GE VERNOVA

DIGITAL

EDGE OS

User Guide

GE VERNOVA

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doc@ge.com

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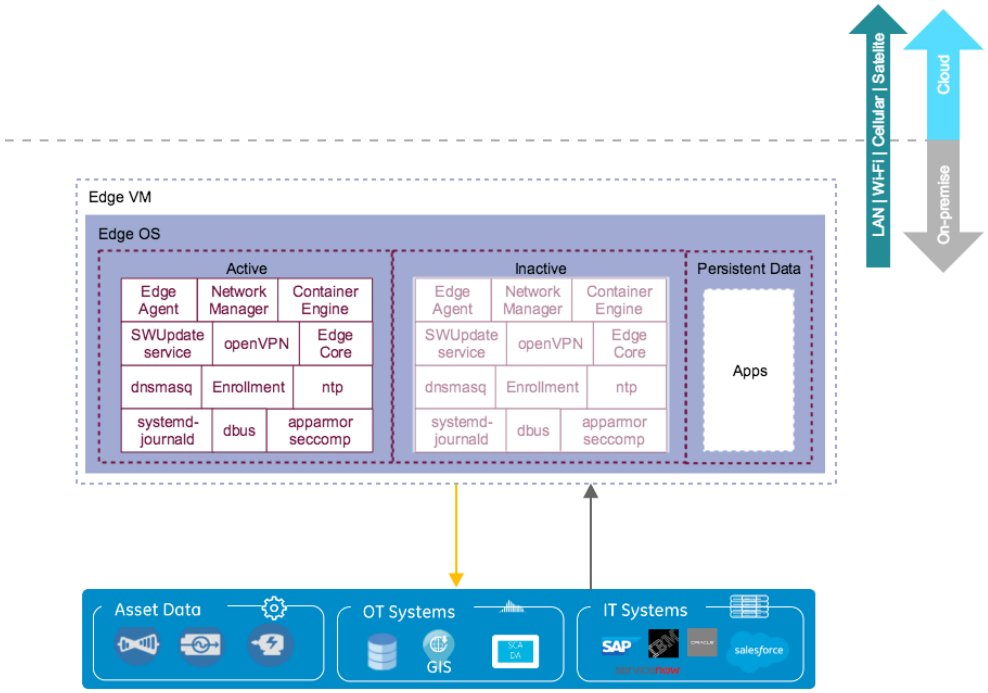
Predix Edge Overview

Predix Edge OS Architecture

The Predix Edge Operating System is a baseline Yocto Linux distribution that can be extended and ported to many bare metal platforms or virtual environments. It is architected around the design goals of small footprint, security, multi-container-based application hosting, and edge platform management.

Partitions

Figure 1. Predix Edge OS Architecture



As seen in the above diagram, the Predix Edge OS image is divided into three partitions (the scale of the partitions in the diagram do not reflect actual partition sizes):

1. **Active Partition:** This partition is the currently running version of the software. (Read Only)
2. **Inactive Partition:** This partition is used as part of the update process.
3. **Persistent Data:** This partition is used to store all mutable data and must endure device restarts and OS upgrades.

When the operating system is updated, the following processes occurs:

1. Active partitions are "snapshotted" to the inactive partition.
2. Updates are applied to the inactive partition.
3. The inactive partition becomes active.
4. The system attempts to reboot.

Installing Predix Edge OS Virtual Machine

Edge OS Image

Edge OS images are stored in Artifactory.

To access Artifactory downloads, you will require a GE SSO (single sign-on) username and approval to access Artifactory.

Request a GE SSO

Use the following steps to obtain a GE SSO if you do not already have one.

1. Complete the Your GE SSO Account request form. All fields marked with a checkmark are required.
2. Click **Submit**.

> **Note:**
> The only non-alphanumeric characters allowed in your GE SSO are an underscore (_) and a period (.). Using any other non-alphanumeric characters for your username will result in an invalid authentication in Artifactory.

Request Artifactory Access

Once you have an SSO, use the following steps to request access to Artifactory.

1. Complete the Edge Artifactory Access Requests form.
2. Click **Submit**.

Image Downloads

- ESXi Developer Image - ssh is enabled; code signing is not enforced for applications.
- ESXi Production Image - ssh is disabled; code signing is enforced for applications and OS updates.

Installing Edge on Mac

If you access the Internet through a corporate proxy server, please review the tutorial *Define network proxy settings*.

Procedure

1. Download and extract the files.
2. If you do not already have VMware Fusion 10, you can download a trial version from https://www.vmware.com/products/fusion/fusion-evaluation.html.
3. Right-click the extracted `predix_edge_OS.ova` file and select **Open With > VMware Fusion**.
4. In the **Choose an Existing Virtual Machine** dialog, ensure the Edge OS image is selected, and click **Continue**.
5. In **Save As**, enter a name for the Edge OS image, and click **Save**.
   The image is imported.
6. Click **Customize Settings** and customize the following settings:

   a. For **Processors**, **Memory** and **Hard Disk**, use the following guideline values:

   Table 1. Minimum and Recommended Virtual Machine Settings

Setting	Minimum	Recommended
Processors/CPUs	1	2
RAM	1 GB	4 GB
Hard disk/disk space	8 GB	20 GB*

   * Certain applications will require more than the recommended 20GB, particularly Historian for Linux on Edge. If you are using this application, please consult the Historian requirements *(on page)* for the disk space recommendation for your tag volume.

   b. **Network Adapter** – Ensure **Connect Network Adapter** is selected. Select **Share with my Mac** to connect to your Mac using Network Address Translation (NAT).

Note:
The default IP addresses for the VM's first interface are as follows:
- VM running Edge OS 2.7.0: 169.254.0.2/16
- VM running Edge OS 2.6.0 and earlier: DHCP

7. Close the settings and click the **Play** button to launch Edge.
   If your version of VMware Fusion is relatively recent, you may see a popup dialog asking if you want to upgrade. Select **Don't Upgrade**.
   Edge OS starts.
8. For the developer (testing) version of Edge, enter the following credentials:

- user: root
- password: root

Installing Edge on Windows

If you access the Internet through a corporate proxy server, please review the tutorial *Define network proxy settings*.

Procedure

1. Download and extract the files.
2. If you do not already have VMware Workstation Pro 14, you can download a trial version from https://www.vmware.com/products/workstation-pro/workstation-pro-evaluation.html.
3. Right-click the extracted `predix_edge_os.ova` file and select **Open With > VMware Workstation**.
4. When the **Import Virtual Machine** popup appears, click **Import**.
5. Select the newly created VM from the left pane. Click **Edit Virtual Machine Settings**.
6. Configure the following settings.

    a. For **Memory**, **Hard Disk** and **Cores**, use the following guideline values:

    Table 2. Minimum and Recommended Virtual Machine Settings

Setting	Minimum	Recommended
Processors/CPUs	1	2
RAM	1 GB	4 GB
Hard disk/disk space	8 GB	20 GB*

    * Certain applications will require more than the recommended 20GB, particularly Historian for Linux on Edge. If you are using this application, please consult the Historian requirements *(on page)* for the disk space recommendation for your tag volume.

    b. Click **Network Adapter**. Select **NAT: Used to share the host's IP address**.

    Note:

    The default IP addresses for the VM's first interface are as follows:

    - VM running Edge OS 2.7.0: 169.254.0.2/16
    - VM running Edge OS 2.6.0 and earlier: DHCP

    c. Click **OK** to save settings.

7. Click **Power on this Virtual Machine** to start Edge OS.
8. For the developer (testing) version of Edge, enter the following credentials:
    a. user: root
    b. password: root

Installing Edge on ESXi

About this task

This procedure assumes VMware ESXi is installed on a blade server and the VMware vCenter Server version is 6.0 or later.

If you access the Internet through a corporate proxy server, please review the tutorial *Define network proxy settings*.

Procedure

1. Download and extract the Edge OS files.
2. Login to the vCenter Server UI, or ESXi client UI.
3. Select **Actions > Deploy OVA Template**.
4. Click **Browse** to locate the extracted Edge OS file on your computer. Click **Next**.
5. Enter a **Name** for the OVF. Select the datacenter and folder for deployment from the list. Click **Next**.
6. In **Select Resource***, select the host that will run the deployed template. Click **Next**.
7. Review the template details. Click **Next**.
8. Make the following selections, using the guideline values in the table where applicable. Click **Next** when finished.

Table 3. Minimum and Recommended Virtual Machine Settings

Setting	Minimum	Recommended
Processors/CPUs	1	2
RAM	1 GB	4 GB
Hard disk/disk space	8 GB	20 GB*

* Certain applications will require more than the recommended 20GB, particularly Historian for Linux on Edge. If you are using this application, please consult the Historian requirements *(on page)* for the disk space recommendation for your tag volume.

    a. Select virtual disk format
    b. VM storage policy
    c. Datastores
9. Select the destination network. Click **Next**.

10. Enter the network details for the deployment. Click **Next**.

> **Note:**
> The default IP addresses for the VM's first interface are as follows:
> - VM running Edge OS 2.7.0: 169.254.0.2/16
> - VM running Edge OS 2.6.0 and earlier: DHCP

11. Review the configuration data for the template. Click **Finish**. The template is built, which will take a few minutes. You can view the status in the **Recent Tasks** view.
12. Once the Edge OS is created, click **Open Console** to launch the console for Edge OS.
13. For the developer (testing) version of Edge, enter the following credentials:
    a. user: root
    b. password: root

Upgrading Predix Edge OS

Upgrading Edge OS

Before you begin

To access Artifactory downloads, you will require a GE SSO (single sign-on) username and approval to access Artifactory.

Request a GE SSO

Use the following steps to obtain a GE SSO if you do not already have one.

1. Complete the Your GE SSO Account request form. All fields marked with a checkmark are required.
2. Click **Submit**.

> **Note:**
> The only non-alphanumeric characters allowed in your GE SSO are an underscore (_) and a period (.). Using any other non-alphanumeric characters for your username will result in an invalid authentication in Artifactory.

Request Artifactory Access

Once you have an SSO, use the following steps to request access to Artifactory.

1. Complete the Edge Artifactory Access Requests form.
2. Click **Submit**.

Upgrade Sequence

Edge OS upgrades must be installed incrementally; you cannot skip a minor release (i.e., if you are running version 2.1.0, you must first upgrade to 2.2.1 and then 2.3.0.). You do not have to install every patch release (indicated by a change to the third digit in the release number).

> **Note:**
> Ensure you download the upgrade file for the next version for your specific platform. File names are in the format `meta-edge-xxxx...` where 'xxxx' is the platform label.

Obtain Upgrade Image File

Software upgrade files are within the **EdgeOS** folder in the **Artifactory Repository Browser**.

1. Expand the **EdgeOS** folder.
2. Expand the folder for the version you wish to install (e.g., 2_3_0).
3. Expand the **os** folder.
4. Expand the **tar.gz** file for your specific platform.
5. Select the software update (SWU) file and click **Download** (the option to download the file is also available by right-clicking the file name).

Once you have downloaded the correct update file, you can deploy it with either the Predix Edge Technician Console *(on page xii)* or Edge Manager *(on page xii)*.

Upgrading Edge OS Via PETC

Procedure

1. Login to the Predix Edge Technician Console (PETC).
2. Click **Update OS**.
3. Click **Upload OS Update**.
4. Click **Choose File** to navigate to where your software upgrade file was saved.
5. Select the software update file. Click **Upload**.
6. After the upload has completed, click **Apply Update**. A confirmation dialog will appear. Click **Apply & Restart** to proceed with the upgrade or **Cancel** to exit without updating.

Upgrading Edge OS Via Edge Manager

Procedure

1. Login to Edge Manager.
2. Navigate to **Repository > Packages**.
3. From the **Action** drop-down menu, select **Upload**. The **Upload** dialog will appear.
4. Within the dialog, enter the following:
    a. **Name** (required): Value must begin with alphanumeric, can contain alphanumeric, hyphens, and underscores. Spaces and periods are not allowed.
    b. **Version** (required): Value must be in the format: <major>.<minor>.<bugfix> with 18 digits maximum for each number (e.g., '1.10.2').
    c. **Type**: Select **Operating System**.
    d. **Platform**: Select **Predix Edge**.

e. **File**: Click **Choose File** to navigate to where your software upgrade file was saved.
f. **Vendor**, **Description** and **Notes** are optional fields, however it is recommended to enter something helpful in **Description** and/or **Notes**.

5. Click **Upload**.
6. Navigate to **Device Manager > Devices**.
7. Select the device(s) for which you want to perform the upgrade.
8. From the **Device Operations** drop-down menu, select **Deploy Software**.
9. The **Select Software** dialog will appear. Select the uploaded upgrade file and click **Next**.
10. In the **Schedule Deployment** dialog, select the date and time for deployment to the device.

> **Note:**
> You can set the time zone timestamp formatting (UTC or local) in the **Settings** page.

a. In **Timeout**, set the timeout for each operation in weeks, days, hours, minutes, or seconds, per device.

> **Note:**
> When the operation is not scheduled, the timeout starts from the moment you create the task. When the operation is scheduled, the timeout is the scheduled time plus the timeout time you set.

b. (Optional) In the **Retries** field, enter a number for how many times to retry the deployment in case of failure (including if the deployment times out).

c. Click **Submit**.

The **Deployment Status** dialog appears.

11. Click **Close**.
12. To monitor the status of the upgrade, click the device the upgrade is being performed on; select **Software** from the menu, the upgrade procedure will be listed in the table.

Setting Up Git and GitHub

Git and GitHub

Git is a version management tool. GitHub is a web-based hosting service for Git repositories. There is a public GitHub site and an internal, GE corporate GitHub site.

Git and Github are not required for Edge development, but the sample projects and other resources reside in GitHub.

To learn more about Git, see https://git-scm.com/documentation.

Install Git

Procedure

1. Download and install the latest version of Git for your platform.

   Note:
   For Windows 10 users, many of the examples for this guide were created in a Unix-flavored environment. You may want Git to auto-convert LFs to CLRFs. See Customizing Git, Formatting and Whitespace for more information.

2. Enter the following command:

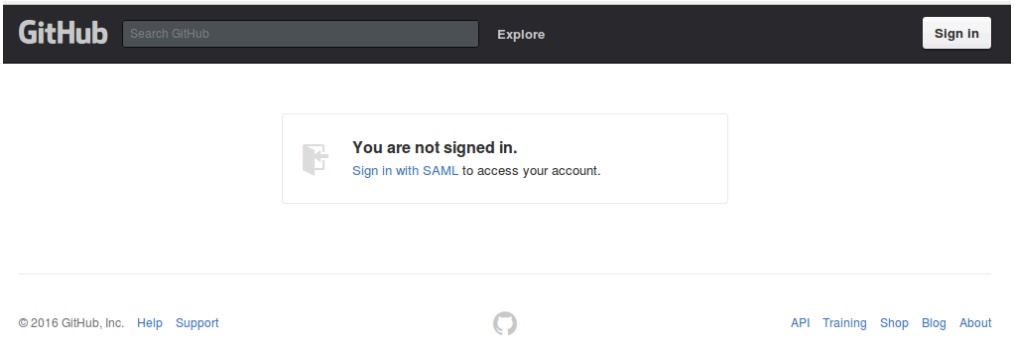
   ```
   git config --global core.autocrlf true
   ```

Request a GE Corporate GitHub Account

Procedure

1. To generate a user account, use your GE SSO to log into GE's corporate GitHub site.
2. If you see the following sign-in page on your first visit, click **Sign in with SAML**.

Figure 2. GitHub Login Screen



SSH Key Setup

GE's GitHub does not allow password access. Setting up an SSH key will allow you to pull code out from a repository and push updates back.

GitHub provides detailed instructions to setup SSH keys for Windows/Linux/Mac operating systems.

Note:
If you copy your ssh key to another system, such as a VM, check the file permissions. Only you should have read/write access. For example, `chmod go-rwx id_rsa`.

Create a New Remote Repo in GitHub

Instructions for creating a remote repository in GitHub

Procedure

1. Open a new browser tab.
2. Go to https://github.build.ge.com/.
3. Click the green **New Repository** button.
4. Enter `sandbox` for the **Repository Name**.
5. Click **Create Repository**.
6. Select `SSH` in the quick setup box and copy the Git address to use when linking the local repo to the remote GitHub repo *(on page xvi)*.

Create a Local Repository

Instructions for creating a local Git repository

Procedure

1. Open a terminal window to create a local version of the repository.

```
mkdir sandbox && cd sandbox
```

2. Create the repository by entering:

```
git init
```

Create readme and Commit to Local Repo

Procedure

1. Create our `readme` file.

```
echo "# sandbox" >> README.md
```

2. Commit the `readme` file to the local repo.

```
git add README.md

git commit –m "repo initialization"
```

Link the Local Repo to the Remote GitHub Repo

Procedure

In a terminal window, enter the following:

```
git remote add origin <paste the git SSH address from above>
```

The Git address should look something like `git@github.build.ge.com:<my sso>/sandbox.git`.

Push the New File to the Remote Repo

Procedure

To push the new file to the remote repository, enter:

```
git push –u origin master   // -u sets upstream remote
```

Setup Mac Only

Get Started Setting up Mac for Edge OS

These instructions will guide you through installing and configuring Git and Docker for Mac OS. We will also provide information on how to configure your terminal session proxies if you have not already done so.

Edge images and containers are built and deployed on several Linux distributions. If you are interested in developing and testing on an OS more closely resembling the target platform, consider using the DevBox VM for development (take a look at Quick Start with DevBox).

Docker for Mac is convenient and performs identically to Docker on a Linux host OS in most cases, but there are some situations in which Docker needs Linux host-system resources to build an image or run a container. While in general it is a best practice to create platform-independent Docker images, be aware that certain cases are unlikely to work on Mac.

Dependencies

- Must be working on a Mac with Brew installed (Brew is native to Mac OS).
- Make sure you have created a GitHub account *(on page xiv)* and installed Git *(on page xiv)*.

Additional Information

Intro to Edge and Docker

Setting up a Mac for Edge

Install Git, Docker, and the Cloud Foundry CLI for Mac from the command line.

Procedure

1. Open a terminal window.
2. Run the following command to install Git, Docker, and the Cloud Foundry CLI (used to set up the Time Series service).

   ```
   bash <( curl https://raw.githubusercontent.com/PredixDev/local-setup/master/setup-mac.sh ) --git --cf --docker
   ```

   Learn more about how this quick start script works (and other available flags) in the Predix Dev local setup GitHub repository.

Configuring Docker for Mac

Configure Docker for Mac.

About this task

Procedure

1. Click the Docker menu bar icon.
2. Select **Preferences > Docker**.
    a. If you are working under a proxy, enter the appropriate `no_proxy` configuration values for your company, for example, `localhost,127.0.0.1,.ge.com` under **Proxies > Manual proxy configuration** in the fields **Web Server (HTTP)** and **Secure Web Server (HTTPS)**.
    b. The following value works robustly for both HTTP and HTTPS fields while on BLUESSO, VPN and home networks: `http://PITC-Zscaler-Americas-Alpharetta3pr.proxy.corporate.ge.com:80` or its IP `http://10.114.20.11:80`.
    c. In **Bypass the proxy settings for these Hosts & Domains** field, enter: `localhost,127.0.0.1,.ge.com`

    You may need different proxy settings at different sites. Contact your local IT administrator for the correct settings.

Configuring Terminal Session Proxies

Instructions for configuring terminal session proxies.

About this task

Set the `http_proxy`, `https_proxy` and `no_proxy` environment variables for your terminal sessions so that http requests and ssh calls from the terminal can resolve correctly behind your company proxy. If you have already configured your proxy environment variables in your `bash_profile`, you can skip this step.

The following proxy values work robustly across sites and over VPN (which usually requires a different proxy).

```
http_proxy="http://PITC-Zscaler-Americas-Alpharetta3pr.proxy.corporate.ge.com:80"

https_proxy="http://PITC-Zscaler-Americas-Alpharetta3pr.proxy.corporate.ge.com:80"

no_proxy="localhost,127.0.0.1,.ge.com"
```

Alternatively, consult your local IT administrator for information about the proxy addresses in your location.

Procedure

1. Open `terminal.app` and append the appropriate values for your GE site into your `~/.bash_profile` file by running the following command:

```
echo '

export http_proxy="http://PITC-Zscaler-Americas-Alpharetta3pr.proxy.corporate.ge.com:80"

export https_proxy="http://PITC-Zscaler-Americas-Alpharetta3pr.proxy.corporate.ge.com:80"

export no_proxy="localhost,127.0.0.1,.ge.com"

' >> ~/.bash_profile
```

2. Once you have added these addresses to the `~/.bas_profile` file, you need to either run the following command or open a new terminal session:

```
source ~/.bash_profile
```

Predix Edge OS Device Development

Yocto Project

Edge OS leverages an open source infrastructure (Yocto and BitBake) and software components (OpenEmbedded) to create a base OS that can be extended with GE-specific customizations.

OpenEmbedded

OpenEmbedded is a build framework that allows developers to create a complete Linux Distribution for embedded systems. The core of this framework is BitBake, a generic task execution engine that allows tasks to be run in parallel while working within complex inter-task dependency constraints.

See OpenEmbedded for more information.

BitBake

BitBake is a tool for building software libraries/applications using recipes such as those provided by meta-openembedded.

- Consumes recipes to create binaries.
- Co-maintained by Yocto and OpenEmbedded.
- Both Yocto and OpenEmbedded maintain collections of open source BitBake layers and recipes that describe how to build and deploy software components.
- Recipes are text-based configuration files that describe how a software library or application should be built.
- Recipes define:
    - Location of source code.
    - Source code patches (optional).
    - Custom built settings (optional).
- Recipes are grouped into layers *(on page xxi)*.
- Recipes in upper layers can augment or override layers below.
- Edge OS uses Yocto's Poky reference Linux Distribution and extends it using OpenEmbedded layers such as _meta-python_ and meta-oe.
    - See Poky for more information.

For more information on BitBake, see https://www.yoctoproject.org/docs/2.5.2/bitbake-user-manual/bitbake-user-manual.html.

Layers

A layer is a collection of recipes and/or configurations that can be used to define how to build and deploy software packages. Typically, each layer is organized around a specific theme (e.g., in OpenEmbedded, recipes for building web server software are provided in the layer meta-webserver).

An Edge OS image is built upon multiple layers. It is possible for multiple layers to reference the same recipe in order to modify the recipe's settings. In some cases, these modifications may conflict with one another. To resolve these conflicts, BitBake allows you to set the priority for each layer. In this way, layers that are higher can augment, or override, lower layers.

To add new recipes or customize existing ones, you can create and add a new layer, which you would assign a higher priority in order for it to supersede lower layers. For example, Edge OS provides customizations on top of the OpenEmbedded layers with two meta layers:

- meta-edge-base
- meta-edge-predix

Learn more about how to create a new layer.

Base Edge OS

The base Edge OS is provided by the meta-edge-base layer. This is the common operating system layer that includes platform independent customizations and new recipes for additional packages added to Edge OS on top of the stock minimal Yocto distribution.

Device-Specific Layers

Adding support for a new device may require platform-dependent recipes and customizations.

For example, different devices may require different initialization procedures:

- A VM-specific layer would typically include an EFI-compatible bootloader and generic device drivers.
- A microcontroller-specific layer would use a simplified boot mechanism and fewer device drivers, which are specific to its hardware.

For more information on Edge OS layers and how to create new layers, please see Layers *(on page xxi)*.

What are System Containers?

System containers are regular Docker containers that are pre-loaded with Edge OS. They are typically responsible for basic system functionality, such as message brokers and administrative consoles.

How are System Containers Loaded?

System containers are Docker applications distributed as compressed tarballs that include the container tarball and a docker-compose YAML file, which specifies services the container provides and how it should be deployed. The compressed tarballs are stored in the `/opt/system-containers` directory in Edge OS. During system startup, the sc-loader service scans the `/opt/system-containers` directory and uses Docker to deploy any system containers found. Adding a new system container to Edge OS essentially adds a new compressed tarball to the `/opt/system-containers` directory.

Adding a New System Container to the Edge OS Image

Procedure

1. System containers are added to the Edge OS image using specific BitBake recipes that download the container's compressed tarball and copy it to the Edge OS build directory.
2. To add a new system container you must first upload the container's compressed tarball to an HTTP repository, such as Artifactory, and create a new recipe that refers to the repository's URL. The new recipe needs to be included as a dependency within the recipe _packagegroup-containers_.
   packagegroup-containers.bbpappend
   ```
   RDEPENDS_${PN}_append = " \
     your-new-system-container \
     "
   ```
3. The new recipe must be saved either in the same layer as the other system containers, or in a new layer that has a higher priority than meta-edge-predix.
4. The new system container tarball will be located in the `/opt/system-containers` directory of the Edge OS image. It will be automatically loaded by the sc-loader service when the system starts up.

Configuring and Building Edge OS for Virtual Machines

About this task

Instructions for configuring and building Edge OS for virtual machine target images.

Edge OS is supported for the following:

- qemu86-64 qcow2 image.
- OVA image.

The following are required in order to build Edge OS for virtual machines:

- Configured Edge OS build environment.
- Installed Google repo tool.

```
mkdir ~/bin

PATH=~/bin:$PATH

curl https://storage.googleapis.com/git-repo-downloads/repo > ~/bin/repo

chmod a+x ~/bin/repo
```

  Additional information about the Google repo tool in at https://source.android.com/setup/develop/repo.

- Installed VMware OVF tool for Linux from https://my.vmware.com/group/vmware/details?downloadGroup=OVFTOOL430&productId=742.
  - Download the VMware OVF tool and copy it to your build machine.
  - If you need to build the OVA image, execute the following command.

```
sudo sh VMware-Workstation-xxxx-xxxx.architecture.bundle
```

Use the following method to build the repository's target.

```
mkdir Edge

cd Edge

repo init -u ssh://git@github.build.ge.com/Edge/meta-edge-vmware -m

 repo-manifest/meta-edge-vmware-repo-manifest-jenkins.xml -b develop

repo sync --detach --prune

./meta-edge-base/scripts/build.sh -C meta-edge-vmware/build.conf
```

The resulting OVA image will be at:

- `./build/images/amd64/predix_edge_os.ova`

Import the OVA image into VMware Fusion or Workstation. Within VMware, click **File > Import**.

Predix Edge OS Release Notes

Edge Release Notes 2.9.0

New Features

The following new features were implemented in Edge 2.9.0.

Edge Application Deployment

Improvements were made to Edge Application deployment for volume mount access and Docker Trusted Registry support. A custom command for "docker login" is required for private DTR access *(on page)*.

Support for Recently Updated Edge Components

This release includes support for the following recently updated Edge components:

- Edge Agent on Ubuntu 23.03.
- Predix Data Broker (CDP) and PETC updates made for the Alpine base kernel image 3.14 update.

Known Issues

This release contains the following known issues.

Erroneous PETC Error Messages

- When you upgrade the Edge OS from PETC, a message may appear to indicate that the upgrade failed. After logging in again you will see that the OS upgrade was successful.
- When you reset a device from PETC, a message may appear to indicate that the reset failed, however, the device reset was successful.

Edge Release Notes 2.8.1

Bug Fixes

The following bug fixes are implemented in Edge 2.8.1.

Data Partition Expansion

An issue with data partition expansion upon VM reboot has been fixed. It now executes only when the VM storage setting is larger than the Edge partition size.

PETC Authentication Security

A fix has been implemented for PETC authentication security and supported cipher suites.

Removed:

- 3DES

Supported:

- AES-128, with SHA256 and SHA384
- AES-256 with SHA256 and SHA384
- ChaCha20-Poly1305

Predix Edge Release Notes 2.8.0

These are the new features, enhancements, and known and resolved issues for the 2.8.0 release of Predix Edge.

Upgrade Path

Predix Edge OS must be installed incrementally; you cannot skip a minor release (i.e., if you are running version 2.6.0, you must first install 2.7.0 and then 2.8.0). You do not have to install every patch release (indicated by a change to the third digit in the release number).

New Features and Enhacements

This release contains the following enhancements:

QNX Hypervisor Support

- Static IP address for QNX host: 192.168.101.236 (netmask 255.355.355.0; no gateway) on device eth1
- Static IP on Predix Edge guest VM interface: 192.168.101.237 (netmask 255.255.255.0; no gateway) on device eth2
- RAM allocation set to 2GB
- Data (storage) set to 4GB

Password Change

The ability to change passwords in Predix Edge Technician Console (PETC) is now supported.

Known Issues

This release has the following known issues:

Time Synchronization May Need to be Started Manually

On the APC910 hardware reference platform, Predix Edge OS QNX VM indicates the `systemd-timesyncd.service` is inactive after a reboot. This occurs for both the DEV and PROD images when booted from an attached USB flash drive.

The issue is resolved by manually starting the `systemd-timesyncd.service` from the console.

Predix Edge OS QNX VM Reboot not Supported

Issuing the reboot command from Predix Edge will only shutdown the virtual machine; it will not reboot/restart. To re-start the Predix Edge VM, run the command `qvm @/vm/edgeos/qvmconf`.

Predix Edge OS QNX VM Software Update not Supported

The OS upgrade feature in the PETC user interface is disabled when on a QNX hypervisor.

Predix Edge Release Notes 2.7.0

These are the new features, enhancements, and known and resolved issues for the 2.7.0 release of Predix Edge.

Upgrade Path

Predix Edge OS must be installed incrementally; you cannot skip a minor release (i.e., if you are running version 2.5.0, you must first install 2.6.0 and then 2.7.0). You do not have to install every patch release (indicated by a change to the third digit in the release number).

New Features and Enhancements

This release contains the following enhancements:

Yocto

The system has been upgraded to Yocto Dunfell 3.1.

Static IP Address for VM First Interface

The Predix Edge OS VMs now have a default static IP address for the Predix Edge Technician Console. See Installing Predix Edge OS Virtual Machine *(on page vi)*

IGS Protocol Adapter Support Discontinued

Predix Edge no longer supports the IGS protocol adapter.

Known Issues

This release has the following known issues:

RFC 1918 Private Address Space

If you upgrade from Predix Edge 2.4.0 or earlier to Predix Edge 2.7.0, private addresses will not be resolved. Use the following steps as a workaround for this issue.

- SSH access is required
- edit `/etc/dnsmasq.conf` to comment out (put "#" in front of):
  - bogus-priv
  - stop-dns-rebind
- restart the dnsmasq.service
  - systemctl stop dnsmasq.service
  - systemctl start dnsmasq.service

Successful Factory Reset Returns Failure Message

After performing a factory reset via PETC, an error message may pop up indicating the operation **Failed to reset device**; however, the factory reset will have been successful.

Docker Apps Flooding Logs

A Docker application that floods the logs can cause system performance to degrade, resulting in the Docker applications restarting.

Serial Port Bootlog

A qemu- or vmware-based OS will output the bootlog out of the serial ports. This can cause problems if they are connected to physical hardware.

Device Clock Modifications

If a device's clock is modified to a time prior to when it was first initialized, all deployed applications will be stopped and all system applications will run after the device reboots.

Application Configurations

Applications will not be able to read application configuration files created without read permissions. Ensure that configuration files have read permissions prior to zipping them in preparation for uploading them to Edge Manager or PETC.

Data Not Forwarding When OPC-UA Adapter Fails to Connect to Broker

In some instances, when the client id is not specified in the application configurations, two separate applications may have identical mqtt client IDs, resulting in the applications failing to connect to the broker and data not being forwarded.

MAC Address Displays as 'unknown'

There is a bug in Predix Edge OS that causes PETC to display MAC addresses as "unknown" for all ethernet interfaces. To obtain the actual MAC address for an ethernet interface, execute the "Run ifconfig" command from Predix Edge Manager. The MAC address will be in the resulting text file output that can be downloaded from the Predix Edge Manager Device Commands tab.

File Permissions on the config-xxxx.json File

Mac/Linux users should ensure that the file permissions on the `config-xxxx.json` file are 644 prior to adding to the zipfile for deployment to your Predix Edge Device. Other file permissions may result in the Edge Application being unable to start up and the journalctl log file will show error messages containing **stream error** and **Unable to parse JSON file**.

Resolved Issues

The following issues were resolved in this release:

Fixed Vulnerabilities

This release contains fixes for the following security vulnerabilities:

- CVE-2021-3156
- CVE-2021-3449
- CVE-2021-3450

Predix Edge Release Notes 2.6.0

These are the new features, enhancements, and known and resolved issues for the 2.6.0 release of Predix Edge.

Upgrade Path

Predix Edge OS must be installed incrementally; you cannot skip a minor release (i.e., if you are running version 2.4.0, you must first install 2.5.0 and then 2.6.0). You do not have to install every patch release (indicated by a change to the third digit in the release number).

New Features and Enhancements

This release contains the following new features and enhancements:

Netdata Device Monitoring

Netdata is a real-time monitoring utility that has been incorporated into Predix Edge Technician Console for monitoring your devices. See Device Monitoring *(on page)*.

Troubleshooting Commands

The following commands are available through SSH access for troubleshooting networking and system operation:

- curl(1)
- dig(1)
- ip(8)
- ss(8)
- ping(8)
- tcpdump(8)
- openssl(1)
- jq(1)
- ssh(1)
- scp(1)
- gzip(1)
- nc(1)
- traceroute(1)

Known Issues

This release has the following known issues:

Successful Factory Reset Returns Failure Message

After performing a factory reset via PETC, an error message may pop up indicating the operation **Failed to reset device**; however, the factory reset will have been successful.

Docker Apps Flooding Logs

A Docker application that floods the logs can cause system performance to degrade, resulting in the Docker applications restarting.

Serial Port Bootlog

A qemu- or vmware-based OS will output the bootlog out of the serial ports. This can cause problems if they are connected to physical hardware.

Device Clock Modifications

If a device's clock is modified to a time prior to when it was first initialized, all deployed applications will be stopped and all system applications will run after the device reboots.

Application Configurations

Applications will not be able to read application configuration files created without read permissions. Ensure that configuration files have read permissions prior to zipping them in preparation for uploading them to Edge Manager or PETC.

Invalid Log Level

A cloud gateway with an invalid log level will not forward data to the cloud and will not generate any log messages.

Data Not Forwarding When OPC-UA Adapter Fails to Connect to Broker

In some instances, when the client id is not specified in the application configurations, two separate applications may have identical mqtt client IDs, resulting in the applications failing to connect to the broker and data not being forwarded.

Predix Edge Release Notes 2.5.0

Upgrade Path

Predix Edge OS must be installed incrementally; you cannot skip a minor release (i.e., if you are running version 2.3.3, you must first install 2.4.0 and then 2.5.0). You do not have to install every patch release (indicated by a change to the third digit in the release number).

General

Consolidated Release Notes

Release notes for all Predix Edge components (i.e., OS, Agent, PETC, etc.) will now be published as one, rather than being separated by component.

Predix Edge Tested Components

This release was tested using the following Predix Edge components:

- Edge OS 2.5.0
- Cloud gateway 20.3.0
- OPC-UA Adapter 20.2.0
- OSI-Pi Adapter 20.2.0
- EGD Adapter 1.3.0
- MQTT Adapter 1.3.0
- Modbus Adapter 1.3.0
- Predix Historian MQTT Collector 2.2.0
- IGS Adapter 1.1.0

New Features and Enhancements

This release contains the following new features and enhancements:

Syslog Forwarding

A new feature now available in Predix Edge Manager allows you to forward syslog events from an Edge device to a remote syslog server with a severity-based filter.

Configure Maximum Transmission Unit (MTU)

The ability to set a value for MTU has been added to the setup of Network Adapters within the Predix Edge Technician Console (PETC). MTU configuration is available in both DHCP and Static modes; the default value is 1500 bytes.

OS Upgrade to Yocto Warrior

Predix Edge OS has been upgraded to Yocto Warrior to deliver bug fixes, security fixes, and new functionality.

Bug Fixes

The following bug fixes are implemented in this release:

Disrupted File Transfers

If a file transfer from Edge Manager to a device is disrupted due to a network outage for example, the transfer will resume automatically once connectivity is restored.

System Proxy Changes

The system restart after a proxy change will automatically stop and restart the applications on next reboot, resolving the issue of system proxy changes not being propagated into deployed applications.

Secure Command Channel

Previously an abrupt loss of power while deploying a secure command channel-enabled application may result in an inability to manage applications that leverage the secure command channel. Now, when this condition is encountered, the previously existing applications will continue to work but the interrupted application will need to be re-deployed.

Timestamp Not Updated after OS Upgrade

The **Last Updated** timestamp in PETC has been removed from the user interface.

Known Issues

This release has the following known issues:

Successful Factory Reset Returns Failure Message

After performing a factory reset via PETC, an error message may pop up indicating the operation **Failed to reset device**; however, the factory reset will have been successful.

Docker Apps Flooding Logs

A Docker application that floods the logs can cause system performance to degrade, resulting in the Docker applications restarting.

Serial Port Bootlog

A qemu- or vmware-based OS will output the bootlog out of the serial ports. This can cause problems if they are connected to physical hardware.

Device Clock Modifications

If a device's clock is modified to a time prior to when it was first initialized, all deployed applications will be stopped and all system applications will run after the device reboots.

Application Configurations

Applications will not be able to read application configuration files created without read permissions. Ensure that configuration files have read permissions prior to zipping them in preparation for uploading them to Edge Manager or PETC.

Invalid Log Level

A cloud gateway with an invalid log level will not forward data to the cloud and will not generate any log messages.

Data Not Forwarding When OPC-UA Adapter Fails to Connect to Broker

In some instances, when the client id is not specified in the application configurations, two separate applications may have identical mqtt client IDs, resulting in the applications failing to connect to the broker and data not being forwarded.

Predix Edge OS Release Notes 2.4.0

Upgrade Path

Predix Edge OS must be installed incrementally; you cannot skip a minor release (i.e., if you are running version 2.2.1, you must first install 2.3.3 and then 2.4.0). You do not have to install every patch release (indicated by a change to the third digit in the release number).

Enhancements

This release contains the following enhancements:

Yocto

The system has been upgraded to Yocto Thud 2.6.3.

Known Issues

This release has the following known issues:

Applications Fail to Start

Applications that use port mapping in their docker compose file may fail to start after an ungraceful shutdown. This situation is likely to occur after a hardware power cycle or a virtual machine reset. To work around this issue, gracefully restart the system.

General

- Large container deployments may time out if running QEMU without KVM enabled.
- The only supported virtual disk controller for VMware VMs is IDE; SCSI and SATA are not currently supported.
- Changes to the system proxy are not propagated into deployed applications. If changing the system proxy settings after deploying applications, the applications need to be stopped and restarted for proxy settings to be propagated into the application.
- In some cases, a command will fail to execute and the Docker logs will indicate there is a runc issue. When this occurs, resend the command.

OVA

- When using VMware Fusion 10, switching networks in the host system may cause Predix Edge OS VMs to change their IP address (e.g. 192.168.0.5 to 192.168.0.6).

Raspberry Pi 3 B+

- Use Predix Edge OS release 2.1.0 for Raspberry Pi 3 B+. This version is intended only for development purposes and is not supported for production use.
- Once an imaged SDcard has been used to boot a specific Raspberry Pi board, it cannot be used to boot another board. The MAC address and model are written to the SDcard on first boot; from that point on, the SDcard is unique to that board.
    - E.g., you would encounter this issue if you booted a device, then removed and duplicated that SDcard. Devices running both the original, and all the duplicates, would come up with the same address.

Predix Edge OS Release Notes 2.3.3

Known Issue

This release has the following known issue:

Applications Fail to Start

Applications that use port mapping in their docker compose file may fail to start after an ungraceful shutdown. This situation is likely to occur after a hardware power cycle or a virtual machine reset. To work around this issue, gracefully restart the system.

Fixed Vulnerability

This release contains fixes for the following security vulnerability:

- CVE-2019-10125

Predix Edge OS Release Notes 2.3.2

Bug Fixes

This release contains the following bug fixes:

Predix Edge Broker Disk Consumption

Resolved an issue where the Predix Edge Broker would consume a large amount of disk space when encountering an error condition.

Fixed Vulnerability

This release contains fixes for the following security vulnerability:

- CVE-2019-9893

Predix Edge OS Release Notes 2.3.0

Upgrade Path

When upgrading Predix Edge OS, you cannot skip over a version; you must install each version incrementally. (I.e., if you are running version 2.1.0, you must first install 2.2.1 and then 2.3.0.)

New Features

This release contains the following new features:

Dell Gateway 3002

The Dell Gateway 3002 is a turnkey offering with Predix Edge OS pre-loaded.

- Of the Gateway's I/Os, only the two Ethernet ports are supported:
  - One designated for WAN.
  - One designated for LAN.
- Predix Edge Technician Console will be accessible on static IP address 192.168.100.2.

Known Issues

This release has the following known issues:

General

- Large container deployments may time out if running QEMU without KVM enabled.
- The only supported virtual disk controller for VMware VMs is IDE; SCSI and SATA are not currently supported.
- Changes to the system proxy are not propagated into deployed applications. If changing the system proxy settings after deploying applications, the applications need to be stopped and restarted for proxy settings to be propagated into the application.
- In some cases, a command will fail to execute and the Docker logs will indicate there is a runc issue. When this occurs, resend the command.

OVA

- When using VMware Fusion 10, switching networks in the host system may cause Predix Edge OS VMs to change their IP address (e.g. 192.168.0.5 to 192.168.0.6).

Raspberry Pi 3 B+

- Use Predix Edge OS release 2.1.0 for Raspberry Pi 3 B+. This version is intended only for development purposes and is not supported for production use.
- Once an imaged SDcard has been used to boot a specific Raspberry Pi board, it cannot be used to boot another board. The MAC address and model are written to the SDcard on first boot; from that point on, the SDcard is unique to that board.
    - E.g., you would encounter this issue if you booted a device, then removed and duplicated that SDcard. Devices running both the original, and all the duplicates, would come up with the same address.

Predix Edge OS Release Notes 2.2.1

Security Issue

This is an out of band maintenance release for a security issue that exists in components of Predix Edge OS, versions 2.2.0 and prior. It is recommended you apply this fix as soon as possible, especially if you are running Predix Edge in a production environment.

Affected versions:

- Predix Edge Virtual Machine (Developer and Production) 2.0.0, 2.0.1, 2.1.0, 2.2.0.
- Predix Edge RaspberryPi 2.1.0.
- Any custom Predix Edge image with a meta-edge-base version 2.2.0 or prior.
- Any custom Predix Edge image that still uses meta-edgeos (any version).

Solutions:

- Predix Edge Virtual Machine: Apply the update to Predix Edge 2.2.1 or start from a fresh 2.2.1 VM.
- Predix Edge Custom Images: Rebuild with the latest meta layers (develop or release branches).
- No fix currently available for prebuilt Predix Edge RaspberryPi images.
- No changes required from Predix Edge application teams beyond updating their platforms.

Upgrade Path

When upgrading Predix Edge OS, you cannot skip over a version; you must install each version incrementally. (I.e., if you are running version 2.0.0, you must first install 2.1.0 and then 2.2.1.)

New Features

This release contains the following new features:

General

The meta-edge-base layer includes a patch for CVE-2019-8912, which is a Linux kernel security issue with a critical Common Vulnerability Scoring System (CVSS) rating of 9.8 (out of 10).

OVA

The production and developer OVA images have been updated to include the fix for CVE-2019-8912.

Known Issues

This release has the following known issues:

General

- Large container deployments may time out if running QEMU without KVM enabled.
- The only supported virtual disk controller for VMware VMs is IDE; SCSI and SATA are not currently supported.
- Changes to the system proxy are not propagated into deployed applications. If changing the system proxy settings after deploying applications, the applications need to be stopped and restarted for proxy settings to be propagated into the application.
- In some cases, a command will fail to execute and the Docker logs will indicate there is a runc issue. When this occurs, resend the command.

OVA

- When using VMware Fusion 10, switching networks in the host system may cause Predix Edge OS VMs to change their IP address (e.g. 192.168.0.5 to 192.168.0.6).

Raspberry Pi 3 B+

- Use Predix Edge OS release 2.1.0 for Raspberry Pi 3 B+.
- Once an imaged SDcard has been used to boot a specific Raspberry Pi board, it cannot be used to boot another board. The MAC address and model are written to the SDcard on first boot; from that point on, the SDcard is unique to that board.
    - E.g., you would encounter this issue if you booted a device, then removed and duplicated that SDcard. Devices running both the original, and all the duplicates, would come up with the same address.

Predix Edge OS Release Notes 2.2.0

These are the enhancements and known issues for Predix Edge OS, version 2.2.0.

Upgrade Path

When upgrading Predix Edge OS, you cannot skip over a version; you must install each version incrementally. (I.e., if you are running version 2.0.0, you must first install 2.1.0 and then 2.2.0.)

New Features

This release contains the following new features:

General

Predix Edge OS images are now delivered as platform-specific packages.

OVA

System packages were upgraded, including Docker to version 18.03.

Known Issues

This release has the following known issues:

General

- Large container deployments may time out if running QEMU without KVM enabled.
- The only supported virtual disk controller for VMware VMs is IDE; SCSI and SATA are not currently supported.
- Changes to the system proxy are not propagated into deployed applications. If changing the system proxy settings after deploying applications, the applications need to be stopped and restarted for proxy settings to be propagated into the application.
- In some cases, a command will fail to execute and the Docker logs will indicate there is a runc issue. When this occurs, resend the command.

OVA

- When using VMware Fusion 10, switching networks in the host system may cause Predix Edge OS VMs to change their IP address (e.g. 192.168.0.5 to 192.168.0.6).

Raspberry Pi 3 B+

- Use Predix Edge OS release 2.1.0 for Raspberry Pi 3 B+.
- Once an imaged SDcard has been used to boot a specific Raspberry Pi board, it cannot be used to boot another board. The MAC address and model are written to the SDcard on first boot; from that point on, the SDcard is unique to that board.
    - E.g., you would encounter this issue if you booted a device, then removed and duplicated that SDcard. Devices running both the original, and all the duplicates, would come up with the same address.

Predix Edge OS Release Notes 2.1.0

These are the enhancements and known issues for Predix Edge OS, version 2.1.0.

New Features

This release contains the following new features:

General

When upgrading Predix Edge OS, the latest versions of system containers (e.g., PETC and Predix Edge Broker) are included in the upgrade file.

OVA

VMware tools are now included in the OVA image.

Raspberry Pi 3 B+

A beta development Predix Edge image for Raspberry Pi 3 B+ is now available.

Note:
This image is not for production use. It is to be used only as a reference or demonstration tool.

- Supported I/Os:
  - 2.4GHz and 5GHz IEEE 802.11.b/g/n/ac wireless LAN, -- CLI only, not configurable via PETC.
  - Gigabit Ethernet over USB 2.0 (maximum throughput 300 Mbps).
  - Full-size HDMI.
  - Four USB 2.0 ports.
- Considerations:
  - We are shipping this as a 64-bit OS, portability to 32-bit applications will work, but we do not currently support 32-bit as a platform.
  - Minimum supported SD card size is 4GB, however, a minimum of 8GB is recommended.
  - Note that this system has no real time clock (RTC), meaning the device's clock will be unreliable until it synchronizes with an NTP server.

Resolved Issues

The following issues were resolved in this release:

- Automatic disk resizingfailure for VMware virtual machines.

Known Issues

This release has the following known issues:

General

- Large container deployments may time out if running QEMU without KVM enabled.
- The only supported virtual disk controller for VMware VMs is IDE; SCSI and SATA are not currently supported.
- Changes to the system proxy are not propagated into deployed applications. If changing the system proxy settings after deploying applications, the applications need to be stopped and restarted for proxy settings to be propagated into the application.
- Under high logging conditions, the system consumes more memory due to caching of logs. GE recommends restarting the system.

OVA

- When using VMware Fusion 10, switching networks in the host system may cause Predix Edge OS VMs to change their IP address (e.g. 192.168.0.5 to 192.168.0.6).

Raspberry Pi 3 B+

- Once an imaged SDcard has been used to boot a specific Raspberry Pi board, it cannot be used to boot another board. The MAC address and model are written to the SDcard on first boot; from that point on, the SDcard is unique to that board.
    - E.g., you would encounter this issue if you booted a device, then removed and duplicated that SDcard. Devices running both the original, and all the duplicates, would come up with the same address.