Troubleshooting
Linux on System z

Troubleshooting
Before using this information and the product it supports, read the information in “Notices” on page 31.

This edition applies to all Linux distributions that are supported on System z mainframes and to all subsequent releases and modifications until otherwise indicated in new editions.

© Copyright IBM Corporation 2013.
US Government Users Restricted Rights – Use, duplication or disclosure restricted by GSA ADP Schedule Contract with IBM Corp.
## Contents

### Summary of changes ........................................ v
SC34-2612-02 ........................................ v
SC34-2612-01 ........................................ v

### About this document ........................................ vii

### Chapter 1. Troubleshooting for Linux on System z .............. 1
Techniques for troubleshooting Linux on System z problems .............. 1
Troubleshooting checklist ..................................... 3
Collecting data for general Linux on System z problems ..................... 4
Collecting data for performance problems ................................ 4
Collecting data for network problems ................................... 5
Collecting data for hung system problems ................................ 5
Collecting data for middleware problems .................................. 5

### Chapter 2. Tools for troubleshooting .......................... 7
Assumptions ................................................. 7
Authority .................................................. 7
sysfs and procfs .......................................... 7
debugfs .................................................. 7
General tools ............................................... 7
dbginfo - Collect information for debugging ................................ 7
supportconfig - SUSE Linux Enterprise Server troubleshooting............... 8
sosreport - Generate debugging information for Red Hat Enterprise Linux systems ................................................. 9
Performance tools ........................................ 10
sadc - System activity data collector ................................ 10
iostat - Monitor input/output device load ................................ 12
z/VM MONWRITE - Collect CP *MONITOR data ................................ 13
Collecting data using DASD statistics ................................... 13
Displaying DASD performance data .................................... 14
Collecting data using SCSI statistics ................................... 15
ziomon - Collect FCP performance data ................................ 16
ziorep - Create FCP performance report ................................ 18
Obtaining QDIO performance statistics ................................... 21
Special tools ............................................... 21
s390dbf traces - Use the kernel debug feature .......................... 21
top - See resource usage .................................... 22
ps - Report a snapshot of the current processes ......................... 23
netstat - Show information about the Linux networking subsystem ........ 23
tcpdump - Collect traffic information for a network interface ........... 23
oprofile - profiling of all running code on Linux systems ............... 24
Dump tools ................................................. 24

### Chapter 3. Contacting IBM Support .......................... 25

### Chapter 4. Exchanging information with IBM .................. 27
Sending information to IBM Support ................................ 27
Receiving information from IBM Support ................................ 27

### Accessibility .............................................. 29

### Notices .................................................. 31
Trademarks ................................................ 32

© Copyright IBM Corp. 2013
Summary of changes

Changes to the troubleshooting information for the latest releases are listed.

SC34-2612-02

Changes compared to SC34-2612-01.

New information
• You can use the ziomon monitor to capture FCP performance data, see "ziorep - Create FCP performance report" on page 18.

Changed Information
• The interface to the QDIO statistics has been updated, see "Obtaining QDIO performance statistics" on page 21.

This revision also includes maintenance and editorial changes. Technical changes or additions to the text and illustrations are indicated by a vertical line to the left of the change.

Deleted Information
• None.

SC34-2612-01

Changes compared to SC34-2612-00.

New information
• You can now use a new command, dasdstat, to display DASD performance statistics. See "Displaying DASD performance data” on page 14.

Changed Information

This revision also includes maintenance and editorial changes. Technical changes or additions to the text and illustrations are indicated by a vertical line to the left of the change.

Deleted Information
• None.
About this document

This document describes troubleshooting of Linux for IBM® System z® instances. It contains troubleshooting checklists, it describes what tools to use for what problem, as well as how to contact IBM support and transfer log files.

In this document, System z is taken to include zSeries in 64- and 31-bit mode.

Unless stated otherwise, all z/VM® related information in this document assumes a current z/VM version, see [www.ibm.com/vm/techinfo](http://www.ibm.com/vm/techinfo).

You can find the latest version of this document on the IBM Information Center for Linux at [pic.dhe.ibm.com/infocenter/linxinfo/v3r0m0/topic/com.ibm.trouble.doc/serviceandsupport.html](http://pic.dhe.ibm.com/infocenter/linxinfo/v3r0m0/topic/com.ibm.trouble.doc/serviceandsupport.html).

Your Linux distribution might provide additional utilities for working with System z devices that are not described in this publication. See the documentation that is provided with your distribution to find out what additional utilities you can use.

For Linux on System z documents that have been adapted to a particular distribution, see one of the following web pages:

Chapter 1. Troubleshooting for Linux on System z

To isolate and resolve problems with Linux on System z, you can use the troubleshooting information. This information contains instructions for using the problem-determination resources that are provided with Linux on System z.

Techniques for troubleshooting Linux on System z problems

Troubleshooting is a systematic approach to solving a problem. The goal of troubleshooting is to determine why something does not work as expected and how to resolve the problem. Certain common techniques can help with the task of troubleshooting.

The first step in the troubleshooting process is to describe the problem completely. Problem descriptions help you and the IBM technical-support representative know where to start to find the cause of the problem. This step includes asking yourself basic questions:
- What are the symptoms of the problem?
- Where does the problem occur?
- When does the problem occur?
- Under which conditions does the problem occur?
- Can the problem be reproduced?

The answers to these questions typically lead to a good description of the problem, which can then lead you to a problem resolution.

What are the symptoms of the problem?

When starting to describe a problem, the most obvious question is “What is the problem?” This question might seem straightforward; however, you can break it down into several more-focused questions that create a more descriptive picture of the problem. These questions can include:
- Who, or what, is reporting the problem?
- What are the error codes and messages?
- How does the system fail? For example, is it a loop, hang, crash, performance degradation, or incorrect result?

Where does the problem occur?

Determining where the problem originates is not always easy, but it is one of the most important steps in resolving a problem. Many layers of technology can exist between the reporting and failing components. Networks, disks, and drivers are only a few of the components to consider when you are investigating problems.

The following questions help you to focus on where the problem occurs to isolate the problem layer:
- Is the problem specific to one platform or operating system, or is it common across multiple platforms or operating systems?
- Is the current environment and configuration supported?
- Do all users have the problem?
(For multi-site installations.) Do all sites have the problem?

If one layer reports the problem, the problem does not necessarily originate in that layer. Part of identifying where a problem originates is understanding the environment in which it exists. Take some time to completely describe the problem environment, including the operating system and version, all corresponding software and versions, and hardware information. Confirm that you are running within an environment that is a supported configuration; many problems can be traced back to incompatible levels of software that are not intended to run together or have not been fully tested together.

**When does the problem occur?**

Develop a detailed timeline of events leading up to a failure, especially for those cases that are one-time occurrences. You can most easily develop a timeline by working backward: Start at the time an error was reported (as precisely as possible, even down to the millisecond), and work backward through the available logs and information. Typically, you need to look only as far as the first suspicious event that you find in a diagnostic log.

To develop a detailed timeline of events, answer these questions:

- Does the problem happen only at a certain time of day or night?
- How often does the problem happen?
- What sequence of events leads up to the time that the problem is reported?
- Does the problem happen after an environment change, such as upgrading or installing software or hardware?

Responding to these types of questions can give you a frame of reference in which to investigate the problem.

**Under which conditions does the problem occur?**

Knowing which systems and applications are running at the time that a problem occurs is an important part of troubleshooting. These questions about your environment can help you to identify the root cause of the problem:

- Does the problem always occur when the same task is being performed?
- Does a certain sequence of events need to happen for the problem to occur?
- Do any other applications fail at the same time?

Answering these types of questions can help you explain the environment in which the problem occurs and correlate any dependencies. Remember that just because multiple problems might have occurred around the same time, the problems are not necessarily related.

**Can the problem be reproduced?**

From a troubleshooting standpoint, the ideal problem is one that can be reproduced. Typically, when a problem can be reproduced you have a larger set of tools or procedures at your disposal to help you investigate. Consequently, problems that you can reproduce are often easier to debug and solve.

However, problems that you can reproduce can have a disadvantage: If the problem is of significant business impact, you do not want it to recur. If possible,
re-create the problem in a test or development environment, which typically offers you more flexibility and control during your investigation.

- Can the problem be re-created on a test system?
- Are multiple users or applications encountering the same type of problem?
- Can the problem be re-created by running a single command, a set of commands, or a particular application?

**Troubleshooting checklist**

When you open a problem, provide as much information as possible about the circumstances.

Answering the following questions can help you or IBM support to determine the cause for problems that occur with Linux on System z:

1. **How does the problem manifest itself? What are the symptoms?**
   - When this problem occurs, is a specific error message or error code issued?
   - Is trace output of the operation available?

2. **How long has the problem been occurring?**
   - Is it a first time occurrence? When did it happen? (Date and time help to analyze the logs.)
   - How frequently does it occur?
   - Is there any pattern?

3. **If the problem occurred subsequent to some period of normal operation, did anything change in the environment?**
   - Was an operating system patch applied?
   - Did the network environment change? For example, was a server moved or a domain migrated?
   - Did the system recently fail or abnormally terminate?

4. **If you know (for example, based on message prefixes or error codes), where does the problem occur? On one or more systems, production or test environment?**

5. **Can you reproduce the problem on a test system (so that you do not negatively affect the production environment)? What steps are required to reproduce the problem?**

6. **How many users are impacted?**
   - Does this problem affect one, some, or all users?
   - Does the problem occur only for a user who was recently added to the environment, such as a new employee?
   - Do differences exist between the users who are affected and the users who are not affected?

7. **How many applications or business processes are impacted?**
   - Does this problem affect one, some, or all applications or business processes?
   - Does the problem occur only for a new application or business process?
   - Do differences exist between the applications or business processes that are affected and the applications or business processes that are not affected by the problem?

In your report, describe the server and storage infrastructure in as much detail as possible:
• Machine setup, for example, IBM zEnterprise® BC12 (zBC12) or IBM zEnterprise EC12 (zEC12).
• Storage server, for example, DS8000®.
• Storage attachment, for example FICON®, or FCP.
• Disk configuration.
• Network, for example OSA (type, mode), HiperSockets™.
• Network topologies.
• Middleware setup (databases, web servers, SAP, or Tivoli Storage Manager. Include version information, if relevant).

You can now collect additional diagnostic data that is required for an IBM technical-support representative to effectively troubleshoot the problem.

**Collecting data for general Linux on System z problems**

Collect diagnostic data when a problem occurs. Then submit the diagnostic data to IBM Support. Whatever the problem, start with this general collection of data.

**About this task**

Collecting data before opening a problem management record (PMR) can help you to answer the following questions:

- Do the symptoms match any known problems? If so, has a fix or workaround been published?
- Can the problem be identified and resolved without a code fix?
- When does the problem occur?

The diagnostic data that you collect, and the sources from which you collect that data, are dependent on the type of problem that you are investigating. A base set of information is typically always required. For specific symptoms, you might need to collect additional problem-specific data.

When you submit a problem to IBM Support, you must provide a base set of information.

**Procedure**

To collect general diagnostic data:
1. Collect the base set of diagnostic information by using the `dbginfo` command.
2. Depending on your distribution, also collect distribution-specific information:
   - On SUSE Linux Enterprise Server, run `supportconfig`.
   - On Red Hat Enterprise Linux, run `sosreport`.

**Collecting data for performance problems**

If performance is a problem, collect diagnostic data that you can use to diagnose and resolve the problem.

**Procedure**

To collect diagnostic data for performance diagnostics:
1. Start sadc (System Activity Data Collection) and provide sar files.
2. If running as guest under z/VM, collect z/VM MONWRITE data
3. Attach the data files to the opened problem report.

**Collecting data for network problems**

If the network has a problem, collect diagnostic data that you can use to diagnose and resolve the problem.

**Procedure**

To collect diagnostic data for network diagnostics:
1. Provide a diagram of your network setup.
2. Use `netstat` to collect diagnostic data.
3. Attach the data files to the opened problem report.

**Collecting data for hung system problems**

If the system hangs, collect diagnostic data that you can use to diagnose and resolve the problem.

**Procedure**

To collect diagnostic data for hung system diagnostics:
1. Create a kernel dump.
2. Include `system.map`, `kerntypes`, `vmlinux` (text) and `vmlinux` (debug) for SUSE Linux Enterprise Server and `vmlinux` (full) for Red Hat Enterprise Linux.

**Collecting data for middleware problems**

If middleware is the problem, collect diagnostic data that you can use to diagnose and resolve the problem.

**Procedure**

To collect data for problems with any middleware product (for example, databases):
1. Contact the product support organization.
2. Collect the appropriate debug data as instructed.
3. Attach the data files to the opened problem report.
Chapter 2. Tools for troubleshooting

A variety of troubleshooting tools are available to help you diagnose and resolve problems for Linux on System z. Assumptions that are used for all tools are summarized here.

Assumptions

You need the correct authorization to use the commands. The examples assume that the file system is set up in a certain way.

Authority

Most of the tasks described require a user with root authority.

In particular, writing to procfs, and writing to most of the described sysfs attributes requires root authority.

Throughout, it is assumed that you have root authority.

sysfs and procfs

Most of the tasks described assume certain mount points for the file systems.

The mount point for the virtual Linux file system sysfs is assumed to be /sys.

Correspondingly, the mount point for procfs is assumed to be /proc.

debugfs

It is assumed that debugfs is mounted at /sys/kernel/debug.

To mount debugfs, you can use this command:

```
# mount none -t debugfs /sys/kernel/debug
```

To mount debugfs persistently, add the following to /etc/fstab:

```
devfs /sys/kernel/debug debugfs auto 0 0
```

General tools

Tools that can be used in most cases when debugging Linux on System z problems.

dbginfo - Collect information for debugging

The dbginfo.sh script collects various system-related files for debugging purposes. It captures the current system environment and generates a tar file.

If the Linux system runs as z/VM guest operating system, dbginfo also collects information about the z/VM guest setup.

The dbginfo.sh script is part of the s390-tools package in SUSE Linux Enterprise Server and the s390-utils package in Red Hat Enterprise Linux.
The service and development team continuously improve dbginfo.sh. You can download the latest version from the developerWorks® website at http://www.ibm.com/developerworks/linux/linux390/s390-tools.html The dbginfo.sh script is included in the s390-tools tar ball.

Authorization

- Running the script requires root authority.
- For z/VM guest operating systems you require privilege class B.

Syntax

```
--dbginfo.sh--
```

Example

To generate a diagnostic report with dbginfo, issue the command:

```
[root@system]# dbginfo.sh
dbginfo.sh
dbginfo.sh: Debug information script version 1.15.0-0.136.13
Copyright IBM Corp. 2002, 2012
Kernel version = 3.0.76 (3.0.76-0.11-default)
Runtime environment = LPAR
1 of 7: Collecting command output
2 of 7: Running in LPAR, no z/VM command output collected
3 of 7: Collecting procfs
4 of 7: Collecting sysfs
5 of 7: Collecting log files
6 of 7: Collecting config files
7 of 7: Collecting osa oat output skipped - not available
Finalizing: Creating archive with collected data
Collected data was saved to:
```

supportconfig - SUSE Linux Enterprise Server troubleshooting

The supportconfig script gathers system troubleshooting information on SUSE Linux Enterprise Server systems. It captures the current system environment and generates a tar-archive.

The script file collects complementary information to the dbginfo.sh script. The supportconfig script is part of the Supportutils package.

Authorization

Running the script requires root authority.

Syntax

See the supportconfig man page for more details.

```
--supportconfig--
```
**Example**

To run `supportconfig`, issue:

```
root@system:~ # supportconfig
```

**Output**

The script produces a tar ball. The location of the tar ball is given in the script output:

```
==================================================================
Support Utilities - Supportconfig
Script Version: 2.25-370
Script Date: 2013 05 29
==================================================================
Gathering system information
Basic Server Health Check... Done
[^...]
Creating Tar Ball
[ DONE ]==================================================================
Log file tar ball: /var/log/nts_h42lp42_100719_1431.tbz
Log file size: 572K
Log file md5sum: 1dfc98f3a3192771ad970ecc31b6e9d9
```

**sosreport - Generate debugging information for Red Hat Enterprise Linux systems**

The `sosreport` script gathers system troubleshooting information. It captures the current system environment and generates a tar file.

The script file collects complementary information to the `dbginfo.sh` script. The `sosreport` script is part of the support-utils package.

**Authorization**

Running the script requires root authority.

**Syntax**

See the `sosreport` man page for details.

```
>>--sosreport
```

**Example**

To run `sosreport`, issue the command:

```
[root@system]# sosreport
```

**Output**

The script produces a .tar file. The location of the .tar file is given in the script output:
Performance tools

Tools that can be used when debugging Linux on System z performance problems.

**sadc - System activity data collector**

The `sadc` command samples system data a specified number of times at a specified interval measured in seconds. It writes to the specified output file or the standard output in binary format. The `sadc` command is a backend to the `sar` command.

Data about, for example, the following areas is captured:
- CPU utilization
- Disk I/O overview and on device level
- Network I/O and errors on device level
- Memory usage and swapping

The tools report statistics data over time and create average values for each item.

**Starting sadc/sar as a service**

Start sadc/sar by using the syssstat service. When started as a service, the data files are written to the `/var/log/sa` directory. The files are named `sa<dd>` and `sar<dd>` respectively, where `<dd>` is the current day’s two-digit date. Both files are constantly updated during the day.

**Procedure**

To start the `sadc` command as a service:

Start the syssstat service.
- To start the syssstat service with Red Hat distributions as a permanent service that persists across reboots, issue:
  
  ```
  service syssstat start
  ```

- To check the status of the service, issue:
  
  ```
  chkconfig -list |grep syssstat
  ```

- To start the syssstat service using SUSE Linux Enterprise Server 10: Either configure the service using YaST, or use the following command:
chkconfig -s sysstat on

To start the sysstat service only for the current session:

service sysstat start

On SUSE Linux Enterprise Server 10 this is not persistent across reboots.

To start the sysstat service with SUSE Linux Enterprise Server 11: You have to configure the service using YaST to have data collection persistent across reboots.

To start the sysstat service directly, issue:

/etc/init.d/boot.sysstat start

This is not persistent across reboots.

To check the status of the sysstat service, issue:

/etc/init.d/boot.sysstat status

Results

To report performance data, include both the sadc and the sar data files with the problem report.

What to do next

After you collect the appropriate diagnostic data, you can complete the following tasks, as appropriate:

- Chapter 3, “Contacting IBM Support,” on page 25
- Chapter 4, “Exchanging information with IBM,” on page 27

Starting sadc/sar directly

If your problem requires data collection that is not covered by the sar/sadc defaults, you can start the tools manually. Start the tools manually, for example, when you need a smaller sampling interval than the default.

About this task

The sampling interval depends on the time period during which performance problems are seen. You can use a default sampling interval of 10 minutes. If performance problems occur for a couple of minutes occasionally, shorten the sampling interval to less than a minute.

Procedure

1. To start the sadc command directly, issue a command of the following form:

/usr/lib64/sa/sadc [options] [interval [count]] > <sadc_outfile>

See the sadc man page for details.

For example:
Omit the count parameter to let sadc sample data until it is stopped.

Use the -S DISK option to collect disk statistics. By default sadc does not report
disks activity to prevent data files from growing too large.

2. Extract data and write records by using the sar command. Use a command of
   the following form:

   ```
   sar -A -f <sadc outfile> > <sar outfile>
   ```

   For example:

   ```
   [root@system:]# sar -A -f sadc_outfile > sar_outfile
   ```

   where:
   -A reports all the collected statistics.
   -f specifies the binary input file.

   The sar command creates a collection of performance reports from the collected
   sadc data and writes these reports to an output file.

**Results**

To report performance data, include both the sadc and the sar data files with the
problem report.

**What to do next**

After you collect the diagnostic data, you can complete the following tasks, as
appropriate:

- Chapter 3, “Contacting IBM Support,” on page 25
- Chapter 4, “Exchanging information with IBM,” on page 27

**iostat - Monitor input/output device load**

The iostat command monitors system input/output device load by observing the
time that the devices are active in relation to their average transfer rates.

The iostat report shows:

- Throughput
- Device queue information
- Service time

**Authorization**

Root access is required on Linux operating systems.
Syntax

See the `iostat` man page for the complete syntax and all options.

```
iostat [options] interval count
```

Parameters

- `-d` Collects disk statistics.
- `-t` Prints a time stamp for each report
- `-k` Displays statistics in kilobytes per second instead of blocks per second.
- `-x` Displays extended statistics, if available.

Examples

To generate a report with a sampling interval of 10 seconds, collecting disk statistics in KB per second, including a time stamp, and extended statistics, issue the command:

```
[root@system]# iostat -dtkx 10
```

SUSE Linux Enterprise Server 9 and Red Hat Enterprise Linux 4

For disk I/O problems, `iostat` is preferred over `sadc/sar`, because the `sadc/sar` version on these distributions does not include appropriate disk I/O statistics.

z/VM MONWRITE - Collect CP *MONITOR data

If your Linux system runs as a guest operating system under z/VM and encounters performance problems, use the MONWRITE utility and include CP *MONITOR data in the problem report.

The z/VM monitor records are in binary format. Make sure that:

- The records are packed and tersed correctly.
- The record size settings are correct.
- The binary to ASCII conversion is made correctly.

For more information about how to collect and upload z/VM MONWRITE data, see www.ibm.com/vm/perf/tips/collect.html

Usage notes

- The sadc and sar files must cover the same time interval as the z/VM MONWRITE data.
- Use the default sampling time interval of 1 minute.

Collecting data using DASD statistics

The DASD statistics kernel function monitors the activities of the DASD device driver and the storage subsystem. It mainly records processing time of I/O operations within a given time interval.
Procedure

To collect diagnostic data by using DASD statistics:

1. Start DASD statistics with the following command:
   
   ```
   # echo set on > /proc/dasd/statistics
   ```

2. Summarized histogram information is available in `/proc/dasd/statistics`, and can be extracted with the following command:
   
   ```
   # cat /proc/dasd/statistics
   ```

3. Stop DASD statistics with the following command:
   
   ```
   # echo set off > /proc/dasd/statistics
   ```

Results

DASD statistics creates a summary for all devices.

An IOCTL interface is available to collect the statistics for individual devices. To get DASD statistics for an individual DASD, use the `tunedasd` command:

```
# tunedasd -P /dev/dasd<xx>
```

What to do next

After you collect the appropriate diagnostic data, you can complete the following tasks:

- Chapter 3, “Contacting IBM Support,” on page 25
- Chapter 4, “Exchanging information with IBM,” on page 27

Displaying DASD performance data

The `dasdstat` command reports the statistics over time and gather data for individual devices or across all devices. The statistics include performance data about Parallel Access Volume (PAV) and High Performance FICON.

Before you begin

Before you can collect DASD performance statistics, the debug file system must be mounted, see “debugfs” on page 7.

About this task

The `dasdstat` command is available as of Red Hat Enterprise Linux version 6.3 and SUSE Linux Enterprise Server 11 SP3. Use `dasdstat` to gather DASD performance statistics and to display them.

Examples

The command can be used to get DASD performance statistics across all devices or for individual ones.

- To start gathering data for a summary of all available DASDs, issue:
What to do next

After you collect the appropriate diagnostic data, you can complete the following tasks:

• Chapter 3, “Contacting IBM Support,” on page 25
• Chapter 4, “Exchanging information with IBM,” on page 27

Collecting data using SCSI statistics

The SCSI statistics collect statistics of I/O operations on FCP devices on a request base, separately for read and write requests. It also gives detailed information about the latency.

About this task

Statistical data on FCP devices can be collected on SUSE Linux Enterprise Server as of:

• Version 9 SP3 and maintenance (kernel version 2.6.5-7.283 and higher)
• Version 10 (kernel version 2.6.16.21-0.8 and higher)

Procedure

By default, data gathering is turned off.

1. To turn on data gathering for the devices, enter:

   echo on=1 > definition

2. To turn off data gathering for the devices, enter:

   echo on=0 > definition

3. To reset the collected data to 0, enter:

   echo data=reset > definition
Results

Depending on your distribution, the files for zfcp statistics can be found as follows:

- **SUSE Linux Enterprise Server 10 and later:** Depending on where debugfs is mounted: `<mount_point_debugfs>/statistics`.
  
  For example, if debugfs is mounted at directory `/sys/kernel/debug/`, all the collected statistics data can be found at `/sys/kernel/debug/statistics/`.

- **Older versions that use /proc:** Depending on where `/proc` is mounted: `<mount_point_proc>/statistics`.

For each device (adapter as well as LUN) a subdirectory is created when you mount the device. The subdirectory is named:

- zfcp-<device-bus-id> for an adapter
- zfcp-<device-bus-id>-<WWPN>-<LUN> for a LUN

Each subdirectory contains two files, a data file and a definition file.

What to do next

After you collect the appropriate diagnostic data, you can complete the following tasks:

- Chapter 3, “Contacting IBM Support,” on page 25
- Chapter 4, “Exchanging information with IBM,” on page 27

ziomon - Collect FCP performance data

As of SUSE Linux Enterprise Server 11, Red Hat Enterprise Linux 6, and Red Hat Enterprise Linux 5.8, use the ziomon tool to gather FCP performance data.

The monitor tool ziomon collects information and details about:

- The FCP configuration
- The system I/O traffic through FCP adapters
- The overall I/O latencies, adapter latencies, and fabric latencies
- The usage of the FCP resources

Use the ziorep tools to analyze the reports created by ziomon. The process is illustrated in Figure 1 on page 17.
Authorization

Root access is required on Linux operating systems.

ziomon syntax

See the ziomon man page for the complete syntax and all options.

```
ziomon [-l <size limit of output file>] [-i <interval>]

- d <duration> - o <output file> - <device node>
```

Parameters

- **-i <interval>**
  Specifies the elapsed time between writing data to disk in seconds. Defaults to 60 seconds.

- **-d <duration>**
  Specifies the monitoring duration in minutes. Must be a multiple of the interval length.

- **-l <size limit of output file>**
  Defines the upper limit of the output files. Must include one of the suffixes M (megabytes), G (gigabytes), or T (terabytes). This limit is only a tentative value that can be slightly exceeded.

- **-o <output file>**
  Specifies the prefix for the log file, configuration file, and aggregation file.
<device>
Denotes one or more device names that are separated by blanks.

Examples

To generate a diagnostic report for devices /dev/sda and /dev/sdb, issue the command:

```
[root@system]# ziomon -i 20 -d 5 -l 50M -o trace_data /dev/sda /dev/sdb
```

Output

The ziomon tool creates two output files in the directory where it was started:

- `<output file>.cfg` holds various configuration data from the system
- `<output file>.log` holds the raw data samples that are taken during the data collection phase in a binary format
- `<output file>.agg` aggregates old sample data when the .log file grows larger than the allowed limit, thus freeing the log file for more recent data.

Usage notes

- Needs vmalloc space for each device node and CPU.
- The ziomon tool can be stopped with CTRL+C before the time period expires.

ziorep - Create FCP performance report

After you collect FCP performance data using the ziomon tool, use the ziorep tool to create appropriate FCP performance reports.

Three reporting tools are available as of SUSE Linux Enterprise Server 11, Red Hat Enterprise Linux 6, and Red Hat Enterprise Linux 5.8.

- “ziorep_config - Configuration report” on page 19
- “ziorep_utilization - Report on utilization details” on page 19
- “ziorep_traffic - Traffic report” on page 20

For more information about the FCP performance reports, see How to use FC-attached SCSI devices with Linux on System z.

For a discussion about using the reports with examples, see the z/Journal article Investigating SCSI Devices on System z: How to Use the Ziomon Utilities to Enhance Performance available from [http://enterprisesystemsmedia.com](http://enterprisesystemsmedia.com)

ziorep_config - Configuration report

Use the ziorep_config to report the configuration of the attached SCSI storage and to visualize the interconnection between the different layers that are involved in the SCSI attachment.

The configuration data is reported according to configuration report type (adapter report, device report, or multipath report).

ziorep_config syntax

See the ziorep_config man page for the complete syntax and all options.
-i or --input <src_file>
   Specifies the configuration file that is created by `ziomon` as source.

-a or --adapter <device_bus_id>
   Limits the output to the list of FCP devices specified.

-A or --Adapter
   Prints the adapter (FCP device) report, this report is the default.

-D or --Device
   Prints the SCSI device report.

-M or --Map
   Prints the multipath mapper report.

**Example**

To generate a device report for a specific SCSI device from a previous `ziomon` run that created the configuration file `myfcp.cfg`, issue the following command:

```
[root@system]# ziorep_config -D -t -l 0x4021400f00000000 -i myfcp.cfg
```

**ziorep_utilization - Report on utilization details**

Use the `ziorep_utilization` command to produce a report on the usage of FCP resources.

There are two different reports available. The first report provides information on the physical adapters. This report includes usage statistics of the card’s bus, CPU, and overall utilization.

The second report provides various metrics on the virtual adapter. This report includes statistics on the Queued Direct I/O (QDIO) queue that is used to transfer data between the Linux system and the FCP adapter. Statistics that are given are average and maximum utilization in each interval and the number of instances when the queue was full.

**ziorep_utilization syntax**

See the `ziorep_utilization` man page for the complete syntax and all options.

```
[root@system]# ziorep_config -s -c chpid
```

-s or --summary
   shows a summary of the data.
-c or --chpid <chpid>
limits the data the specified FCP adapters. The format is a 2-byte hexadecimal
number. You can specify multiple FCP channels by using multiple -c command
line switches.

Example

To generate a utilization report for the specific physical adapter (CHPID) 50, issue
the following command:

[root@system]# ziorep_config -c 50 myutil.log

ziorep_traffic - Traffic report

Use the ziorep_traffic command produces a report about the systems I/O traffic
through FCP channels and traffic latency.

There are two reports available, varying by the level of detail:
• The default report shows traffic information on a summary level.
• A report that is limited to certain devices that gives detailed traffic information.

Each device is identified by WWPN or LUN and gives information about I/O rate
and throughput and latencies in the I/O subsystem, channel, and fabric. See the
ziorep_traffic man page for more details about possible aggregation levels.

ziorep_traffic syntax

See the ziorep_config man page for the complete syntax and all options.

```
    ziorep_traffic [-i <time>] [-D] [-C <val>] <out_file>
```

- i <time> or --interval <time>
    Sets the aggregation interval to <time> in seconds. Must be a multiple of the
    interval size of the source data. Set to 0 to aggregate over all data.

- C or --collapse <val>
    Specifies on what level you want to aggregate data. See the ziorep_traffic
    man page for more details about possible aggregation levels.

- D or --Device
    Gives detailed information about the traffic.

Example

To generate a traffic report that is called mytraffic.log for all devices with the
data aggregated to a 60-second interval, issue the following command:

[root@system]# ziorep_traffic -i 60 mytraffic.log
Obtaining QDIO performance statistics

For SUSE Linux Enterprise Server 11 SP2 and Red Hat Enterprise Linux 6.2, use the QDIO performance statistics to obtain information of QDIO devices. These statistics apply to FCP devices and to qeth devices.

About this task

To look at these debug logs use the Linux file system debugfs, which must be mounted. See "debugfs" on page 7 for details.

These statistics are located in <debugfs_mount>/qdio/<device_bus_id>/statistics where <debugfs_mount> is the mount point for debugfs and <device_bus_id> is the bus ID of an FCP or qeth device.

Procedure

- To collect QDIO performance statistics for the device fc00, issue the command:
  ```
  # echo 1 > /sys/kernel/debug/qdio/0.0.fc00/statistics
  ```

- To stop collecting QDIO performance statistics, issue:
  ```
  # echo 0 > /sys/kernel/debug/qdio/0.0.fc00/statistics
  ```

- To read the collected data, issue:
  ```
  # cat /sys/kernel/debug/qdio/0.0.fc00/statistics
  ```

What to do next

After you collect the appropriate diagnostic data, you can complete the following tasks:

- Chapter 3, “Contacting IBM Support,” on page 25
- Chapter 4, “Exchanging information with IBM,” on page 27

Special tools

Tools for special circumstances that can be used when debugging Linux on System z problems.

s390dbf traces - Use the kernel debug feature

All device drivers and other kernel components write debug log records. These records are available after a system crash. You can also read and save them on a running system.

To look at these debug logs use the Linux file system debugfs, which must be mounted. See "debugfs" on page 7 for details.

Below the s390dbf directory each registered component is represented by a subdirectory with the name of that component. The subdirectories contain files that represent different views of the debug log. Available views are: hex_ascii, sprintf, flush, pages, and level.

The debug information that is written to the logs depends on the debug level that is set for that log. The debug level ranges from 0 for the least detail to 6 for the
most detail. The default level is 2. Only debug entries with a level that is lower or equal to the actual level are written to the log.

To set or change a debug level, from the s390dbf subdirectory for the component you want to work with, issue:

```
echo <value> > level
```

**Examples**

- To collect the maximum amount of debug information, issue:
  ```
echo 6 > level
  ```

- To flush the debug log buffer for the component, issue:
  ```
echo - > flush
  ```

- The kernel debug feature uses wraparound memory buffers. To increase the buffer size, read it first and then enter a higher value with the following command:
  ```
echo 10 > pages
  ```

**top - See resource usage**

The `top` command provides a dynamic, real-time view of a running system and shows resource usage on a thread level. It can show, for example, CPU usage and detailed memory usage.

**Syntax**

See the `top` man page for the complete syntax and all options.

```
--top -d delay -n iterations
```

**Parameters**

- `-b` Writes the output for each interval into a file.
- `-d` Specifies the delay time interval in seconds.
- `-n` Indicates that the maximum number of iterations `top` should produce before it ends.
- `-p` Limits the output to the specified processes.

In the running `top` program, use the F key to configure the displayed columns. Use the W key to write the current configuration to `~/toprc` This is the default directory.
Example

To write 180 iterations 1 second apart into a file, issue:

```
[root@system]# top -b -d 1 -n 180 >top.log 2>&1
```

ps - Report a snapshot of the current processes

The `ps` command gives comprehensive statistics data on process level and reports a snapshot of the current processes.

See the `ps` man page for the complete syntax and all options.

Example

The following sample command shows every process in an easily readable format:

```
[root@system]# ( DELAY=10; while [ true ]; do echo "*** `date`; 
pidslo pid,user,%cpu,
%mem,wchan:15,nwchan,stat,time,flags,etime,command:50;
sleep $DELAY; done ) | tee psinfo.out
```

netstat - Show information about the Linux networking subsystem

The `netstat` command shows information about the Linux networking subsystem.

In particular `netstat` shows:

- Summary information of each protocol
- Detailed information about each connection and interface statistics
- Various error states, for example TCP segments retransmitted
- Information about routing tables

See the `netstat` man page for the complete syntax and all options.

Example

The following sample command shows summary statistics for each protocol:

```
[root@system]# netstat -s
```

Where:

- `-s` shows summary statistics that includes the number of incoming and outgoing packages.

tcpdump - Collect traffic information for a network interface

The `tcpdump` network analysis tool dumps traffic collected for a given network interface.
**tcpdump syntax**

See the `tcpdump` man page for the complete syntax and all options.

```
tcpdump [-s <length>] [-X] [-i <interface>]
```

**Parameters**

- `-s <length>`
  Writes `<length>` of data from each packet rather than the default 65535 bytes.

- `-X`  Writes each packet in hexadecimal and in ASCII format.

- `-i <interface>`
  Identifies the network interface.

**Example**

To dump network traffic for interface eth0, issue the command:

```
[root@system]# tcpdump -s 65000 -X -i eth0
```

**oprofile - profiling of all running code on Linux systems**

The oprofile tool offers profiling of all running code on Linux systems, providing various statistics.

For more information, see


**Dump tools**

When the system hangs, create a memory dump.

The following dump tools are available:

- The DASD dump tool writes the memory dump directly to a DASD partition. It supports both ECKD™ and FBA DASDs.
- The tape dump tool writes the memory dump directly to an ESCON/FICON tape device.
- The SCSI dump tool writes the memory dump into file system. It is supported for LPAR and as of z/VM 5.4.
- VMDUMP (for z/VM guest operating systems) writes the memory dump to z/VM spool space (VM reader). VMDUMP uses a dump format specific to z/VM, the dump must be converted. Do not use VMDUMP to dump large VM guests; the dump process is very slow.

For more information about dump tools, see Using the Dump Tools available at

pic.dhe.ibm.com/infocenter/lnxinfo/v3r0m0/topic/linz_r_main.html

In particular, the Using the Dump Tools book contains a chapter about handling large dumps that describes how to split large dumps, for example, with `makedumpfile`. 
Chapter 3. Contacting IBM Support

IBM Support provides assistance with product defects, answers FAQs, and helps users resolve problems with the product.

Before you begin

After trying to find your answer or solution by using other self-help options such as technote, you can contact IBM Support. Before contacting IBM Support, your company or organization must have an active IBM software maintenance agreement (SWMA), and you must be authorized to submit problems to IBM. For information about the types of available support, see the Support portfolio topic in the “Software Support Handbook”.

Procedure

To contact IBM Support about a problem:

1. Define the problem, gather background information, and determine the severity of the problem. For more information, see the Getting IBM support topic in the Software Support Handbook.
2. Gather diagnostic information.
3. Submit the problem to IBM Support in one of the following ways:
   - Using IBM Support Assistant (ISA):
   - Online through the IBM Support Portal. You can open, update, and view all of your service requests from the Service Request portlet on the Service Request page.
   - By phone: For the phone number to call in your region, see the Directory of worldwide contacts web page.

Results

If the problem that you submit is for a software defect, IBM Support creates a software patch. Missing or inaccurate documentation is normally corrected in the next documentation update. The patch is sent to the Linux distributor for inclusion. Whenever possible, IBM Support provides a workaround that you can implement until the patch is available. For a subscription service for Linux operating system software updates, see the Linux support site available at http://www.ibm.com/systems/z/os/linux/support/
Chapter 4. Exchanging information with IBM

To diagnose or identify a problem, you might need to provide IBM Support with data and information from your system. In other cases, IBM Support might provide you with tools or utilities to use for problem determination.

Sending information to IBM Support

To reduce the time that is required to resolve your problem, you can send trace and diagnostic information to IBM Support.

Procedure

To submit diagnostic information to IBM Support:

1. Open a problem management record (PMR).
2. Collect the diagnostic data that you need. Diagnostic data helps reduce the time that it takes to resolve your PMR. See the following topics:
   - "Collecting data for general Linux on System z problems" on page 4
   - "Collecting data for performance problems" on page 4
   - "Collecting data for network problems" on page 5
   - "Collecting data for hung system problems" on page 5
   - "Collecting data for middleware problems" on page 5
3. Compress the files by using the .zip or .tar file format.
4. Transfer the files to IBM. You can use one of the following methods to transfer the files to IBM:
   - Standard data upload methods: FTP, HTTP
     There are two servers available for uploading data:
     - testcase.boulder.ibm.com (US only)
     - ecurep.ibm.com (international)
   - For upload instructions, see http://www.ibm.com/de/support/ecurep/index.html
   - Secure data upload methods: FTPS, SFTP, HTTPS
   - IBM Support Assistant
   - The Service Request tool
All of these data exchange methods are explained on the IBM Support website.

Receiving information from IBM Support

Occasionally an IBM technical-support representative might ask you to download diagnostic tools or other files. You can use FTP to download these files.

Before you begin

Ensure that your IBM technical-support representative provided you with the preferred server to use for downloading the files and the exact directory and file names to access.
Procedure

To download files from IBM Support:
1. Use FTP to connect to the site that your IBM technical-support representative provided and log in as anonymous. Use your email address as the password.
2. Change to the appropriate directory:
   a. Change to the /fromibm directory.
      \texttt{cd fromibm}
   b. Change to the directory that your IBM technical-support representative provided.
      \texttt{cd nameofdirectory}
3. Enable binary mode for your session.
   \texttt{binary}
4. Use the \texttt{get} command to download the file that your IBM technical-support representative specified.
   \texttt{get filename.extension}
5. End your FTP session.
   \texttt{quit}
Accessibility

Accessibility features help users who have a disability, such as restricted mobility or limited vision, to use information technology products successfully.

Documentation accessibility

The Linux on System z publications are in Adobe Portable Document Format (PDF) and should be compliant with accessibility standards. If you experience difficulties when you use the PDF file and want to request a Web-based format for this publication, use the Reader Comment Form in the back of this publication, send an email to eservdoc@de.ibm.com, or write to:

IBM Deutschland Research & Development GmbH
Information Development
Department 3282
Schoenaicher Strasse 220
71032 Boeblingen
Germany

In the request, be sure to include the publication number and title.

When you send information to IBM, you grant IBM a nonexclusive right to use or distribute the information in any way it believes appropriate without incurring any obligation to you.

IBM and accessibility

See the IBM Human Ability and Accessibility Center for more information about the commitment that IBM has to accessibility at www.ibm.com/able
Notices

This information was developed for products and services offered in the U.S.A. IBM may not offer the products, services, or features discussed in this document in other countries. Consult your local IBM representative for information on the products and services currently available in your area. Any reference to an IBM product, program, or service is not intended to state or imply that only that IBM product, program, or service may be used. Any functionally equivalent product, program, or service that does not infringe any IBM intellectual property right may be used instead. However, it is the user's responsibility to evaluate and verify the operation of any non-IBM product, program, or service.

IBM may have patents or pending patent applications covering subject matter described in this document. The furnishing of this document does not give you any license to these patents. You can send license inquiries, in writing, to:

IBM Director of Licensing
IBM Corporation
North Castle Drive
Armonk, NY 10504-1785
U.S.A.

The following paragraph does not apply to the United Kingdom or any other country where such provisions are inconsistent with local law:

INTERNATIONAL BUSINESS MACHINES CORPORATION PROVIDES THIS PUBLICATION “AS IS” WITHOUT WARRANTY OF ANY KIND, EITHER EXPRESS OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF NON-INFRINGEMENT, MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. Some states do not allow disclaimer of express or implied warranties in certain transactions, therefore, this statement may not apply to you.

This information could include technical inaccuracies or typographical errors. Changes are periodically made to the information herein; these changes will be incorporated in new editions of the publication. IBM may make improvements and/or changes in the product(s) and/or the program(s) described in this publication at any time without notice.

Any references in this information to non-IBM Web sites are provided for convenience only and do not in any manner serve as an endorsement of those Web sites. The materials at those Web sites are not part of the materials for this IBM product and use of those Web sites is at your own risk.

IBM may use or distribute any of the information you supply in any way it believes appropriate without incurring any obligation to you.

The licensed program described in this information and all licensed material available for it are provided by IBM under terms of the IBM Customer Agreement, IBM International Program License Agreement, or any equivalent agreement between us.

All statements regarding IBM's future direction or intent are subject to change or withdrawal without notice, and represent goals and objectives only.
This information is for planning purposes only. The information herein is subject to change before the products described become available.

**Trademarks**

IBM, the IBM logo, and ibm.com are trademarks or registered trademarks of International Business Machines Corp., registered in many jurisdictions worldwide. Other product and service names might be trademarks of IBM or other companies. A current list of IBM trademarks is available on the Web at "Copyright and trademark information" at [www.ibm.com/legal/copytrade.shtml](http://www.ibm.com/legal/copytrade.shtml)

Adobe is either a registered trademark or trademark of Adobe Systems Incorporated in the United States, and/or other countries.

Linux is a registered trademark of Linus Torvalds in the United States, other countries, or both.
Index

Special characters
/debug, mount point 7
/proc, mount point 7
/sys, mount point 7
/sys/kernel/debug, mount point 7

A
accessibility 29
assumptions 7
authority
  root 7

C
checklists
  troubleshooting
    Linux on System z 3
collecting data for general Linux on System z problems 4
conventions 7

D
DASD statistics 14
dasdstat
  troubleshooting tool 14
dbginfo 7
diagnostic data
  collecting for hung system problems 5
  collecting for middleware problems 5
  collecting for network problems 5
  collecting for performance problems 10
    starting sadc/sar directly 11
dump tools 24

G
general Linux on System z problems
collecting data for 4

H
hung system
  troubleshooting
    collecting diagnostic data 5

I
iostats
  troubleshooting tool 12

L
Linux on System z
  troubleshooting checklist 3

M
middleware
  troubleshooting
    collecting diagnostic data 5
MONWRITE 13
mount point
debugfs 7
procs 7
sysfs 7

N
network
  troubleshooting
    collecting diagnostic data 5

O
oprofile 24

P
performance
  statistics, QDIO 21
performance problems
  collecting diagnostic data 10
problem determination
  exchanging information with IBM Support 27
ps 23

Q
QDIO performance
  statistics 21

R
root
  authority 7

S
s390dbf 21
sadc
  starting as service 10
  troubleshooting tool 10
sar
  starting as service 10
SCSI statistics 15
starting sadc/sar directly
  troubleshooting
    collecting diagnostic data 11
statistics
  QDIO performance 21
supportconfig 8, 9

© Copyright IBM Corp. 2013
troubleshooting

Linux on System z 3
collecting data for general Linux on System z problems 4
collecting data for hung system problems 5
collecting data for middleware problems 5
collecting data for network problems 5
collecting data for performance problems 10
starting sadc/sar directly 11
general tools 7
identifying problems, techniques for 1
Linux on System z 1
performance tools 10
special tools 21
tools 7
sadc 10
troubleshooting and support
contacting IBM Support 25
exchanging information with IBM Support 27
troubleshooting techniques 1
troubleshooting tools
DASD statistics 14
dasdstat 14
dbginfo 7
dump tools 24
iostats 12
MONWRITE 13
oprofile 24
ps 23
s390dbf 21
SCSI statistics 15
supportconfig 8, 9
tcpdump 24
top 22
ziomon 16
ziorep 18
ziorep_config 18
ziorep_traffic 20
ziorep_utilization 19
Readers’ Comments — We'd Like to Hear from You

Linux on System z
Troubleshooting

Publication No. SC34-2612-02

We appreciate your comments about this publication. Please comment on specific errors or omissions, accuracy, organization, subject matter, or completeness of this book. The comments you send should pertain to only the information in this manual or product and the way in which the information is presented.

For technical questions and information about products and prices, please contact your IBM branch office, your IBM business partner, or your authorized remarketer.

When you send comments to IBM, you grant IBM a nonexclusive right to use or distribute your comments in any way it believes appropriate without incurring any obligation to you. IBM or any other organizations will only use the personal information that you supply to contact you about the issues that you state on this form.

Comments:

Thank you for your support.
Submit your comments using one of these channels:
• Send your comments to the address on the reverse side of this form.
• Send your comments via email to: eservdoc@de.ibm.com

If you would like a response from IBM, please fill in the following information:

Name

Address

Company or Organization

Phone No.

Email address