SAS Event Stream Processing for Edge Computing 4.3: Deployment Guide

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Introduction

About This Guide

SAS Event Stream Processing enables developers to build applications that can process and analyze a large number of continuously flowing events in real time. SAS Event Stream Processing for Edge Computing can also rapidly process streaming events near their source. Processing takes place on remote devices at the edges of your network or in the field.

The deployment process includes the installation of programming tools to build and execute event stream processing applications. SAS Event Stream Processing for Edge Computing also filters streaming event data for relevant information before sending data back to the SAS Event Stream Processing server for analysis and reporting.

Use this guide to deploy SAS Event Stream Processing for Edge Computing on the edges of your enterprise computing architecture.

To use this guide successfully, you should have a working knowledge of the Linux operating system and basic commands.

About Deployment on Edge Devices

The robust and flexible architecture of SAS Event Stream Processing provides many options for deploying the software. This guide includes separate chapters with information that is specific to each supported Linux platform. However, SAS generally recommends using a machine that runs Red Hat Enterprise Linux to serve as a secure administrative host (a "jump server") for deployment to your edge devices.

This guide describes steps to retrieve the SAS software (in RPM format) and to save it to a jump server. You can then deploy the software from the Linux machine to the devices that are running on the other supported platforms. SAS recommends creating a yum repository in order to retrieve the software from SAS secure repositories. The use of an APT repository on Ubuntu is recommended because, by default, an Ubuntu distribution lacks the two yum tools that are required to create a yum repository.

Contact SAS Technical Support

Technical support is available to all customers who license SAS software. However, we encourage you to engage your designated on-site SAS support personnel as your first support contact. If your on-site SAS support personnel cannot resolve your issue, have them contact SAS Technical Support to report your problem.

Before you call, explore the SAS Support website at support.sas.com/techsup/. This site offers access to the SAS Knowledge Base, as well as SAS communities, Technical Support contact options, and other support materials that might answer your questions.

When you contact SAS Technical Support, you are required to provide information, such as your SAS site number, company name, email address, and phone number, that identifies you as a licensed SAS software customer.

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System Requirements

Hardware Requirements

A single machine is the minimum requirement. SAS recommends using an additional Linux machine to serve as a jump server where a mirror repository is created. The same requirements apply to the jump server and to the deployment targets.

The following table describes a standard set of specifications for a machine where SAS Event Stream Processing for Edge Computing is deployed:

Hardware Requirements for SAS Event Stream Processing

Item	Recommended Level*
CPU	Dual or quad core x86_64 compatible processor
Memory	4 GB of available RAM
Disk Space	1 GB or more of free space for the installation

*The bare minimum requirements for an installation of SAS Event Stream Processing for Edge Computing are a single-core x86_64 compatible processor, 1 GB of available RAM, and 700 MB of free disk space. However, a minimum configuration is not recommended.

Operating System Requirements

Supported Operating Systems

The following operating systems are supported:

- Red Hat Enterprise Linux versions 6.7 (64-bit) and later within 6.*x*
- Red Hat Enterprise Linux versions 7.0 and later within 7.*x*
- Yocto Linux version 1.7.2 for x86
- Ubuntu Linux LTS version 14 and version 16

Linux Prerequisites

The typical Linux installation includes all the packages and libraries that SAS requires. Problems can occur if default packages were removed from the base operating system.

Before you start the deployment, verify that the numactl package is installed. The libnuma library, which is included with numactl, is also required.

Additional Linux Requirements

The SAS Event Stream Processing Engine libraries were built using gcc-4.4.7-16 and the Boost library 1.58. The Boost library 1.58 is automatically installed with SAS Event Stream Processing. The libraries where compiled using the following compiler options:

```
-D_REENTRANT
```

```
-D_THREAD_SAFE
```

All the SAS Event Stream Processing applications that you build with SAS Event Stream Processing Studio must also use the same compiler options.

The SAS Event Stream Processing 4.x libraries have been built using gcc-4.4.7-16 on Red Hat Enterprise Linux Server 6.7 using libc-2.12.so, libstdc++.so.6.0.13, and libgcc_s-4.4.7-20120601.so.1.

SAS Support for Alternative Operating Systems

SAS provides support on a limited basis for alternative operating system distributions that customers might select. For more information, see the official support policy statement at
http://support.sas.com/techsup/pcn/altopsys.html.

Software Requirements

Java Requirements

The Java Runtime Environment (JRE) must be installed on each machine where you install SAS Event Stream Processing components. Only the JRE is required; the full JDK is not required. For a list of supported JRE

distributions, see the following website:
https://support.sas.com/en/documentation/third-party-software-reference/viya/support-for-jre.html.

User Accounts

Verify the following prerequisites before you start the deployment:

- Administrator privileges are required for the Linux machine where you are launching the SAS software deployment.

- The user account that you are using for the deployment must have super user (sudo) access. To verify that the user ID is included in the sudoers file, run the following command:

    ```
    sudo -v
    ```

    To verify your sudoers privileges, run the following command:

    ```
    sudo -l
    ```

    Note: The ability to start a shell (with the `!SHELL` entry in some sudoers files) as root is not required.

During the software deployment, one required user account (sas) and one group (also named sas) are created for you unless they already exist. Because the sas account is required for the SAS Event Stream Processing Studio component to run during normal product operation, you must not delete it or change its name. It does not run as root. If you must log on to this account, use sudo to access it.

The following table describes the predefined sas user account:

Account Name and Group	Parameters	Purpose
sas; member of sas group	Non-login service account without user restrictions. No password; can add password after installation if desired. Password does not expire. Default user name is required until the installation is complete. Any post-installation changes to this account do not prevent future software updates.	Required for the installation. The installation process sets user and group ownership permissions on all of the installation files. This user must exist to enable ownership. After the installation has completed, this user account enables required components to run, including the web application server for SAS Event Stream Processing Studio.

Administrator privileges are not required after the installation to run SAS Event Stream Processing. The installation directory path enables write access per user group, and it is owned by the sas user. To grant permission to edit the configuration files, the administrator must add any user requiring write access to these files to the sas group.

(Optional) Encryption and Authentication

SAS Event Stream Processing provides optional encryption and authentication features. Both of these features require encryption libraries that are included in the SAS Event Stream Processing Encryption and Authentication Overlay package, which is installed automatically when you install SAS Event Stream Processing. You can then enable encryption with OpenSSL on TCP/IP connections within an event stream processing engine.

OpenSSL is included with the SAS Event Stream Processing Encryption and Authentication Overlay package. You can also configure SAS Event Stream Processing engines to require client authentication for SAS TCP/IP clients. Authentication and encryption apply to the following Event Stream Processing Engine APIs:

- C or Java Publish/Subscribe API

  - Connections that are created by a client that uses the C or Java Publish/Subscribe API to communicate with a SAS Event Stream Processing engine

  - Connections that are created by an adapter to communicate with a SAS Event Stream Processing engine

- Event Stream Processing XML Server HTTPS API

  - Connections that are created by the Event Stream Processing XML Client (dfesp_xml_client) to communicate with the Event Stream Processing XML server using the HTTPS protocol

  - Connections that are created by the Streamviewer component (streamviewer.html) to communicate with the Event Stream Processing XML server using the HTTPS protocol

If you set up authentication for a SAS Event Stream Processing server, you must then provide authentication tokens or credentials in Streamviewer. You can copy and paste the token directly into an appropriate dialog box in Streamviewer. Alternatively, you can specify a URL that supplies the token. Authentication tokens and credentials are cached for the duration of a Streamviewer session. For more information, see *SAS Event Stream Processing 4.3: Security*.

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Yum Installation on Red Hat Enterprise Linux

Installation Overview

Perform a series of steps to download the SAS Event Stream Processing for Edge Computing software and install it using yum. You can then use your preferred centralized management software to deploy SAS Event Stream Processing for Edge Computing on multiple targets from the local repository that you have created.

When you order SAS software, SAS sends a Software Order Email (SOE) to your business or organization. Your SOE includes information about the software order, including several file attachments. The following files are required for deployment:

- the license file

- certificates that enable access to your software from SAS repositories (PEM files)

- the ESP_Edge_Script.sh file, which contains customized commands that are required for accessing and downloading software from SAS repositories

This chapter contains the required steps to create a local yum repository, download the SAS software to the repository, and install the software for Red Hat Enterprise Linux. If you do not want to use a local yum repository, you can skip to .

Prepare the Yum Repository

The topics in this section explain how to deploy on a Red Hat Enterprise Linux platform using a yum repository. These topics assume that you are using a machine running Red Hat Enterprise Linux to retrieve the SAS software from secure repositories and to deploy it on edge devices that run on other platforms. Follow these steps to create a local copy of the secure SAS repositories.

Create and Use the setup_repos.sh File

To prepare the target host where you will create a local copy of the SAS software repository, copy the custom shell script file that was attached to your SOE to a directory where you can edit it.

Note: Some of the steps in this procedure require you to log on as the root user.

1 Copy the customized deployment script (ESP_Edge_Script.sh) and change its name to setup_repos.sh:

```
cp ESP_Edge_Script.sh setup_repos.sh
```

You now have two shell scripts. You will use the original script, ESP_Edge_Script.sh, when you install the software. For more information, see .

2 Use your preferred text editor to open setup_repos.sh.

3 Comment out the `Install` statement in setup_repos.sh by adding a number sign (#) to the beginning of the line. Here is an example:

```
# Install the software
# yum groupinstall "SAS Event Stream Processing"
```

4 Save and close setup_repos.sh.

5 As root, run setup_repos.sh to configure the required certificates and to locate the SAS hosted repositories. Running the script enables the repository mirror host to mirror the content.

Create and Use the createrepos.sh File

To prepare the target host where you will create the local copy of the SAS repository:

1 Install the required yum utilities package by running the following command:

```
sudo yum install createrepo yum-utils
```

2 Using a text editor, create a new file named createrepos.sh that contains the following content:

```
#!/bin/bash
rpm --import /etc/pki/sas/rpm-gpg/RPM-GPG-KEY-sas
mkdir -p /var/www/html/pulp/repos
for f in $(ls /etc/yum.repos.d/sas-esp*.repo | cut -f4 -d/ | sed s/.repo//g | grep -v sas-meta)
do
  reposync --gpgcheck -l -n --repoid=${f} \
          --download_path=/var/www/html/pulp/repos --downloadcomps --download-metadata
  cd /var/www/html/pulp/repos/${f}
  createrepo -v /var/www/html/pulp/repos/${f}/ -g comps.xml
done
```

3 Set the Execute bit for createrepos.sh:

```
sudo chmod +x createrepos.sh
```

4 Run createrepos.sh:

```
sudo ./createrepos.sh
```

Deploy the Software on the Local Machine

Perform these steps to install the SAS Event Stream Processing for Edge Computing components on the same machine. In other words, you install the software on the machine from which you manage configurations on the remote machines.

The software order email (SOE) that you received from SAS directs you to save the attached files to a directory on the host from which you will perform the installation. You must save those files before performing any steps in this section.

1 Verify that the entitlement certificates (PEM files that were attached to the SOE) have been saved in the same directory as the deployment shell script, ESP_Edge_Script.sh.

2 Use your preferred text editor to open the shell script.

3 Add the directory path where you saved the certificates and the shell script.

   Here is an example:

       CERTDIR=/opt/sas/installfiles

4 Save and close the edited shell script file.

5 (Optional) If you use FTP to move the files from the SOE to their final location, it is possible for the deployment shell script file to lose its Execute bit. To ensure that the file has the required Execute bit, run the following command:

   chmod +x ESP_Edge_Script.sh

6 Run the script:

       sudo ./ESP_Edge_Script.sh

Proceed to the final steps to complete your deployment.

Complete the Installation

The procedures in the following topics are required to complete the installation.

Apply the License

A valid license file is required in order to run any applications that use SAS Event Stream Processing for Edge Computing.

Your SOE contained a license file that you were instructed to save. Now you must apply the license file to the local machine by saving it to the license directory.

1 Locate the license file that you previously saved.

2 Copy the license file to the default license directory.

   Substitute the actual name of the license file in the following command:

       sudo cp *license-filename* /opt/sas/viya/home/SASEventStreamProcessingEngine/4.3.0/etc/license/

Set the Required Environment Variables

You must set several environment variables before you start SAS Event Stream Processing for Edge Computing. For a shell that is used to invoke SAS Event Stream Processing only, run the following commands:

```
export DFESP_HOME=/opt/sas/viya/home/SASEventStreamProcessingEngine/4.3.0
export LD_LIBRARY_PATH=$DFESP_HOME/lib:/opt/sas/viya/home/SASFoundation/sasexe
```

Start the Software

To start the SAS processes and to verify that the software is running:

1 On the machine where you installed SAS Event Stream Processing for Edge Computing, run the following command to start the Event Stream Processing XML server:

```
$DFESP_HOME/bin/dfesp_xml_server -http-admin 9900
```

The `-http-admin` argument runs the Event Stream Processing server as a factory server that supports the creation of projects. In the example, port 9900 is used for HTTP administration requests.

2 The following INFO message is displayed:

```
Access control disabled (could not open permissions.yml, error: file not found)
```

The file that is referenced is required only to enable access control on the Event Stream Processing server. You can ignore this message.

3 Validate the deployment. For more information, see .

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Installing on Yocto Linux

Installation Overview

The previous chapter provided instructions for installing the SAS Event Stream Processing for Edge Computing software directly onto a machine running Red Hat Enterprise Linux. Those instructions assumed that you could stage the software from a Linux jump server to devices on the edges of your network. Those steps also instructed you to download the software from SAS secure repositories and to run a customized deployment script in order to install the software locally.

On Yocto, you do not use the deployment script to deploy the software. You must create a local copy of the SAS repository before you deploy the software to the target devices. This chapter describes a series of steps to use reposync to download the SAS software and to install it from a yum repository. You can then use your preferred centralized management software to deploy SAS Event Stream Processing for Edge Computing to multiple targets from the local yum repository. SAS recommends that you use a machine that runs Red Hat Enterprise Linux as a jump server where the yum repository is created.

When you order SAS software, SAS sends a Software Order Email (SOE) to your business or organization. Your SOE includes information about the software order, including several file attachments. The following files are required for deployment:

- the license file

- certificates that enable access to your software from SAS repositories (*.pem files)

- the ESP_Edge_Script.sh file, which contains customized commands that are required for accessing and downloading software from SAS repositories

  Note: This script is not used for Yocto Linux deployments.

This chapter contains the required steps to create a local copy of the SAS software repository so that you can then install the software for Yocto Linux. The reposync steps that are performed on the jump server describe a Red Hat Enterprise Linux environment.

Prepare the Machine and Download the RPM Contents

First, identify a machine to which you can download and install multiple RPMs, which contain the SAS Event Stream Processing for Edge Computing software. You can then copy the entire repository that you have downloaded to the Yocto instance. Perform these steps:

1   As instructed in the SOE, save the two attached entitlement files and the license file to a directory on the machine where you plan to launch your deployment. Make sure that you have Write permission to the target directory.

    It is not necessary to copy the attached deployment script for an installation on Yocto Linux.

2   Install the reposync yum utility. Run the following command:

    ```
    sudo yum install yum-utils createrepo
    ```

3   Set the required environment variable for the entitlement certificates. Run the following command:

    ```
    export CERTDIR=$(pwd)
    ```

4   Download the RPMs. Run the following command:

    Note: Specify the commands on a single line. Multiple lines are used here to improve readability.

    ```
    curl -OLv --cert $CERTDIR/entitlement_certificate.pem
    --cacert $CERTDIR/SAS_CA_Certificate.pem
    https://ses.sas.download/ses/repos/meta-repo//sas-meta-repo-1-1.noarch.rpm
    ```

5   Install the RPMs that you downloaded. Run the following command:

    ```
    sudo yum install sas-meta-repo-1-1.noarch.rpm
    ```

6   Create a directory for the entitlement certificates. If **/etc/pki/sas/private** does not exist, create it. Run the following command:

    ```
    sudo mkdir -p /etc/pki/sas/private/
    ```

7   Copy the entitlement certificate to the **/etc/pki/sas/private/** directory. Run the following command:

    ```
    sudo cp $CERTDIR/entitlement_certificate.pem
    /etc/pki/sas/private/entitlement_certificate.pem
    ```

    You can run the following command to verify that entitlement_certificate.pem was copied:

    ```
    sudo ls /etc/pki/sas/private/
    ```

8   Install definitions of the specific repositories for the products in your SAS software order. Refer to the list of SAS repository paths to which you are entitled. This list was included in your SOE.

9   Run one or both of the following commands, as appropriate. Substitute the SAS repository paths that were listed in your SOE:

    ```
    sudo yum install "path-to-sas-espedge-repository"
    ```

    ```
    sudo yum install "path-to-sas-espanalyt-repository"
    ```

    Installation of sas-espanalyt (SAS Event Stream Processing Analytics) is optional. Here is an example of the full command syntax:

    ```
    sudo yum install "sas-espanalyt-100.0.0-x64_yocto_linux_1-yum"
    ```

```
"sas-espedge-100.0.0-x64_yocto_linux_1-yum"
```

10 For each SAS product that you ordered, download the entire repository using reposync. Run one or both of the following commands, as appropriate. Substitute the SAS repository paths that were listed in your SOE:

```
sudo reposync -r path-to-sas-espedge-repository
```

```
sudo reposync -r path-to-sas-espanalyt-repository
```

Downloading the sas-espanalyt (SAS Event Stream Processing Analytics) repository is optional. Here is an example of the full command syntax:

```
sudo reposync -r sas-espedge-100.0.0-x64_yocto_linux_1-yum
sudo reposync -r sas-espanalyt-100.0.0-x64_yocto_linux_1-yum
```

The next step is to transfer the RPMs that you downloaded to one or more target systems.

Install the Software on Yocto Linux

You have already downloaded the SAS RPMs that contain the SAS Event Stream Processing for Edge Computing software. Now you can copy the RPM contents to the Yocto machine that is the target of the SAS Event Stream Processing for Edge Computing deployment.

Note: SAS Event Stream Processing Analytics is an optional software package. Commands that use the **espanalyt** identifier apply to this optional installation. SAS recommends installing SAS Event Stream Processing Analytics at the same time as SAS Event Stream Processing.

1 Create one or two directories on the Yocto machine, as appropriate:

```
 mkdir espedge
 mkdir espanalyt
```

2 Copy the downloaded RPMs to the Yocto instance. On the machine where you used reposync to download the RPMs, run one or both of the following commands, as appropriate.

Note: Specify the commands on a single line. Multiple lines are used here to improve readability.

```
scp -r sas-espedge-100.0.0-x64_yocto_linux_1-yum
root@yocto-instance-IP-address:path-to-sas-espedge-repo
scp -r sas-espanalyt-100.0.0-x64_yocto_linux_1-yum
root@yocto-instance-IP-address:path-to-sas-espanalyt-repo
```

For *yocto-instance-IP-address*, substitute the IP address of the Yocto target machine. For *path-to-sas-espedge-repo* and *path-to-sas-espanalyt-repo*, substitute the actual path to your local repository.

3 On the Yocto machine target, run the following command to install the packages:

```
rpm -Uvh [ path-to-sas-espedge-repo/ ]*.rpm path-to-sas-espanalyt-repo/*.rpm
```

The *path-to-sas-espedge-repo* argument is optional. Specify the command on a single line. Multiple lines are used here to improve readability.

For *path-to-sas-espedge-repo* and *path-to-sas-espanalyt-repo*, substitute the actual path to your local repository.

Here is an example of the full command syntax:

```
rpm -Uvh espedge/sas-espedge-100.0.0-x64_yocto_linux_1-yum/*.rpm
espanalyt/sas-espanalyt-100.0.0-x64_yocto_linux_1-yum/*.rpm
```

Processing messages are displayed for the duration of the installation. Here is an example of a typical message that is displayed after the installation completes.

```
34:sas-tkstat          ########################### [100%]
```

Complete the Installation

The following procedures are required in order to complete the installation.

Apply the License

A valid license file is required in order to run any applications that use SAS Event Stream Processing for Edge Computing.

Your SOE contained a license file that you were instructed to save. Now you must apply the license file to the Yocto instance by saving it to the license directory.

1   Locate the license file that you previously saved.

2   From the machine where you used reposync to download the RPMs (the Linux jump server), copy the license file to the default license directory. Run the following command:

   Note: Specify the commands on a single line. Multiple lines are used here to improve readability.

   ```
   scp -r path/license-filename root@yocto-instance-IP-address:/opt/sas/viya/home/
   SASEventStreamProcessingEngine/4.3.0/etc/license/
   ```

   Substitute the actual path to the license file, including the license filename for *path/license-filename*. Substitute the IP address of the target Yocto machine for *yocto-instance-IP-address*.

Set the Required Environment Variables

You must set several environment variables before you start SAS Event Stream Processing for Edge Computing. For a shell that is used to invoke SAS Event Stream Processing only, run the following commands:

```
export DFESP_HOME=/opt/sas/viya/home/SASEventStreamProcessingEngine/4.3.0
export LD_LIBRARY_PATH=$DFESP_HOME/lib:/opt/sas/viya/home/SASFoundation/sasexe
```

Start the Software

To start the SAS processes and to verify that the software is running, perform these steps:

1   On the machine where you installed SAS Event Stream Processing for Edge Computing, run the following command to start the Event Stream Processing XML server:

   ```
   $DFESP_HOME/bin/dfesp_xml_server -http-admin 9900
   ```

   The `-http-admin` argument runs the Event Stream Processing server as a factory server, which supports the creation of projects. Port 9900 in the example corresponds to the adminport parameter, which designates the port that is used for HTTP administration requests.

2   The following INFO message is displayed:

   ```
   Access control disabled (could not open permissions.yml, error: file not found)
   ```

   The file that is referenced is required only to enable access control on the Event Stream Processing server. You can ignore this message.

3   Validate the deployment. For more information, see .

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Installing on Ubuntu Linux

Installation Overview

Perform a series of steps to install SAS software on Debian Ubuntu operating systems. Installation options are slightly different for the two supported versions of Ubuntu (14 and 16). For Ubuntu 14, create and use an APT mirror repository that you can then use to push the software to edge devices. For Ubuntu 16, you can either create an APT repository or install the software directly, using a customized deployment script.

In both cases, you retrieve the SAS software on a machine that can serve as a jump server. You can then use your preferred centralized management software to deploy SAS Event Stream Processing for Edge Computing on multiple targets from the local repository that you have created on a machine or VM image running Ubuntu Linux.

When you order SAS software, SAS sends a Software Order Email (SOE) to your business or organization. Your SOE includes information about the software order, including several file attachments. The following files are required for deployment:

- the license file

- certificates that enable access to your software from SAS repositories (PEM files)

- the ESP_Edge_Script.sh file, which contains customized commands that are required for accessing and downloading software from SAS repositories

  Note: This script is not used for Ubuntu Linux 14 deployments.

This chapter contains the required steps to create an APT repository and to install the software for Ubuntu Linux.

Install the Software Using a Local APT Repository Mirror

To install on Ubuntu 14, prepare and then populate a local repository in Advanced Packaging Tool (APT) format. APT is an open-source package management tool that handles dependencies automatically. You can secure it with GNU Privacy Guard (GPG) keys. An APT repository is optional for Ubuntu 16. To skip the repository creation steps, proceed to "Deploy the Software on the Local Machine (Ubuntu 16 Only)" on page 18.

Prepare the Machine

Perform the following steps to prepare your environment to allow access to the SAS repositories:

1 Update the APT repository packages cache. Run the following commands to download and to install APT software updates and certificates:

```
sudo apt-get update
sudo apt-get install apt-transport-https openssl ca-certificates
```

2 Install the apt-mirror utility. Run the following command:

```
sudo apt-get install apt-mirror
```

3 Install the certificates that were included in your software order email (SOE). Run the following commands to create the work directory, to export the certificates, and to copy them:

```
sudo mkdir -p /etc/ssl/sas

export CERTDIR=$(pwd)
export CA_PATH=/etc/ssl/sas/SAS_CA_Certificate.pem
export CERT_PATH=/etc/ssl/sas/entitlement_certificate.pem

sudo cp -v $CERTDIR/SAS_CA_Certificate.pem $CA_PATH
sudo cp -v $CERTDIR/entitlement_certificate.pem $CERT_PATH
sudo chmod 644 /etc/ssl/sas/entitlement_certificate.pem
sudo chmod 644 /etc/ssl/sas/SAS_CA_Certificate.pem
```

Note: On Ubuntu 16, run the following additional command:

```
sudo chown -R _apt:root /etc/ssl/sas
```

Create the Local APT Repository

Use the apt-mirror utility to configure the APT repository. You installed the utility when you updated your APT repository packages cache.

Perform the following steps to configure the apt-mirror utility:

1 The apt-mirror utility requires a skeleton directory structure. To create the skeleton directories, run the following commands:

```
sudo mkdir -p /mirrors/sas/mirror
sudo mkdir -p /mirrors/sas/var
sudo mkdir -p /mirrors/sas/skel
```

2 Change directories to the **/mirrors** directory that you created previously:

```
cd /mirrors
```

3 The apt-mirror configuration file contains some default settings. Modify the file to add a list of the present entitlement certificates. Use your preferred text editor to modify the root user's .wgetrc file. Here is an example:

```
sudo vi /root/.wgetrc
```

4 Add the following entries:

```
certificate=/etc/ssl/sas/entitlement_certificate.pem
private_key=/etc/ssl/sas/entitlement_certificate.pem
ca_certificate=/etc/ssl/sas/SAS_CA_Certificate.pem
```

Note: When mirror configuration has completed, you can remove these entries.

5 Create a file named sas_mirror.list to provide the locations for the installation and the download from SAS:

```
sudo vi sas_mirror.list
```

You must supply the paths to the SAS software repositories to which you are entitled. These paths are listed in your SOE.

Here is an example of sas_mirror_list:

```
set base_path /mirrors/sas/
set mirror_path /mirrors/sas/mirror
set skel_path /mirrors/sas/skel
set var_path /mirrors/sas/var
set run_postmirror 1

deb-amd64 https://path-to-mirror-repository/espedge stable main
deb-amd64 https://path-to-mirror-repository/espanalytics stable main
clean https://ses.sas.download
```

Note: The path to the SAS Event Stream Processing Analytics repository (espanalytics) is optional. This path is included in your SOE only if you ordered SAS Event Stream Processing Analytics.

6 To specify the sas_mirror.list file as the configuration file for the apt-mirror utility, run the following command:

```
sudo apt-mirror sas_mirror.list
```

You are now ready to install SAS Event Stream Processing for Edge Computing using the local APT repository, which will function as a mirror of SAS software repositories.

Create a List of Repository Sources

When you have configured your APT repository for the SAS Event Stream Processing for Edge Computing installation, you are ready to install the software.

Create a list of repository sources to be mirrored. Run the following command:

```
sudo vi /etc/apt/sources.list.d/sas.list
```

The contents of your list should resemble the following:

```
deb [arch=amd64] file:/mirrors/sas/mirror/ses.sas.download/ses/deb/shipped/espedge/
    /path-to-espedge-repository
deb [arch=amd64] file:/mirrors/sas/mirror/ses.sas.download/ses/deb/shipped/espanalyt/
    /path-to-espanalyt-repository
```

For */path-to-espedge-repository* and */path-to-espanalyt-repository*, substitute the paths to the SAS repositories that are listed in your SOE. The espanalyt repository is optional.

Here is an example of the full syntax:

```
deb [arch=amd64] file:/mirrors/sas/mirror/ses.sas.download/ses/deb/shipped/espedge/100.0/
    espedge-100.0.0-x64_ubuntu_linux_14-apt-latest stable main
deb [arch=amd64] file:/mirrors/sas/mirror/ses.sas.download/ses/deb/shipped/espanalyt/100.0/
    espanalyt-100.0.0-x64_ubuntu_linux_14-apt-latest stable main
```

Install the Software on the Local Machine

Perform these steps to retrieve and then install the SAS Event Stream Processing for Edge Computing components on the local machine.

1   Update the repositories. Run the following command:

```
sudo apt-get update
```

2   Search for SAS Event Stream Processing software in the repositories. Run the following command:

```
sudo apt-cache search sas-espbase
```

(Optional) Search for SAS Event Stream Processing Analytics software:

```
sudo apt-cache search sas-espanalyt
```

3   Install the software. Run the following command:

Note: Specify the commands on a single line. Multiple lines are used here to improve readability.

```
sudo apt-get --allow-unauthenticated install $(apt-cache search 'sas-'
| egrep '^sas-' | awk '{print $1}')
```

This command also installs any optional packages such as SAS Event Stream Processing Analytics.

For Ubuntu 16, perform the steps in the next section to complete the installation. Otherwise, skip to "Complete the Installation" on page 19 for the next steps to perform.

Deploy the Software on the Local Machine (Ubuntu 16 Only)

Follow these steps to perform a same-machine installation. On Ubuntu 16, you can deploy the SAS Event Stream Processing for Edge Computing components directly on the local machine. For example, you might perform these steps on the server from which you manage configurations on remote machines.

Note: This type of installation is not supported on Ubuntu 14.

The software order email (SOE) that you received from SAS directs you to save the attached files to a directory on the host from which you will perform the installation. You must save those files before performing any steps in this section.

1   Verify that the entitlement certificates (PEM files that were attached to the SOE) have been saved in the same directory as the deployment shell script, ESP_Edge_Script.sh.

2   Use your preferred text editor to open the shell script.

3   Add the directory path where you saved the certificates and the shell script.

Here is an example:

```
CERTDIR=/opt/sas/installfiles
```

4   Save and close the edited shell script file.

5   (Optional) If you use FTP to move the files from the SOE to their final location, it is possible for the deployment shell script file to lose its Execute bit. To ensure that the file has the required Execute bit, run the following command:

```
chmod +x ESP_Edge_Script.sh
```

6   Run the script:

```
sudo ./ESP_Edge_Script.sh
```

Proceed to the final steps to complete your deployment. For more information, see "Complete the Installation."

Complete the Installation

The procedures in the following topics are required to complete the installation.

Apply the License

A valid license file is required in order to run any applications that use SAS Event Stream Processing for Edge Computing.

Your SOE contained a license file that you were instructed to save. Now you must apply the license file to the local machine by saving it to the license directory.

1   Locate the license file that you previously saved.

2   Copy the license file to the default license directory.

Substitute the actual name of the license file in the following command:

```
sudo cp license-filename /opt/sas/viya/home/SASEventStreamProcessingEngine/4.3.0/etc/license/
```

Set the Required Environment Variables

You must set several environment variables before you start SAS Event Stream Processing for Edge Computing. For a shell that is used to invoke SAS Event Stream Processing only, run the following commands:

```
export DFESP_HOME=/opt/sas/viya/home/SASEventStreamProcessingEngine/4.3.0
export LD_LIBRARY_PATH=$DFESP_HOME/lib:/opt/sas/viya/home/SASFoundation/sasexe
```

Start the Software

To start the SAS processes and to verify that the software is running:

1   On the machine where you installed SAS Event Stream Processing for Edge Computing, run the following command to start the Event Stream Processing XML server:

```
$DFESP_HOME/bin/dfesp_xml_server -http-admin 9900
```

The `-http-admin` argument runs the Event Stream Processing server as a factory server that supports the creation of projects. In the example, port 9900 is used for HTTP administration requests.

2   The following INFO message is displayed:

```
Access control disabled (could not open permissions.yml, error: file not found)
```

The file that is referenced is required only to enable access control on the Event Stream Processing server. You can ignore this message.

3   Validate the deployment. For more information, see "Validating the Deployment" on page 21.

6

Validating the Deployment

Verify the Installed Packages

The steps that you can take to verify that all of your software has been installed are different if you installed on Red Hat Enterprise Linux, Yocto Linux, or Ubuntu platforms.

Validate the SAS RPM Packages

When you deployed on Red Hat Enterprise Linux or Yocto Linux, your SAS software was delivered in RPM (Red Hat Package Manager) packages. You can check these packages for errors after you have installed them.

To obtain a list of all SAS Event Stream Processing RPM packages that are deployed on your system, run the following command:

```
rpm -qa sas-esp*
```

Then you can run this basic command to verify an individual RPM package from the list that is returned:

```
rpm -Vv package-name
```

The full name of each RPM is not required. For example, to verify the contents of the sas-espexam-4.3.0-20170109.060004533214.x86_64 package, run the following command:

```
rpm -Vv sas-espbase
```

Note: Run the above commands for each host on which you have deployed SAS Event Stream Processing and its optional web application components.

You can also create a for loop command for verifying multiple packages that share a common naming convention. For example, to verify all packages whose names begin with `sas-`, use the following query:

```
for i in $(rpm -qa | grep -e "^sas-");do rpm -Vv $i;done
```

A successful verification shows the list of files that make up the RPM and with no error indicators, as follows:

```
rpm -Vv sas-espexam
......... /opt/sas/viya/home/lib/esp/sas-init-functions
```

An unsuccessful verification provides error indicators beside the filename. Here is an example:

```
rpm -Vv sas-espexam
package sas-espexam is not installed
```

The error indicators are shown in the following format:

```
SM5DLUGT c
```

In addition, if a file is missing, the error message contains the word "missing":

```
missing  /opt/sas/viya/home/lib/esp/sas-init-functions
```

The meaning of each error indicator is described as follows:

- S - file size

  RPM keeps track of file sizes. A difference of even one byte triggers a verification error.

- M - file mode

  The permissions mode is a set of bits that specifies access for the file's owner, group members, and others. Even more important are two additional bits that determine whether a user's group or user ID should be changed if they execute the program that is contained in the file. Since these bits permit any user to become root for the duration of the program, you must be cautious with a file's permissions.

- 5 - MD5 checksum

  The MD5 checksum of a file is a 128-bit number that is mathematically derived from the contents of the file. The MD5 checksum conveys no information about the contents of the original file, but, any change to the file results in a change to the MD5 checksum. RPM creates MD5 checksums for all files that it manipulates, and stores the checksums in its database. If one of these files is changed, the MD5 checksum changes and the change is detected by RPM.

- D - major and minor numbers

  Device character and block files contain a major number. The major number is used to communicate information to the device driver that is associated with the special file. For example, under Linux, the special files for SCSI disk drives should have a major number of 8, and the major number for an IDE disk drive's special file should be 3. Any change to a file's major number could produce disastrous effects. RPM tracks such changes.

  A file's minor number is similar to the major number, but conveys different information to the device driver. For disk drives, this information can consist of a unit identifier.

- L - symbolic link

  If a file is a symbolic link, RPM checks the text string that contains the name of the symbolically linked file.

- U - file owner

  Most operating systems keep track of each file's creator, primarily for resource accounting. Linux and UNIX also use file ownership to help determine access rights to the file. In addition, some files, when executed by a user, can temporarily change the user's ID, normally to a more privileged ID. Therefore, any change of file ownership might have significant effects on data security and system availability.

- G - file group

  Similar to file ownership, a group specification is attached to each file. Primarily used for determining access rights, a file's group specification can also become a user's group ID if that user executes the file's contents. Therefore, any changes in a file's group specification are important and should be monitored.

- T - modification time

  Most operating systems keep track of the date and time that a file was last modified. RPM keeps modification times in its database.

- c - configuration file

  This is useful for quickly identifying configuration files, since they are likely to change and therefore are unlikely to verify successfully.

Validate the SAS Packages on Ubuntu

When you install SAS Event Stream Processing for Edge Computing on Ubuntu platforms, the software is copied to your machine in DEB packaging format. You can use the dpkg and debsums utilities to validate the deployment. Perform the following steps to check the SAS packages for errors after you have completed the installation:

1 On the machine where you installed the SAS packages from the SAS repositories, run the following commands to verify the packages:

```
dpkg -l | grep -i sas
```

A list of installed packages is returned.

2 Validate the MD5 checksums of all files that have them. For files that do not have MD5 checksums, use dpkg to verify them. Run the following commands to install debsums and to perform validation:

```
sudo apt-get install debsums

debsums $(dpkg -l | awk '{print $2}' | grep -e "^sas-")

dpkg -V sas-tasksel
```

3 Check the return codes for errors. Here is an example of the output showing typical return codes:

```
??5??????   /usr/share/tasksel/sas.desc
```

- A '?' character indicates that the check could not be performed. For example, permissions on the file might not allow a check.

- A '.' character indicates that the check passed.

- An alphanumeric character indicates that a specific check failed.

- A '5' in the third position indicates the MD5 checksum verification. A '5' is typically followed by a space, an attribute character, and then another space before the path to the file whose checksum was verified.

7

Next Steps

Directory Structure and Permissions

After you install SAS Event Stream Processing, the files for the engine, the user interface components, and the authentication package are located in the following directory:

`/opt/sas/viya/home/SASEventStreamProcessingEngine/`

Configuration files for adapters and logs are located in the following directory:

`/opt/sas/viya/config/etc/SASEventStreamProcessingEngine/default`

Later, if you update your deployment, the configuration files are not altered.

The basic directory path enables write access per user group, and it is owned by the sas user. To grant permission to users to edit the configuration files, the administrator must add them to the sas group.

Product Documentation

After you install, configure, and verify the deployment, you are ready to begin writing applications that capture and analyze streaming event data in real time.

The next step is to consult the product documentation. The product documentation is included in SAS Help Center. A link to all SAS Event Stream Processing documentation is available on the SAS Event Stream Processing product page. SAS recommends starting with *SAS Event Stream Processing 4.3: Overview*, which provides an introduction to product features and explains how to proceed with creating event stream processing models and incorporating them into applications.

8

Uninstalling SAS Event Stream Processing

Uninstall SAS Event Stream Processing

Use yum or apt-get to uninstall your SAS software. The steps provided are specific to the supported Linux platforms.

If you have questions about removing a specific file, you might want to consult a professional. For more information, see Contact SAS Technical Support on page 2.

Uninstall from Red Hat Enterprise Linux or Yocto Linux

Perform the following steps to uninstall SAS Event Stream Processing for Edge Computing from Red Hat Enterprise Linux or Yocto Linux machines:

1 Remove the license file:

```
sudo rm /opt/sas/viya/home/SASEventStreamProcessingEngine/4.3.0/etc/license/license-filename.txt
```

For *license-filename.txt*, substitute the filename of the license file that you received as an attachment to your SOE.

2 Uninstall the SAS Event Stream Processing software. Run the following command:

```
rpm -e $(rpm -qg SAS)
```

3 Remove the entitlement certificate. Run the following command on the jump server:

```
sudo rm /etc/pki/sas/private/entitlement_certificate.pem
```

Uninstall from Ubuntu Linux

Perform the following steps to uninstall SAS Event Stream Processing for Edge Computing from Ubuntu Linux machines:

1 Remove the license file:

```
sudo rm /opt/sas/viya/home/SASEventStreamProcessingEngine/4.3.0/etc/license/license-filename.txt
```

For *license-filename.txt*, substitute the filename of the license file that you received as an attachment to your SOE.

2   Uninstall the SAS Event Stream Processing software by running the following command:

Note: Specify the commands on a single line. Multiple lines are used here to improve readability.

```
sudo apt-get remove --purge $(sudo dpkg -l | grep SAS | grep "^rc"
| awk '{print $2}' | tr '\n' ' ')
```

This command also removes any additional products that were included in your SAS Event Stream Processing order, such as SAS Event Stream Processing Analytics. It also removes all residual packages, including configuration files.

3   Remove the entitlement certificate. Run the following command on the jump server:

```
sudo rm /etc/pki/sas/private/entitlement_certificate.pem
```