Deployment Manager wizard and then begin and continue to process the installation:

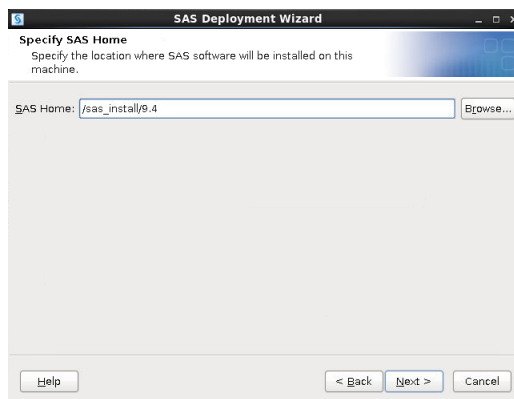
su sas (The SAS® 9.4 can only be installed using a sas installer id and not the root id)

cd /SAS_9.4_Software_Depot (Switch to the SAS® 9.4 software depot directory)

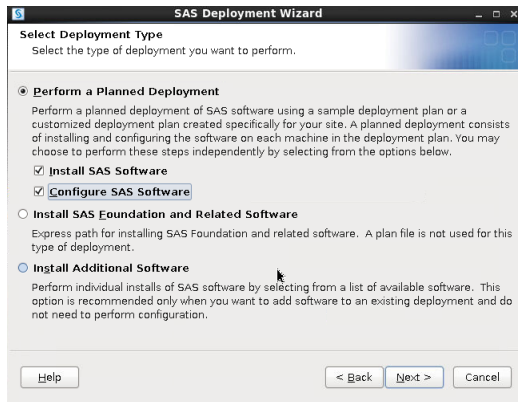
./setup.sh -record -deploy (-record allows the wizard to capture your inputs into a response file)



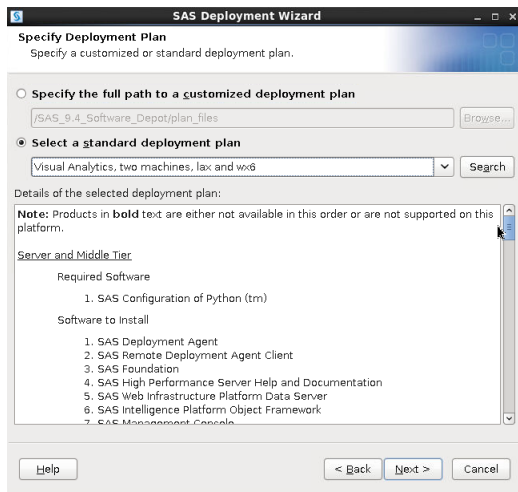
Display 23. Select SAS deployment task



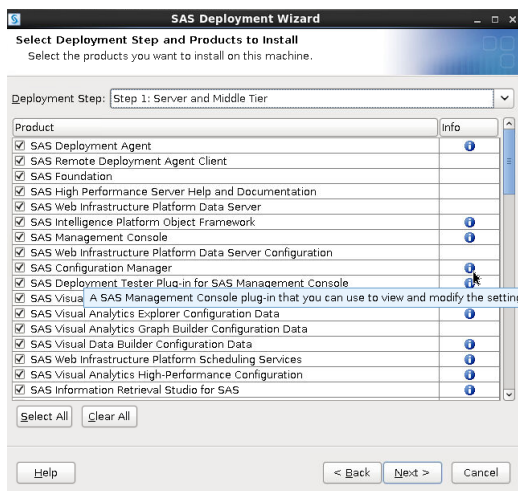
Display 24. Select SAS home directory



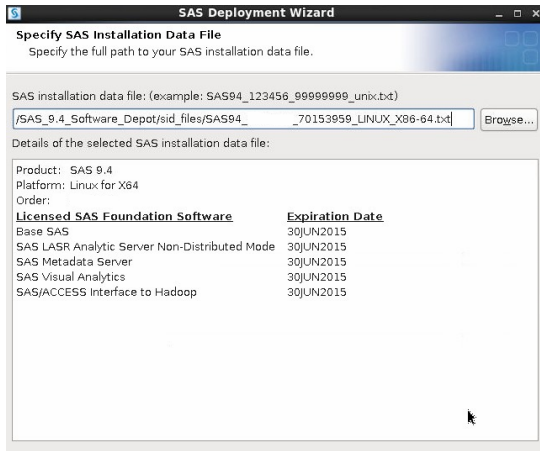
Display 25. Select SAS deployment type



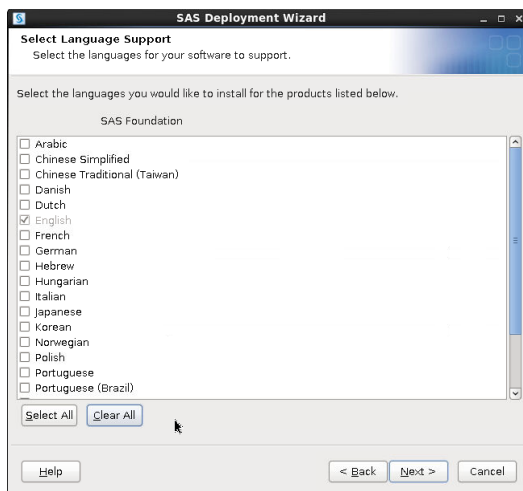
Display 26. Select SAS deployment plan



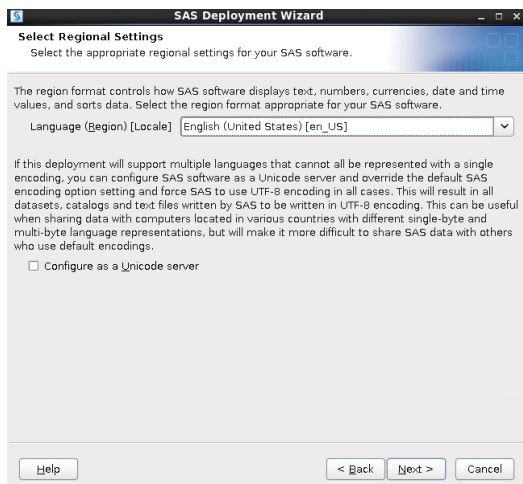
Display 27. Select SAS products to install



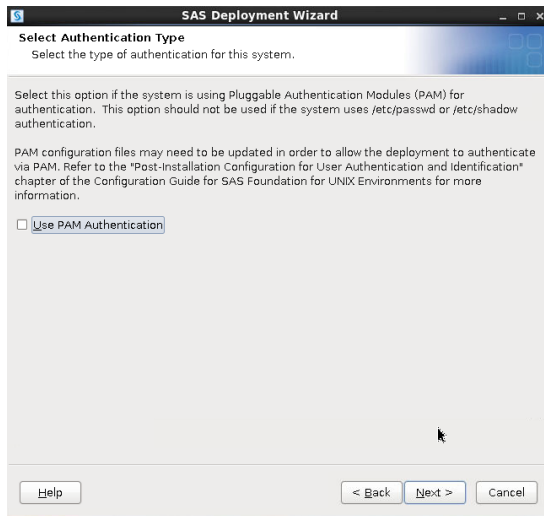
Display 28. Select SAS installation data file and take note of expiration dates



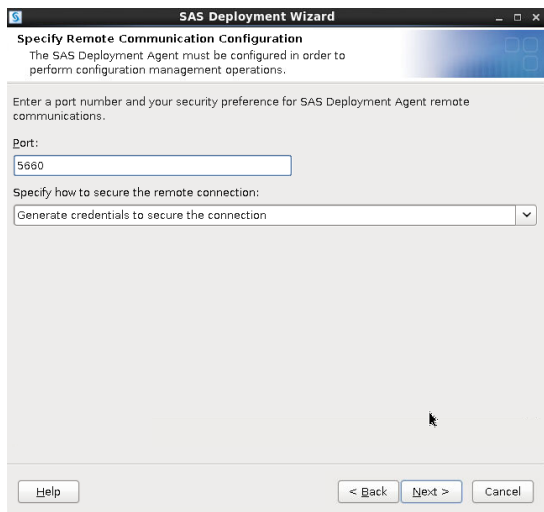
Display 29. Select SAS deployment task



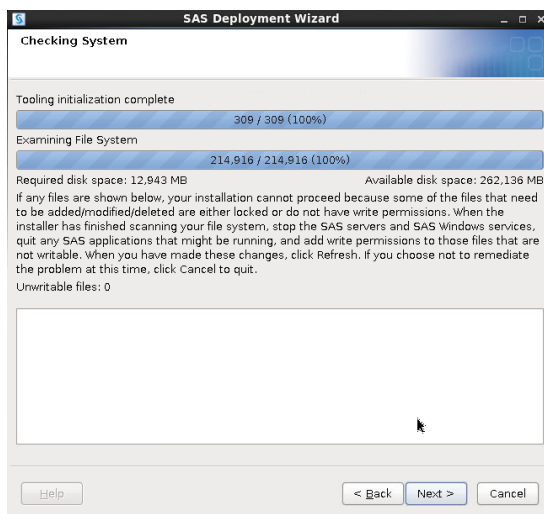
Display 30. Select Regional Settings



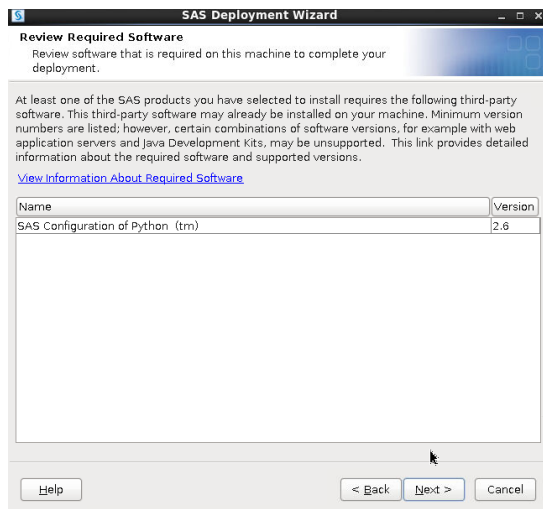
Display 31. Select Authentication Type



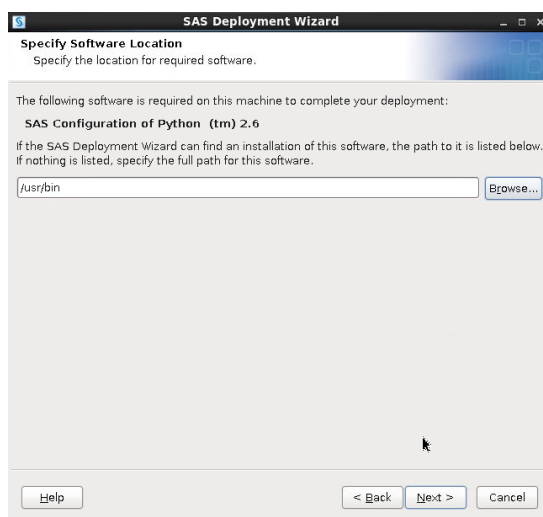
Display 32. Specify Remote Communication Configuration



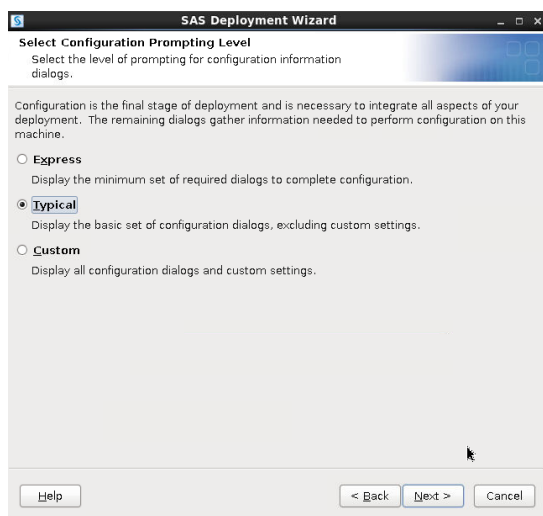
Display 33. Checking File System



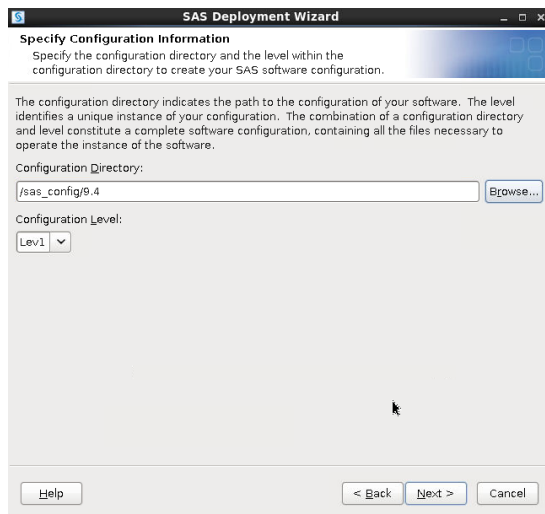
Display 34. Review Required Software



Display 35. Specify Software Location



Display 36. Select Configuration Prompting Level



SAS Deployment Wizard

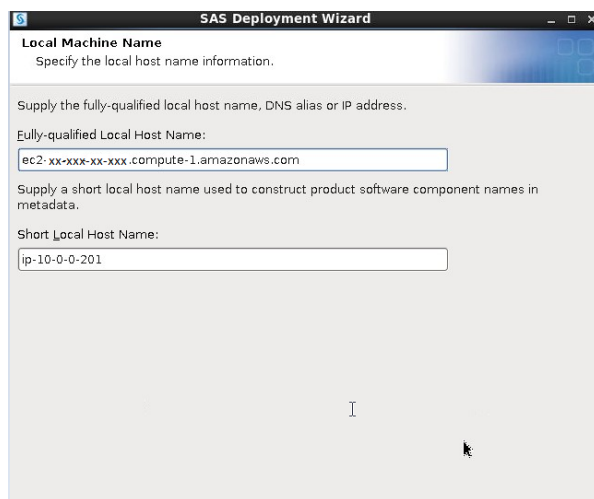
Specify Configuration Information
Specify the configuration directory and the level within the configuration directory to create your SAS software configuration.

The configuration directory indicates the path to the configuration of your software. The level identifies a unique instance of your configuration. The combination of a configuration directory and level constitute a complete software configuration, containing all the files necessary to operate the instance of the software.

Configuration Directory:

Configuration Level:

Display 37. Specify Configuration Information



SAS Deployment Wizard

Local Machine Name
Specify the local host name information.

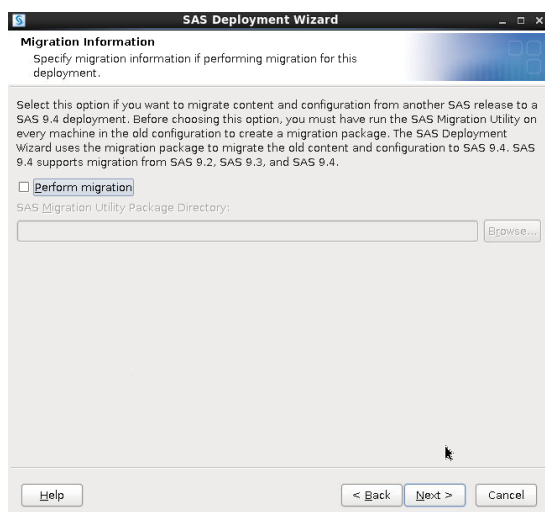
Supply the fully-qualified local host name, DNS alias or IP address.

Fully-qualified Local Host Name:

Supply a short local host name used to construct product software component names in metadata.

Short Local Host Name:

Display 38. Specify Local Host Name



SAS Deployment Wizard

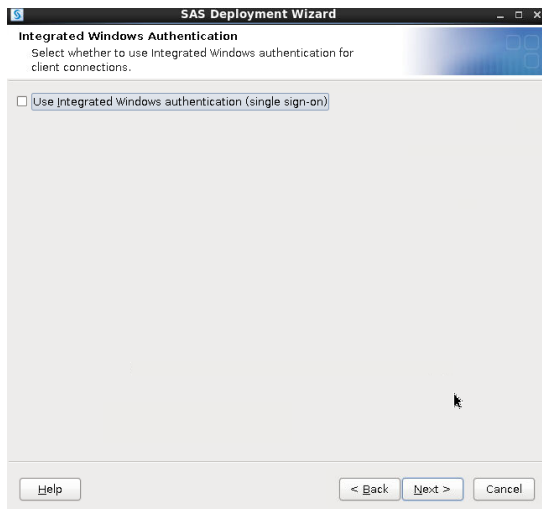
Migration Information
Specify migration information if performing migration for this deployment.

Select this option if you want to migrate content and configuration from another SAS release to a SAS 9.4 deployment. Before choosing this option, you must have run the SAS Migration Utility on every machine in the old configuration to create a migration package. The SAS Deployment Wizard uses the migration package to migrate the old content and configuration to SAS 9.4. SAS 9.4 supports migration from SAS 9.2, SAS 9.3, and SAS 9.4.

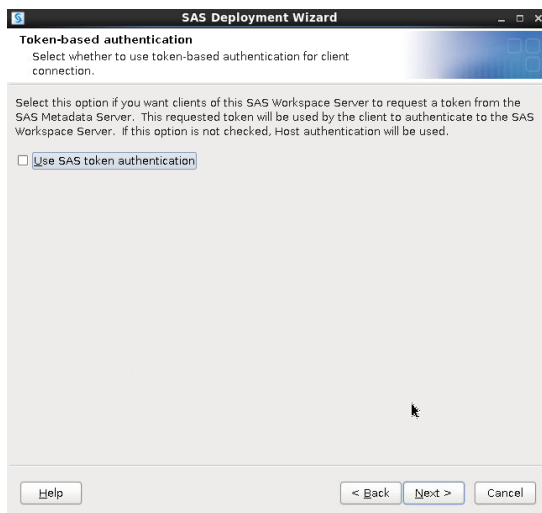
☐ ☒ **Perform migration**

SAS Migration Utility Package Directory:

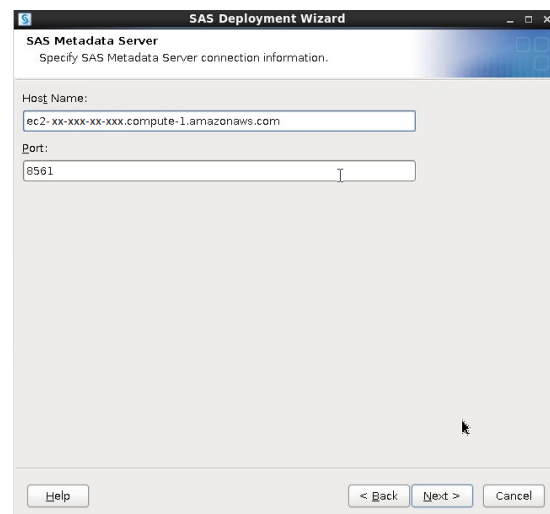
Display 39. Migration Information



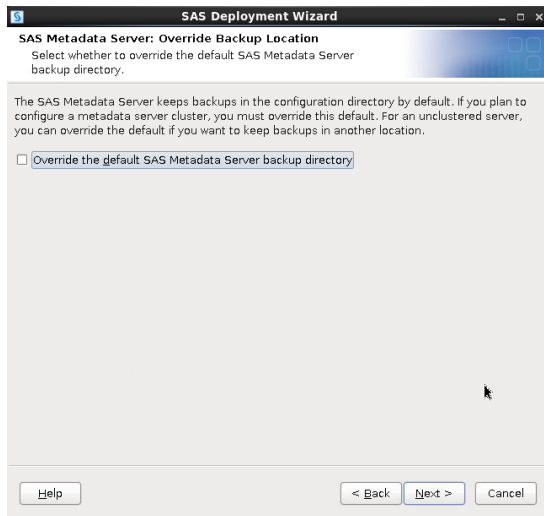
Display 40. Integrated Windows Authentication



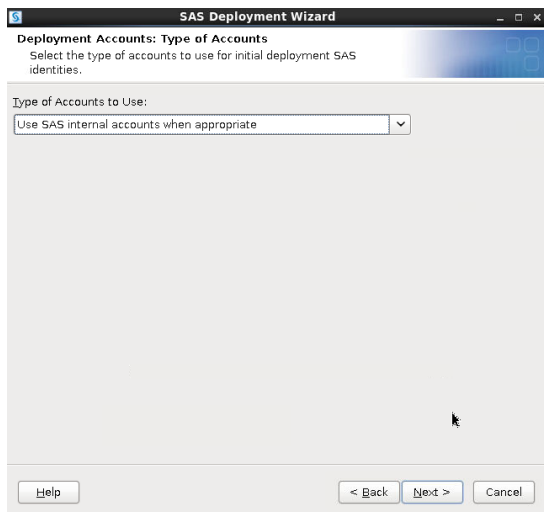
Display 41. Integrated Windows Authentication



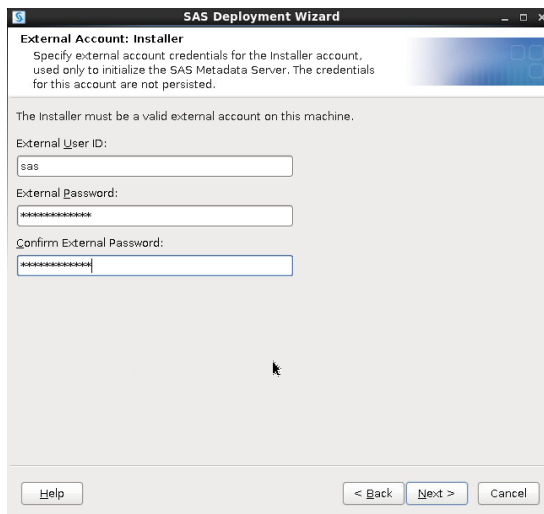
Display 42. SAS Metadata Server details



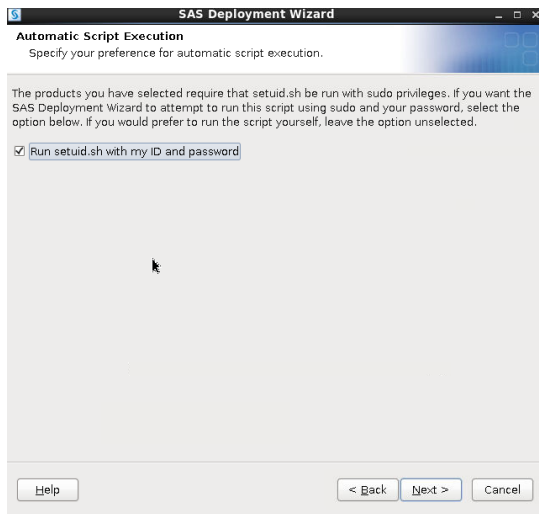
Display 43. SAS Metadata Server: Override Backup Location



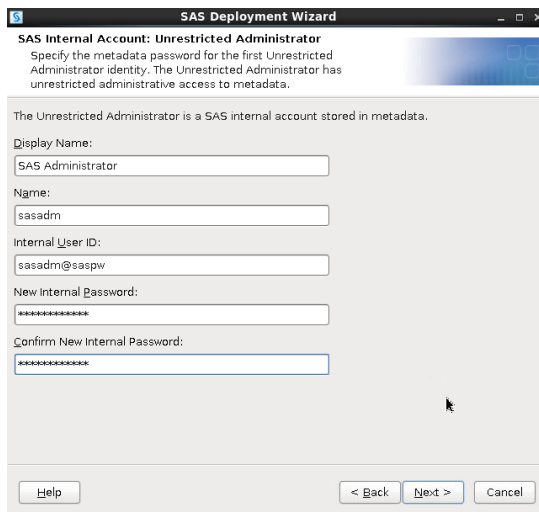
Display 44. Deployment Accounts: Type of Accounts



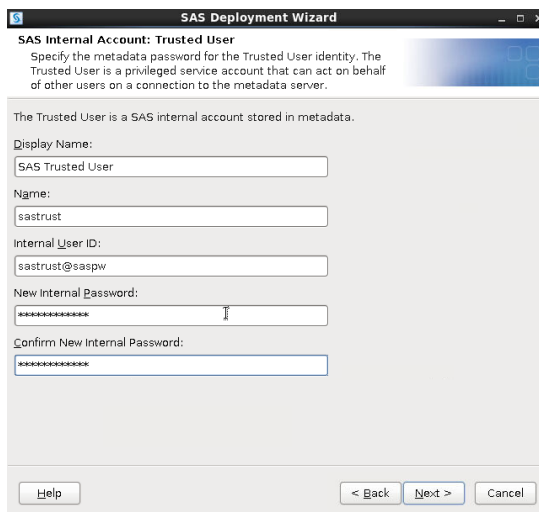
Display 45. External Account: Installer



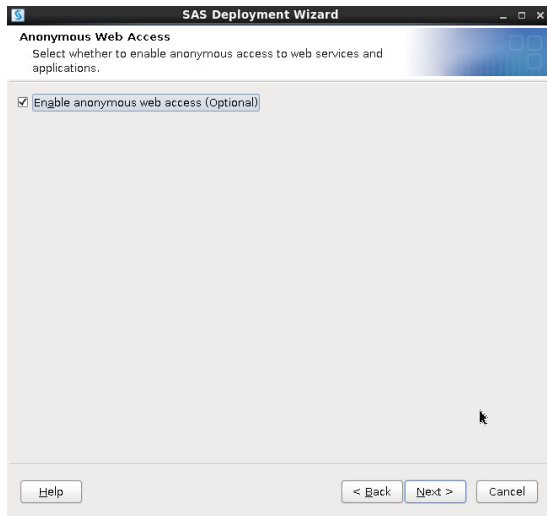
Display 46. Automatic Script Execution



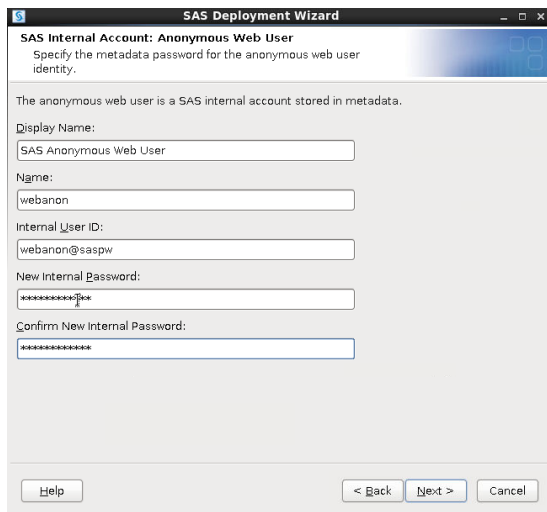
Display 47. SAS Internal Account: Unrestricted Administrator



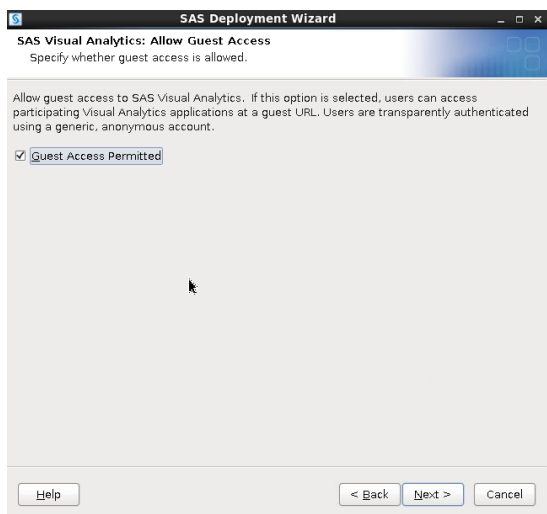
Display 48. SAS Internal Account: Trusted User



Display 49. Anonymous Web Access



Display 50. SAS Internal Account: Anonymous Web Access



Display 51. SAS Visual Analytics: Allow Guest Access

SAS Deployment Wizard

External Account: SAS Spawned Servers Account
Specify credentials for the SAS Spawned Servers account, used to launch back-end stored process and pooled workspace servers.

The SAS Spawned Servers account must be a valid external account on this machine.

External User ID:
sassrv

External Password:

Confirm External Password:

Help < Back Next > Cancel

Display 52. External Account: SAS Spawned Servers Account

SAS Deployment Wizard

Deployment Accounts: First User
Select whether to set up a First User identity for demonstration purposes.

☒ Set up a First User Identity (Optional)

Help < Back Next > Cancel

Display 53. Deployment Account: First User

SAS Deployment Wizard

External Account: First User
Specify an external user ID for the First User identity. The SAS Deployment Wizard does not validate credentials for this identity, so you do not enter a password.

The First User must be a valid external account on this machine.

Display Name:
SAS Demo User

Name:
sasdemo

External User ID:
sasdemo

Help < Back Next > Cancel

Display 54. External Account: First User

SAS Deployment Wizard

Server Encryption
Select the encryption settings to use when communicating with the SAS Metadata Server.

Server Encryption Level:
Credentials

Server Encryption Algorithm:
SAS Proprietary

Help < Back Next > Cancel

Display 55. Server Encryption

SAS Deployment Wizard

Estimated System Size
Specify the size of the system to be configured based on the expected number of users and the size of the workload.

Size Estimate:
Medium System

Help < Back Next > Cancel

Display 56. Estimated System Size

SAS Deployment Wizard

E-mail Server
Specify e-mail server information.

An unauthenticated SMTP e-mail server is used to send alert e-mail messages when the SAS Metadata Server encounters problems.

Host Name:
ec2-xx-xxx-xx-xxx.compute-1.amazonaws.com

Port:
25

Help < Back Next > Cancel

Display 57. E-mail Server details

SAS Deployment Wizard

E-mail Addresses
Specify the e-mail addresses that will be used when communicating with the system administrator.

Sender E-mail Address:
SAS_Server@ec2-xx-xxx-xx-xxx.compute-1.amazonaws.com

Recipient E-mail Address:
SAS_Server@ec2-xx-xxx-xx-xxx.compute-1.amazonaws.com

Specify whether your e-mail server requires authentication. You will be prompted for e-mail server credentials if you select this option.

☐ E-mail server requires authentication

Help < Back Next > Cancel

Display 58. E-mail Addresses

SAS Deployment Wizard

SAS Object Spawner
Specify SAS Object Spawner information.

Operator Port:
8581

Help < Back Next > Cancel

Display 59. SAS Object Spawner port selection

SAS Deployment Wizard

SAS Object Spawner: Port Bank
Specify SAS Object Spawner port bank ports.

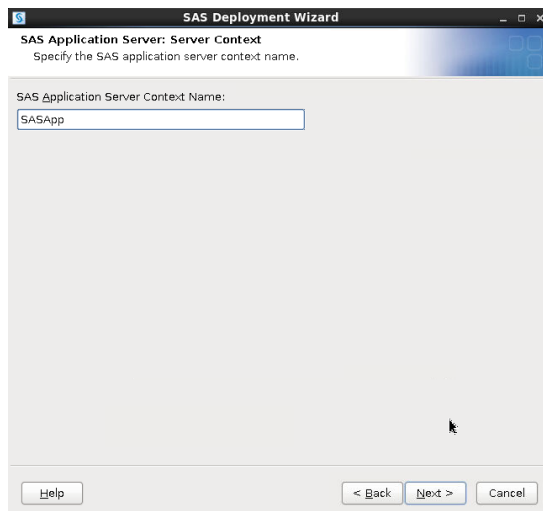
Port Bank Port 1:
8801

Port Bank Port 2:
8811

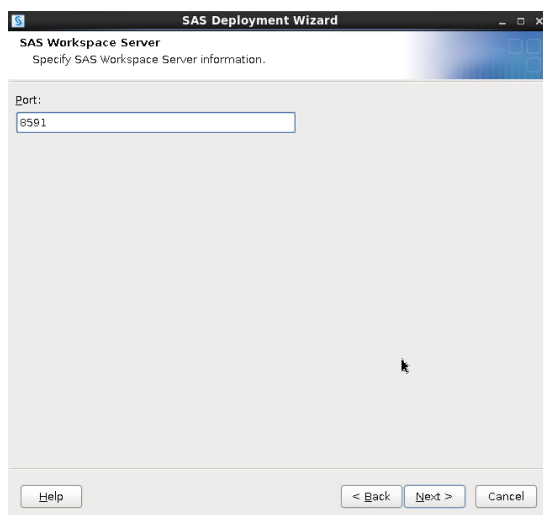
Port Bank Port 3:
8821

Help < Back Next > Cancel

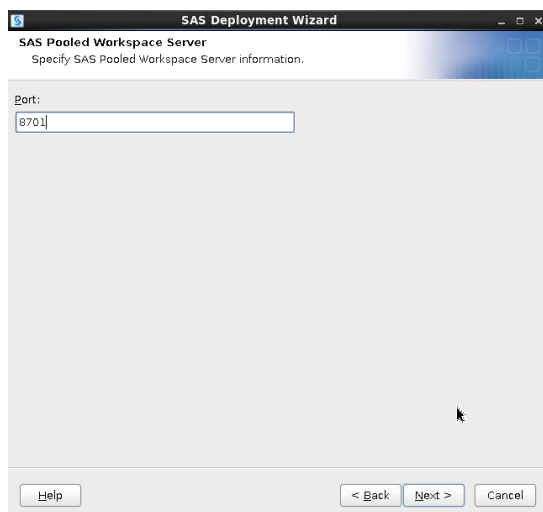
Display 60. SAS Object Spawner port bank



Display 61. SAS Application Server: Server Context



Display 62. SAS Workspace Server port



Display 63. SAS Pooled Workspace Server port

SAS Deployment Wizard

SAS Stored Process Server
Specify SAS Stored Process Server information.

Bridge Port:
8601

Help < Back Next > Cancel

Display 64. SAS Stored Process Server port

SAS Deployment Wizard

Stored Process Server: MultiBridge Connections
Specify multibridge connection information for the SAS Stored Process Server.

Multibridge Port 1:
8611

Multibridge Port 2:
8621

Multibridge Port 3:
8631

Help < Back Next > Cancel

Display 65. SAS Stored Process Server: MultiBridge Connections

SAS Deployment Wizard

SAS Web Infrastructure Platform Data Server
Specify information for SAS Web Infrastructure Platform Data Server.

Host Name:
ec2-xx-xxx-xx-xxx.compute-1.amazonaws.com

Port:
9432

Data Server Administrator:
dbmsowner

Data Server Administrator Password:

Confirm Password:

Help < Back Next > Cancel

Display 66. SAS Web Infrastructure Platform Data Server details

SAS Deployment Wizard

SAS DATA Step Batch Server
Specify SAS DATA Step Batch Server information.

Deployed Jobs Directory:
 [Browse...](#)

Deployed Jobs Directory Name:

[Help](#) [< Back](#) [Next >](#) [Cancel](#)

Display 67. SAS Data Step Batch Server

SAS Deployment Wizard

Operating System Services Scheduling Server
Specify the Operating System Services Scheduling Server information.

Port:

[Help](#) [< Back](#) [Next >](#) [Cancel](#)

Display 68. Operating System Services Scheduling Server

SAS Deployment Wizard

SAS Deployment Tester Server
Specify SAS Deployment Tester Server connection information.

Port:

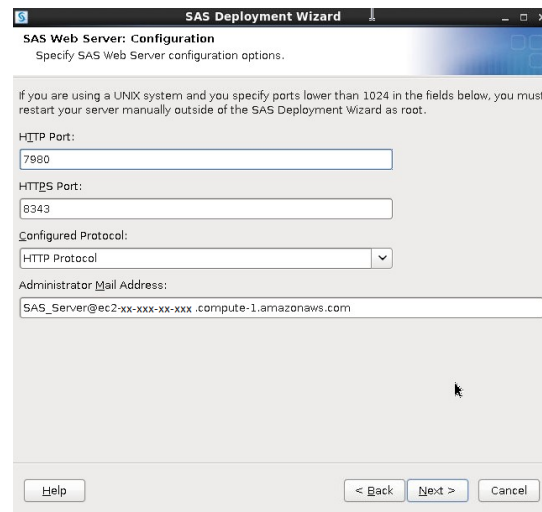
JUnit JAR File:
 [Browse...](#)

[Help](#) [< Back](#) [Next >](#) [Cancel](#)

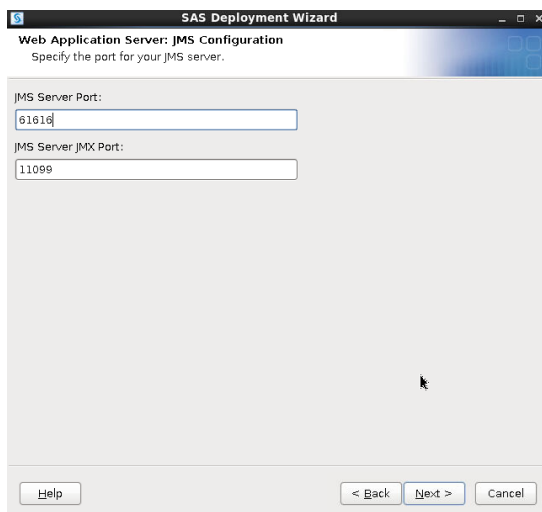
Display 69. SAS Deployment Tester Server details



Display 70. SAS Web Server: Automated or Manual Configuration Op



Display 71. SAS Web Server: Configuration



Display 72. SAS Web Application Server: JMS Configuration

SAS Deployment Wizard

Web Application Server: Cache Locator Configuration

Specify the port for your cache locator.

Cache Locator Port:
41415

Help < Back Next > Cancel

Display 73. SAS Web Application Server: Cache Locator Configuration

SAS Deployment Wizard

Web Application Server: Server Configuration

Specify the web application server information.

Server Name (a suffix is automatically added to the name in order to distinguish cluster membe...)
SASServer1

Help < Back Next > Cancel

Display 74. SAS Web Application Server: Server Configuration

SAS Deployment Wizard

Web Application Server: Server Ports

Specify the web application server information.

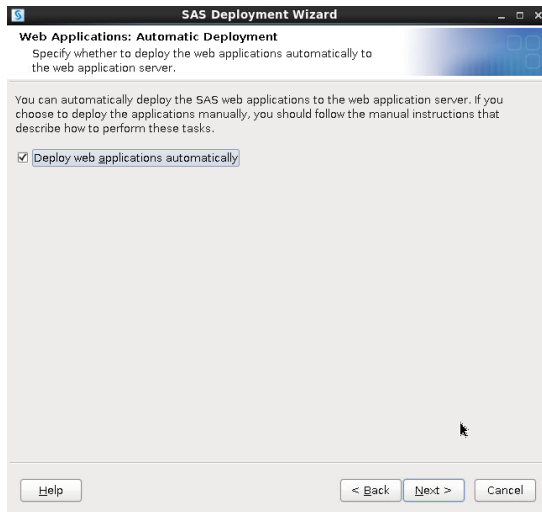
HTTP Port:
8080

JMX Port:
6969

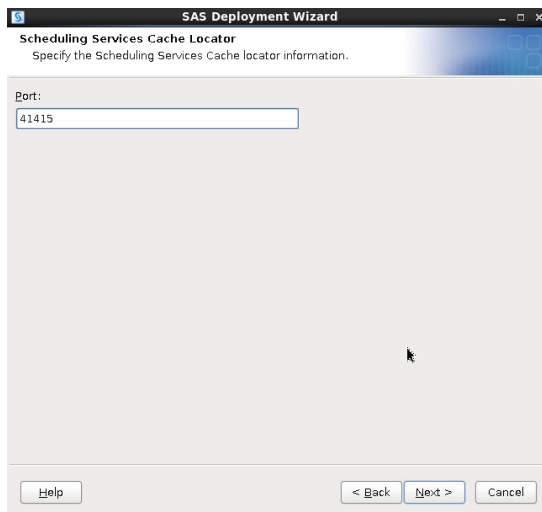
Cluster Member Multiplier:
1

Help < Back Next > Cancel

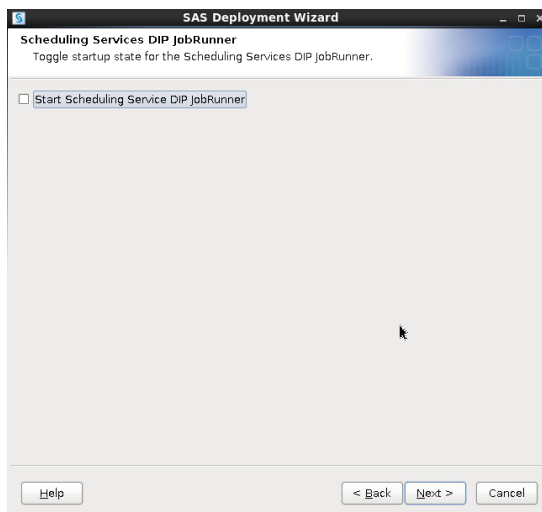
Display 75. SAS Web Application Server: Server Ports



Display 76. SAS Web Application Server: Automatic Deployment



Display 77. Scheduling Services Cache Locator



Display 78. Scheduling Services DIP JobRunner

SAS Deployment Wizard

SAS Web Application Themes
Specify information for SAS Web Application Themes

Host Name:
ec2-xx-xxx-xx-xxx.compute-1.amazonaws.com

Port:
7980

Configured Protocol:
HTTP Protocol

Help < Back Next > Cancel

Display 79. Web Application Themes

SAS Deployment Wizard

IP Multicast Version
Specify the IP version to use for the IP Multicast address.

Multiple IP versions are detected on this machine. Select the version appropriate for your environment.

IP Version:
IPv4

Help < Back Next > Cancel

Display 80. IP Multicast Version

SAS Deployment Wizard

IP Multicast
Specify IP Multicast information to allow status communication amongst applications.

A multicast group communications protocol is used to communicate among middle tier SAS applications in a single SAS deployment (the set of applications connected to the same SAS Metadata Server). The combination of multicast IP address and multicast UDP port should be different for each SAS deployment and also different from those used by other multicast applications at your site. The TTL and authentication token choices have security implications. The multicast group communication includes all information needed to bootstrap SAS mid-tier applications. Because this includes sending the SAS environment credentials (such as the "sasadm" account name and its password), scoping and encryption options are provided. The defaults are most appropriate for deployments in a firewall-isolated data center environment. See the help for more details.

IP Multicast Address:
239.0.0.201

IP Multicast UDP Port:
8561

IP Multicast TTL:
1

☐ Use an authentication token to connect.

Help < Back Next > Cancel

Display 81. IP Multicast details

SAS Deployment Wizard

SAS Content Server: Repository Directory
Specify the SAS Content Server repository directory.

Repository Directory:

☒ Start initial node as clustered. See Help for more details.

Display 82. SAS Content Server: Repository Directory

SAS Deployment Wizard

SAS Web Infrastructure Platform Database: JDBC Properties
Specify the connection information for the SAS Web infrastructure Database JDBC connection.

Database Name:

User ID:

Password:

Confirm Password:

Display 83. SAS Web Infrastructure Platform Database: JDBC Properties

SAS Deployment Wizard

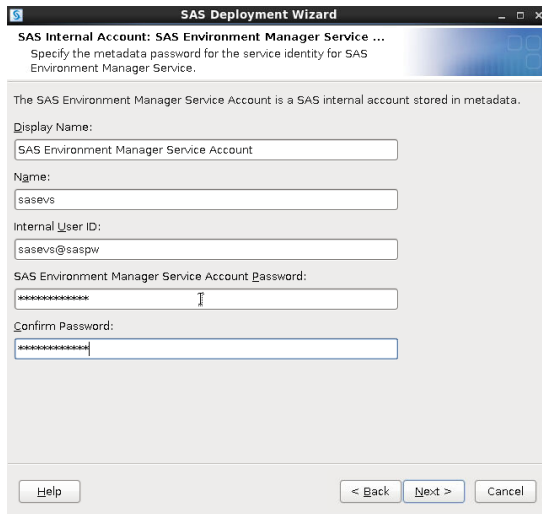
SAS Environment Manager: Administration Database Connection
Specify the SAS Environment Manager Administration database information.

User ID:

Password:

Confirm Password:

Display 84. SAS Environment Manager: Administration Database ID



SAS Deployment Wizard

SAS Internal Account: SAS Environment Manager Service ...
Specify the metadata password for the service identity for SAS Environment Manager Service.

The SAS Environment Manager Service Account is a SAS internal account stored in metadata.

Display Name:
SAS Environment Manager Service Account

Name:
sasevs

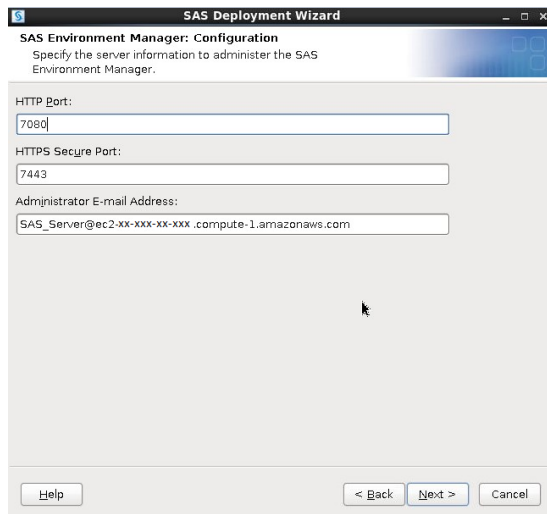
Internal User ID:
sasevs@saspsw

SAS Environment Manager Service Account Password:

Confirm Password:

Help < Back Next > Cancel

Display 85. SAS Internal Account: SAS Environment Manager Service



SAS Deployment Wizard

SAS Environment Manager: Configuration
Specify the server information to administer the SAS Environment Manager.

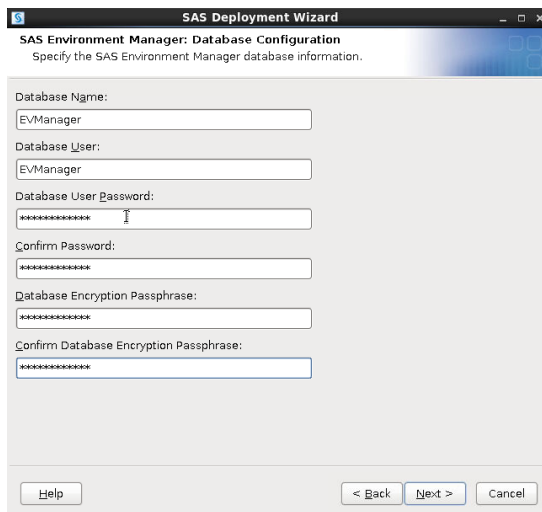
HTTP Port:
7080

HTTPS Secure Port:
7443

Administrator E-mail Address:
SAS_Server@ec2-xx-xx-xx-xx.compute-1.amazonaws.com

Help < Back Next > Cancel

Display 86. SAS Environment Manager: Configuration



SAS Deployment Wizard

SAS Environment Manager: Database Configuration
Specify the SAS Environment Manager database information.

Database Name:
EVManager

Database User:
EVManager

Database User Password:

Confirm Password:

Database Encryption Passphrase:

Confirm Database Encryption Passphrase:

Help < Back Next > Cancel

Display 87. SAS Environment Manager: Database Configuration

SAS Deployment Wizard
SAS Environment Manager Agent Configuration
 Specify the SAS Environment Manager/Agent information.

SAS Environment Manager Agent Listening Port:

Display 88. SAS Environment Manager Agent Configuration

SAS Deployment Wizard
SAS Flex Application Themes
 Specify information for SAS Flex Application Themes

Host Name:

Port:

Configured Protocol:
 ▾

Display 89. SAS Flex Application Themes

SAS Deployment Wizard
SAS Visual Analytics High-Performance Configuration Information
 SAS Visual Analytics High-Performance Configuration requires information about the SAS High-Performance Analytics environment. Specify the requested information.

SAS High-Performance Analytics Environment Host:

SAS High-Performance Analytics Environment Port:

Signature files location:

Display 90. SAS Visual Analytics High-Performance Configuration details

SAS Visual Analytics Public Data Provider
 SAS Visual Analytics library definition for public non-distributed data provider.

Data Reload Library Name:

Data Reload Libref:

Data Reload Path:

Help < Back Next > Cancel

Display 91. SAS Visual Analytics Public Data Provider

SAS Visual Analytics Public Data Library Information
 SAS Visual Analytics Public Data Library requires information about the SAS High-Performance Analytics environment. Specify the requested information.

SAS Visual Analytics Public Data Library Port:

Help < Back Next > Cancel

Display 92. SAS Visual Analytics Data Library Information

SAS Visual Analytics AutoLoad Location
 SAS Visual Analytics AutoLoad Location is the host directory from which tables are automatically loaded to memory.

SAS Visual Analytics AutoLoad Location:

Help < Back Next > Cancel

Display 93. SAS Visual Analytics Autoload Location

SAS Deployment Wizard

SAS Information Retrieval Studio
Specify information for SAS Information Retrieval Studio.

Host Name:
ec2-xx-xxx-xx-xxx.compute-1.amazonaws.com

Port:
10651

Help < Back Next > Cancel

Display 94. SAS Information Retrieval Studio

SAS Deployment Wizard

Search Interface to SAS Content Feeder Configuration
Specify feeder information for Search Interface to SAS Content.

Index Loader Interval in Minutes:
60

Help < Back Next > Cancel

Display 95. Search Interface to SAS Content Feeder Configuration

SAS Deployment Wizard

SAS Internal Account: Search Interface to SAS Content U...
Specify the metadata password for the Search Interface to SAS Content User identity.

The Search Interface to SAS Content User is a SAS internal account stored in metadata.

Display Name:
Search Interface to SAS Content User

Name:
sassearch

Internal User ID:
sassearch@saspw

New Internal Password:

Confirm New Internal Password:

Help < Back Next > Cancel

Display 96. SAS Internal Account: Search Interface to SAS Content

SAS Deployment Wizard
SAS Visual Analytics Administration: SAS LASR Analytic Se...
 Specify the library information.

Library Name:

Libref:

Display 97. SAS Visual Analytics Administration: SAS LASR Analytic Server

SAS Deployment Wizard
SAS Visual Analytics Services Database Credentials
 Specify the connection information for the SAS Visual Analytics Services Database JDBC connection.

User ID:

Password:

Confirm Password:

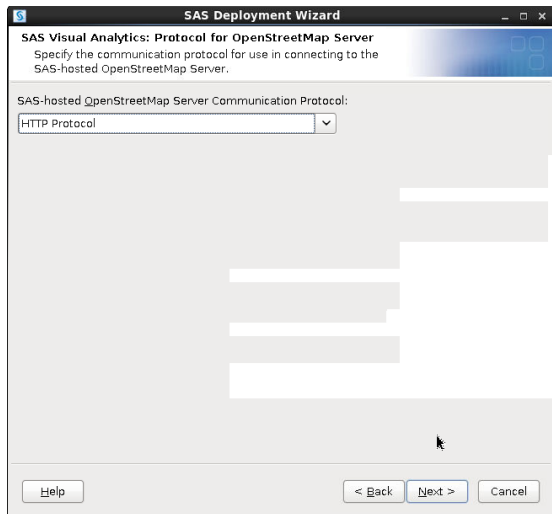
Display 98. SAS Visual Analytics Services Database Credentials

SAS Deployment Wizard
SAS Visual Analytics Transport Service: Whitelist Mobile ...
 Specify whether to enforce whitelisting for mobile devices.

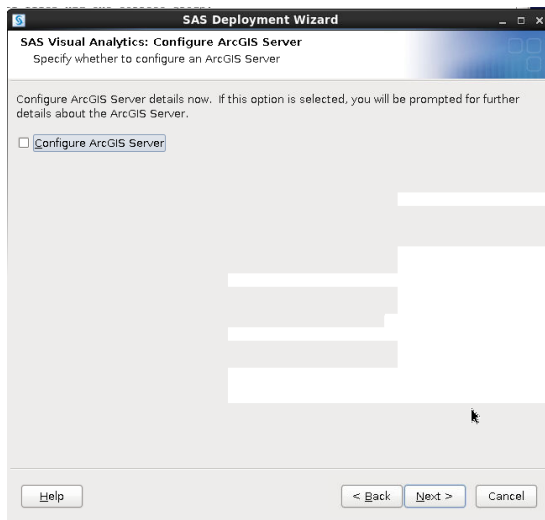
A deployment enforces either the blacklist or the whitelist. These features are mutually exclusive. If the whitelist is enforced, only those devices that are on the whitelist can use SAS Mobile BI.

☐ Enforce whitelist for mobile devices

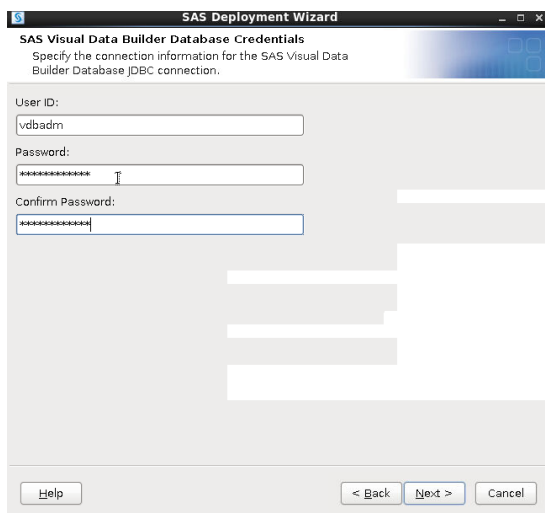
Display 99. SAS Visual Analytics Transport Service: Mobile Whitelist



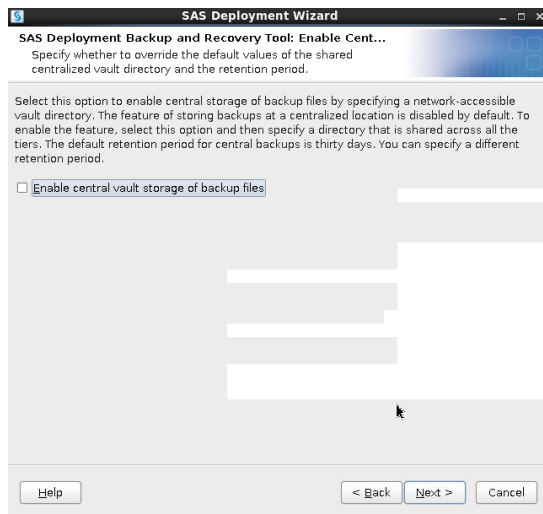
Display 100. SAS Visual Analytics: Protocol for OpenStreetMap Server



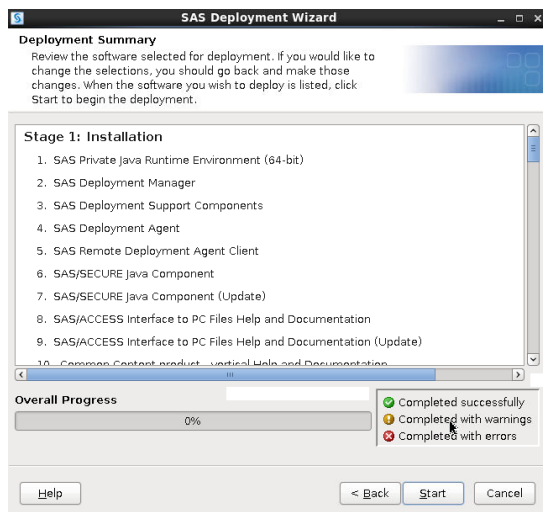
Display 101. SAS Visual Analytics: Configure ArcGIS Server



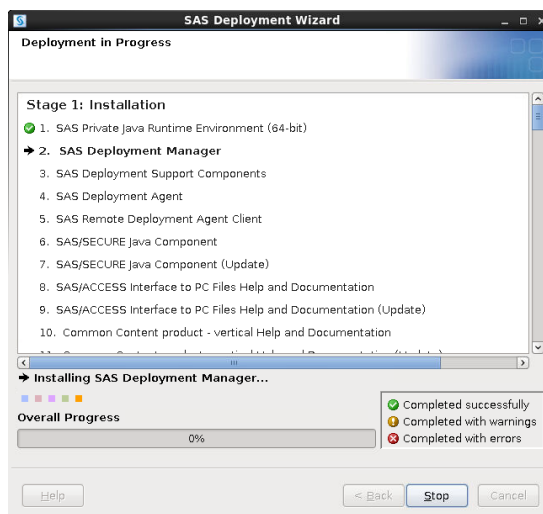
Display 102. SAS Visual Data Builder Database Credentials



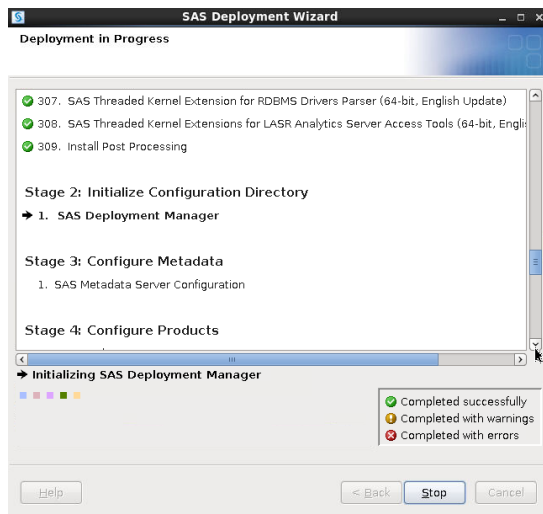
Display 103. SAS Deployment Backup and Recovery Tool: Enable Storage



Display 104. Deployment Summary



Display 105. Deployment in Progress (Installation steps occur in Stage 1)



Display 106. Deployment in Progress (Configuration steps at Stage 2)

COMPLETE SAS® 9.4 POST-INSTALLATION TASKS AND CONFIGURATION

The last remaining to do items to complete the SAS installation have to do with both efficiencies as well as practical items such as how to connect to a few of the SAS® 9.4 software clients.

34. Complete all the tasks and validations that are required in *instructions.html*, which is produced at the end of SAS® 9.4 deployment wizard installation/configuration process. Also, maintain a copy in your records of *DeploymentSummary.html*.
35. Review the following logs in the directory, \$HOME/.SASAppData/SASDeploymentWizard/9.4:
SDW.log, SDW_<date>.log, sdwprefs.txt
36. Create a home directory for each user to store SAS data and programs. For example, create a directory named /users and add a sub-directory for all users individually. Provide appropriate read/write permissions for each user.
37. Change the temp file WORK location for SAS users logged onto SAS clients from its default /tmp location to another chosen directory location. Create that new directory and provide appropriate permissions for SAS software to write to that directory. Add a new line at the bottom of the sasv9.cfg file in /sas_config_directory/Lev1/SASApp:
-work /temp_files_work_dir
40. [Set appropriate SAS option settings](#) [17] for the following:
MEMSIZE, SORTSIZE, BUFFSIZE, IBUFFSIZE, UBUFFSIZE, SGIO, WORKTERM, WORKINIT
These settings can be effected in the sasv9.cfg in
/sas_config_directory/Lev1/SASMeta/MetadataServer
The sub-optimal default for MEMSIZE, for example, is MAX. (max memory setting is not efficient)

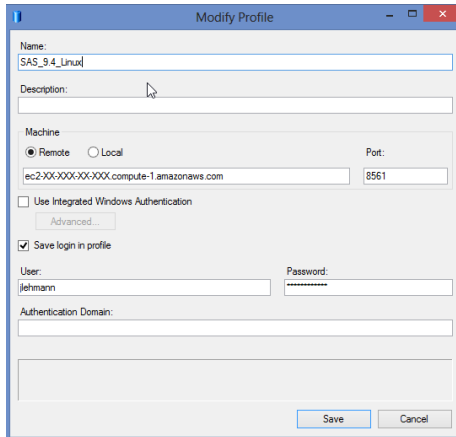
41. Install and configure SAS® 9.4 clients on your laptop. Here is a sample configuration setup for SAS® Enterprise Guide 7.1:

Name: **SAS9.4_Linux**

Port: **8561**

Machine: **ec2-XX-XXX-XX-XXX.compute-1.amazonaws.com**

(XX-XXX-XX-XXX is a mask for an IP Address. Your installation will have its own IP address)



Display 107. SAS® Enterprise Guide 7.1 client profile configuration

CONCLUSION

SAS administrators now have an additional, low-cost method to deploy a new test environment. The AWS method of deployment allows for quick, autonomous implementation of SAS® 9.4 by an informed SAS administrator. This paper's tactical, step-by-step perspective will hopefully be a helpful guide in setting up an AWS cloud instance of SAS® 9.4 for those looking beyond an enterprise data center's offerings.

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CONTACT INFORMATION

Your comments and questions are valued and encouraged. Contact the author at:

Name:	Jeff Lehmann
Enterprise:	Slalom Consulting
E-mail:	jeffl@slalom.com

Twitter: @jefflehmann

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