

# Analyzing Performance Metrics Using the Performance Co-Pilot Analysis Toolkit

## WHAT?

For performance monitoring purposes, SUSE Linux Enterprise Micro provides a container image that enables you to run the Performance Co-Pilot (PCP) analysis toolkit in a container.

## WHY?

You want to monitor performance on your system, and this article provides information on how to configure and use the toolkit.

## EFFORT

It takes approximately 40 minutes of reading time.

## GOAL

You will be able to start the PCP container with a configuration that suits your needs.

## REQUIREMENTS

- A running instance of SLE Micro.

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# 1 Performance Co-Pilot analysis toolkit

The toolkit comprises tools for gathering and processing performance information collected either in real time or from PCP archive logs.

The performance data is collected by *performance metrics domain agents* and passed to the `pm-cd` daemon. The daemon coordinates the gathering and exporting of performance statistics in response to requests from the PCP monitoring tools. `pmlogger` is then used to log the metrics. For details, refer to the [PCP documentation \(https://pcp.readthedocs.io/en/latest/UAG/IntroductionToPcp.html#\)](https://pcp.readthedocs.io/en/latest/UAG/IntroductionToPcp.html#).

## 1.1 Getting the PCP container image

The PCP container image is based on the *BCI-Init* container that utilizes `systemd` used to manage the PCP services.

You can pull the container image using Podman or from the Cockpit Web management console. To pull the image by using Podman, run the following command:

```
# podman pull registry.suse.com/suse/pcp:latest
```

To get the container image using Cockpit, go to *Podman containers*, click *Get new image*, and search for *pcp*. Then select the image from the [registry.suse.com](https://registry.suse.com) for SLE 15 SP4 and download it.

## 2 Running the PCP container

The following command shows minimal options that you need to use to run a PCP container:

```
# podman run -d \  
--systemd always \  
-p HOST_IP:HOST_PORT:CONTAINER_PORT \  
-v HOST_DIR:/var/log/pcp/pmlogger \  
PCP_CONTAINER_IMAGE
```

where the options have the following meaning:

`-d`

The container runs in a detached mode without tty.

### --systemd always

Runs the container in the systemd mode. All services needed to run in the PCP container are started automatically by systemd in the container.

### --privileged

The container runs with extended privileges. Use this option if your system has SELinux enabled, otherwise the collected metrics are incomplete.

### -v HOST\_DIR:/var/log/pcp/pmlogger

Creates a bind mount so that pmlogger archives are written to the HOST\_DIR on the host. By default, pmlogger stores the collected metrics in /var/log/pcp/pmlogger.

### PCP\_CONTAINER\_IMAGE

Is the downloaded PCP container image.

Other useful options of the podman run command follow:

### OTHER OPTIONS

### -p HOST\_IP:HOST\_PORT:CONTAINER\_PORT

Publishes ports of the container by mapping a container port onto a host port. If you do not specify HOST\_IP, the ports are mapped on the local host. If you omit the HOST\_PORT value, a random port number is used. By default, the pmcd daemon listens on and exposes the PMAPI to receive metrics on the port 44321, so we recommend mapping this port on the same port number on the host. The pmproxy daemon listens on and exposes the REST PMWEBAPI to access metrics on the 44322 port by default, so it is recommended to map this port on the same host port number.

### --net host

The container uses the host's network. Use this option to collect metrics from the host's network interfaces.

### -e

The option enables you to set the following environment variables:

### PCP\_SERVICES

Is a comma-separated list of services to start by systemd in the container.

Default services are: pmcd, pmie, pmlogger, pmproxy.

You can use this variable to run a container with a list of services that is different from the default one, for example, only with pmlogger:

```
# podman run -d \
```

```
--name pmlogger \  
--systemd always \  
-e PCP_SERVICES=pmlogger \  
-v pcp-archives:/var/log/pcp/pmlogger \  
registry.suse.com/suse/pcp:latest
```

## HOST\_MOUNT

Is a path inside the container to the bind mount of the host's root file system. The default value is not set.

## REDIS\_SERVERS

Specifies a connection to a Redis server. In a non-clustered setup, provide a comma-separated list of host specs. In a clustered setup, provide any individual cluster host, other hosts in the cluster are discovered automatically. The default value is: `localhost:6379`.

If you need to use a different configuration than the one provided by the environment variables, proceed as described in [Section 3, "Configuring PCP services"](#).

## 2.1 Starting the PCP container automatically on boot

After you run the PCP container, you can configure `systemd` to start the container on boot. To do so, follow the procedure below:

1. Create a unit file for the container by using the `podman generate systemd` command:

```
# podman generate systemd --name CONTAINER_NAME > /etc/systemd/system/  
container-CONTAINER_NAME.service
```

where `CONTAINER_NAME` is the name of the PCP container you used when running the container from the container image.

2. Enable the service in `systemd`:

```
# systemctl enable container-CONTAINER_NAME
```

## 3 Configuring PCP services

All services that run inside the PCP container have a default configuration that might not suit your needs. If you need a custom configuration that cannot be covered by the environment variables, create configuration files for the PCP services and pass them to the PCP using a bind mount as follows:

```
# podman run -d \  
  --name CONTAINER_NAME \  
  --systemd always \  
  -v $HOST_CONFIG:CONTAINER_CONFIG_PATH:z \  
  -v HOST_LOGS_PATH:/var/log/pcp/pmlogger \  
  registry.suse.com/suse/pcp:latest
```

Where:

CONTAINER\_NAME

Is an optional container name.

HOST\_CONFIG

Is an absolute path to the config you created on the host machine. You can choose any file name you want.

CONTAINER\_CONFIG\_PATH

Is an absolute path to a particular configuration file inside the container. Each available configuration file is described in the corresponding sections further.

HOST\_LOGS\_PATH

Is a directory that should be a bind mount to the container logs.

For example, a container called `pcp`, with the configuration file `pmcd` on the host machine and the `pcp-archives` directory for logs on the host machine, is run by the following command:

```
# podman run -d \  
  --name pcp \  
  --systemd always \  
  -v $(pwd)/pcp-archives:/var/log/pcp/pmlogger \  
  -v $(pwd)/pmcd/etc/sysconfig/pmcd \  
  registry.suse.com/suse/pcp:latest
```

## 3.1 Custom `pmcd` daemon configuration

The `pmcd` daemon configuration is stored in the `/etc/sysconfig/pmcd` file. The file stores environment variables that modify the behavior of the `pmcd` daemon.

You can add the following variables to the `/etc/sysconfig/pmcd` file to configure the `pmcd` daemon:

### PMCD\_LOCAL

Defines whether the remote host can connect to the `pmcd` daemon. If set to `0`, remote connections to the daemon are allowed. If set to `1`, the daemon listens only on the local host. The default value is `0`.

### PMCD\_MAXPENDING

Defines the maximum count of pending connections to the agent. The default value is `5`.

### PMCD\_ROOT\_AGENT

If the `pmdaroot` is enabled (the value is set to `1`), adding a new PDMA does not trigger restarting of other PMDAs. If `pmdaroot` is not enabled, `pmcd` will require restarting all PMDAs when a new PDMA is added. The default value is `1`.

### PMCD\_RESTART\_AGENTS

If set to `1`, the `pmcd` daemon tries to restart any exited PDMA. Enable this option only if you have enabled `pmdaroot`, as `pmcd` itself does not have privileges to restart PDMA.

### PMCD\_WAIT\_TIMEOUT

Defines the maximum time in seconds `pmcd` can wait to accept a connection. After this time, the connection is reported as failed. The default value is `60`.

### PCP\_NSS\_INIT\_MODE

Defines the mode in which `pmcd` initializes the NSS certificate database when secured connections are used. The default value is `readonly`. You can set the mode to `readwrite`, but if the initialization fails, the default value is used as a fallback.

An example follows:

```
PMCD_LOCAL=0
PMCD_MAXPENDING=5
PMCD_ROOT_AGENT=1
PMCD_RESTART_AGENTS=1
PMCD_WAIT_TIMEOUT=70
PCP_NSS_INIT_MODE=readwrite
```

## 3.2 Custom **pmlogger** configuration

The custom configuration for the **pmlogger** is stored in the following configuration files:

- /etc/sysconfig/pmlogger
- /etc/pcp/pmlogger/control.d/local

### 3.2.1 The /etc/sysconfig/pmlogger file

You can use the following attributes to configure the **pmlogger**:

#### PMLOGGER\_LOCAL

Defines whether **pmlogger** allows connections from remote hosts. If set to *1*, **pmlogger** allows connections from a local host only.

#### PMLOGGER\_MAXPENDING

Defines the maximum count of pending connections. The default value is 5.

#### PMLOGGER\_INTERVAL

Defines the default sampling interval **pmlogger** uses. The default value is *60 s*. Keep in mind that this value can be overridden by the **pmlogger** command line.

#### PMLOGGER\_CHECK\_SKIP\_LOGCONF

Setting this option to *yes* disables the regeneration and checking of the **pmlogger** configuration if the configuration **pmlogger** comes from pmlogconf. The default behavior is to regenerate configuration files and check for changes every time **pmlogger** is started.

An example follows:

```
PMLOGGER_LOCAL=1
PMLOGGER_MAXPENDING=5
PMLOGGER_INTERVAL=10
PMLOGGER_CHECK_SKIP_LOGCONF=yes
```

### 3.2.2 The /etc/pcp/pmlogger/control.d/local file

The file /etc/pcp/pmlogger/control.d/local stores specifications of the host, which metrics should be logged, the logging frequency (default is 24 hours), and **pmlogger** options. For example:

```
# === VARIABLE ASSIGNMENTS ===
```



```

#
# DO NOT REMOVE OR EDIT THE FOLLOWING LINE
$version=1.1

# Uncomment one of the lines below to enable/disable compression behaviour
# that is different to the pmlogger_daily default.
# Value is days before compressing archives, 0 is immediate compression,
# "never" or "forever" suppresses compression.
#
#$PCP_COMPRESSAFTER=0
#$PCP_COMPRESSAFTER=3
#$PCP_COMPRESSAFTER=never

# === LOGGER CONTROL SPECIFICATIONS ===
#
#Host          P? S? directory          args

# local primary logger
LOCALHOSTNAME y  n  PCP_ARCHIVE_DIR/LOCALHOSTNAME  -r -T24h10m -c config.default -v
100Mb

```



### Note: Defaults point to local host

If you run the **pmlogger** in a container on a different machine than the one that runs the **pmcd** (a client), change the following line to point to the client:

```

# local primary logger
CLIENT_HOSTNAME y  n  PCP_ARCHIVE_DIR/CLIENT_HOSTNAME  -r -T24h10m -c
config.default -v 100Mb

```

For example, for the **slmicro\_1** host name, the line should look as follows:

```

# local primary logger
slmicro_1 y  n  PCP_ARCHIVE_DIR/slmicro_1  -r -T24h10m -c config.default -v
100Mb

```

## 4 Managing PCP metrics

### 4.1 Listing PCP metrics

From within the container, you can use the command `pminfo` to list metrics. For example, to list all available performance metrics, run:

```
# pminfo
```

You can list a group of related metrics by specifying the metrics prefix:

```
# pminfo METRIC_PREFIX
```

For example, to list all metrics related to kernel, use:

```
# pminfo disk

disk.dev.r_await
disk.dm.await
disk.dm.r_await
disk.md.await
disk.md.r_await
...
```

You can also specify additional strings to narrow down the list of metrics, for example:

```
# pminfo disk.dev

disk.dev.read
disk.dev.write
disk.dev.total
disk.dev.blkread
disk.dev.blkwrite
disk.dev.blktotal
...
```

To get online help text of a particular metric, use the `-t` option followed by the metric, for example:

```
# pminfo -t kernel.cpu.util.user

kernel.cpu.util.user [percentage of user time across all CPUs, including guest CPU time]
```

To display a description text of a particular metric, use the `-T` option followed by the metric, for example:

```
# pminfo -T kernel.cpu.util.user

Help:
percentage of user time across all CPUs, including guest CPU time
```

## 4.2 Checking local metrics

After you start the PCP container, you can verify that metrics are being recorded properly by running the following command inside the container:

```
# pcp

Performance Co-Pilot configuration on localhost:

platform: Linux localhost 5.3.18-150300.59.68-default #1 SMP Wed May 4 11:29:09 UTC 2022
(ea30951) x86_64
hardware: 1 cpu, 1 disk, 1 node, 1726MB RAM
timezone: UTC
services: pmcd pmproxy
          pmcd: Version 5.2.2-1, 9 agents, 4 clients
          pmda: root pmcd proc pmproxy xfs linux mmv kvm jbd2
pmlogger: primary logger: /var/log/pcp/pmlogger/localhost/20220607.09.24
          pmie: primary engine: /var/log/pcp/pmie/localhost/pmie.log
```

Now check if the logs are written to a proper destination:

```
# ls PATH_TO_PMLLOGGER_LOGS
```

where PATH\_TO\_PMLLOGGER\_LOGS should be /var/log/pcp/pmlogger/localhost/ in this case.

## 4.3 Recording metrics from remote systems

You can deploy collector containers that collect metrics from different remote systems than the ones where the **pmlogger** containers are running. Each remote collector system needs the **pmcd** daemon and a set of *pmda*. To deploy several collectors with a centralized monitoring system, proceed as follows.

1. On each system you want to collect metrics from (clients), run a container with the `pmcd` daemon:

```
# podman run -d \  
  --name pcp-pmcd \  
  --privileged \  
  --net host \  
  --systemd always \  
  -e PCP_SERVICES=pmcd \  
  -e HOST_MOUNT=/host \  
  -v /:/host:ro,rslave \  
  registry.suse.com/suse/pcp:latest
```

2. On the monitoring system, create a `pmlogger` configuration file for each client `control.CLIENT` with the following content:

```
$version=1.1  
  
CLIENT_HOSTNAME n n PCP_ARCHIVE_DIR/CLIENT -N -r -T24h10m -c config.default -v 100Mb
```

Keep in mind that the `CLIENT_HOSTNAME` must be resolvable in DNS. You can use IP addresses or fully qualified domain names (FQDN) instead.

3. On the monitoring system, create a directory for each client to store the recorded logs:

```
# mkdir /root/pcp-archives/CLIENT
```

For example, for `slemicro_1`:

```
# mkdir /root/pcp-archives/slemicro_1
```

4. On the monitoring system, run a container with `pmlogger` for each client:

```
# podman run -d \  
  --name pcp-pmlogger-CLIENT \  
  --systemd always \  
  -e PCP_SERVICES=pmlogger \  
  -v /root/pcp-archives/CLIENT:/var/log/pcp/pmlogger:z \  
  -v $(pwd)/control.CLIENT:/etc/pcp/pmlogger/control.d/local:z \  
  registry.suse.com/suse/pcp:latest
```

For example, for a client called `slemicro_1`:

```
# podman run -d \  
  --name pcp-pmlogger-slemicro_1 \  
  registry.suse.com/suse/pcp:latest
```

```
--systemd always \  
-e PCP_SERVICES=pmlogger \  
-v /root/pcp-archives:/var/log/pcp/pmlogger:z \  
-v $(pwd)/control.slemicro_1:/etc/pcp/pmlogger/control.d/local:z \  
registry.suse.com/suse/pcp:latest
```



## Note

The second bind mount points to the configuration file created in [Step 2](#) and replaces the default **pmlogger** configuration. If you do not create this bind mount, **pmlogger** uses the default `/etc/pcp/pmlogger/control.d/local` file and logging from clients fails as the default configuration points to a local host. For details about the configuration file, refer to [Section 3.2.2, “The /etc/pcp/pmlogger/control.d/local file”](#).

5. To check if the log collection is working properly, run:

```
# ls -l pcp-archives/CLIENT/CLIENT
```

For example:

```
# ls -l pcp-archives/slemicro_1/slemicro_1  
  
total 1076  
-rw-r--r--. 1 systemd-network systemd-network 876372 Jun  8 11:24 20220608.10.58.0  
-rw-r--r--. 1 systemd-network systemd-network    312 Jun  8 11:22  
20220608.10.58.index  
-rw-r--r--. 1 systemd-network systemd-network 184486 Jun  8 10:58  
20220608.10.58.meta  
-rw-r--r--. 1 systemd-network systemd-network    246 Jun  8 10:58 Latest  
-rw-r--r--. 1 systemd-network systemd-network  24595 Jun  8 10:58 pmlogger.log
```

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