
Vertica Database 2.0.5-0

Installation Guide

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PostgreSQL

This product uses the PostgreSQL Database Management System(formerly known as Postgres, then as Postgres95)

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Python Dialog

The Administration Tools part of this product uses Python Dialog,a Python module for doing console-mode user interaction.

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On Vertica systems, complete source code of the Python dialog package and complete text of the GNU Lesser General Public License can be found on the Vertica Systems website at <http://www.vertica.com/licenses/pythondialog-2.7.tar.bz2> <http://www.vertica.com/licenses/pythondialog-2.7.tar.bz2>

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Technical Support

To submit problem reports, questions, comments, and suggestions, please use the Technical Support page on the Vertica Systems, Inc. Web site:

<http://www.vertica.com/support> (http://www.vertica.com/support)

You must be a registered user in order to access the page.

Before reporting a problem, please run the Diagnostics Utility described in the Troubleshooting Guide and attach the resulting .zip file.

About the Documentation

Where to Find the Vertica Documentation

Vertica Systems, Inc. recommends that you copy the Vertica documentation from the database server (any cluster host) to a client system on which you can use a browser and/or the Adobe Reader.

Database Server Systems

The Vertica Database Documentation Set is automatically installed in the `/opt/vertica/doc/` directory on all cluster hosts. If you have a browser and/or the Adobe Reader installed on a cluster host, you can access the documentation directly.

<code>/opt/vertica/doc/HTML/Master/index.htm</code>
<code>/opt/vertica/doc/JDBC/index.htm</code>
<code>/opt/vertica/doc/PDF/book-name.pdf</code>

Database Client Systems

To create a copy of the Vertica documentation on a client system, do one of the following:

- Download the documentation package (`.tar.gz` or `.zip`) from the Vertica Systems, Inc. Web site and extract the files to a directory on the client system, using the original pathnames
- Copy the documentation directories from a database server system to a convenient location in your client system. All cross-references within the HTML documentation are relative so there is no location dependency.

<code><your-location>HTML/Master/index.htm</code>
<code><your-location>JDBC/index.htm</code>
<code><your-location>PDF/book-name.htm</code>

World Wide Web

You can read and/or download the Vertica documentation from the [Vertica Systems, Inc. Web site](http://www.vertica.com/v-zone/product_documentation):

http://www.vertica.com/v-zone/product_documentation `http://www.vertica.com/v-zone/product_documentation`.

You need a V-Zone login to access the Product Documentation page.

The documentation on the Vertica Systems, Inc. Web site is updated each time a new release is issued. If you are using an older version, refer to the documentation on your database server or client systems.

Reading the HTML Files

The Vertica documentation files are provided in HTML browser format for platform independence. The HTML files only require a browser that can **display frames** properly and has **JavaScript** enabled. The HTML files **do not require a Web (HTTP) server**.

The Vertica documentation has been tested on the following browsers:

- Internet Explorer 7
- FireFox
- Opera
- Safari

Please report any script, image rendering, or text formatting problems to **Technical Support** (on page 9).

The Vertica documentation may contain links to Web sites of other companies or organizations that Vertica does not own or control. If any of these links are broken, please inform us.

Printing the PDF Files

The documentation files are supplied in **Adobe Acrobat™ PDF** document format for the purpose of making printed copies as needed. The documents are designed to be printed on standard 8½ x 11 paper using full duplex (two sided printing).

You can open and print any of the PDF documents using the **Adobe Reader**. (You can download the latest version of the free Acrobat Reader from the **Adobe Web site** (<http://www.adobe.com/products/acrobat/readstep2.html>).

HTML links to the PDF files are provided here for browser access.

- Database Administrator's Guide
- Database Administrator's Guide (Advanced)
- Glossary of Terms
- Installation Guide
- Product Overview
- Quick Start
- Release Notes
- SQL Programmer's Guide
- SQL Reference Manual
- Troubleshooting Guide

Suggested Reading Paths

This section provides a suggested reading path for various types of users. Read the manuals listed under All Users first.

All Users

- Product Overview (basic concepts critical to understanding Vertica)
- Quick Start (step-by-step guide to getting Vertica up and running)
- Glossary of Terms (glossary of terms)

System Administrators

- Installation Guide (platform configuration and software installation)
- Release Notes (release-specific information)
- Troubleshooting Guide (general troubleshooting information)

Database Administrators

- Installation Guide (platform configuration and software installation)
- Database Administrator's Guide (database configuration, loading, security, and maintenance)
- Troubleshooting Guide (general troubleshooting information)

Application Developers

- SQL Programmer's Guide (connecting to a database, queries, transactions, etc.)
- SQL Reference Manual (Vertica-specific language information)
- Troubleshooting Guide (general troubleshooting information)

Where to Find Additional Information

Visit the **Vertica Systems, Inc. Web site** (<http://www.vertica.com>) to keep up to date with:

- Downloads
- Frequently Asked Questions (FAQs)
- Discussion forums
- News, tips, and techniques

Typographical Conventions

It is important to understand the terms and typographical conventions used in this document.

General Convention	Description
colored bold text	introduces new terms defined either in the text, the glossary, or both.
<i>normal italic text</i>	indicates emphasis and the titles of other documents.
UPPERCASE TEXT	indicates the name of an SQL command or keyword.
monospace text	indicates literal interactive or programmatic input/output.
<i>italic monospace text</i>	indicates user-supplied information in interactive or programmatic input/output.
bold monospace text	indicates literal interactive user input
↵	indicates the Return/Enter key; implicit on all user input that includes text
SQL Syntax Convention	Description
indentation	is an attempt to maximize readability; SQL is a free-form language.
backslash \	continuation character used to indicate text that is too long to fit on a single line.
braces { }	indicate required items.
brackets []	indicate optional items.
ellipses ...	indicate an optional sequence of similar items.
vertical ellipses ≡	indicate an optional sequence of similar items or that part of the text has been omitted for readability.
vertical line	within braces or brackets, indicates a choice .

Preface

This document explains how to:

- configure the hardware platform (hosts) needed to support a Vertica database
- obtain and install the Vertica software
- install optional features such as ODBC, JDBC, vsql, etc.

For best results, Vertica strongly recommends that you read this Installation Guide completely prior to installation, particularly the ***Before You Install*** (page 21) section.

Audience

This guide is intended for anyone responsible for installing and configuring Vertica.

Prerequisites

- This document assumes that you have **become familiar with the concepts** discussed in the Product Overview.
- You must have the **root password** for all cluster hosts. If this requirement conflicts with your organization's security policies, request that the procedures in this manual be performed by authorized personnel.

Vertica's physical architecture is designed to distribute physical storage and to allow parallel query execution over a potentially large collection of computing resources.

Terminology

The most important terms to understand are host, instance, node, cluster, and database:

Host

A host is a computer system with a 32-bit or 64-bit Intel or AMD processor, RAM, hard disk, and TCP/IP network interface (IP address and hostname). Hosts share neither disk space nor main memory with each other.

Instance

An instance of Vertica consists of the running Vertica process and disk storage (catalog and data) on a host. There can be only one instance of Vertica running on a host at any time.

Node

A node is a host configured to run an instance of Vertica. It is a member of a database cluster (see Node Definition). For a database to have the ability to recover from the failure of a node requires at least three nodes. Vertica Systems, Inc.

recommends that you use a minimum of four nodes.

Cluster

A cluster generally refers a collection of hosts or a collection of nodes bound to a database. A cluster is not part of a database definition and thus does not have a name.

Database

A database is a cluster of nodes that, when active, can perform distributed data storage and SQL statement execution through administrative, interactive, and programmatic user interfaces.

Overview

Carefully follow the instructions in the following sections:

1. **Before You Install** (page 21)

This section describes how to construct a hardware platform and how to prepare Linux for Vertica installation.

2. **Installing Vertica** (page 27)

This section describes how to:

- install the Vertica rpm package
- configure a cluster using `install_vertica`, a powerful shell script provided by Vertica that configures a cluster of hosts that can be used to create a database. The script does a number of checks to catch common Linux misconfigurations. It checks the connectivity and bandwidth characteristics of the communication links among the cluster machines and verifies other pre-requisites.

You must be logged in as root to use `install_vertica` and you must run `install_vertica` for all installations, including **upgrades** and **single-node** installations.

3. **After You Install** (page 35)

This section describes how to install your license key. The other procedures do not apply to all applications of Vertica and are optional.

Manual procedures are still provided in this document in case of installation problems. Use them only when you are instructed to do so by **Technical Support** (on page 9).

When you have completed these procedures, log into the Database Administrator Linux account and proceed to Configuring the Database in the Database Administrator's Guide.

Before You Install

Complete all of the tasks in this section before installing Vertica. When you have completed this section, proceed to *Installing Vertica* (page 27)

Obtain a Vertica License Key

Obtaining a License Key File

1. Go to <http://www.vertica.com/support> (<http://www.vertica.com/support>) and follow the instructions there. You will be given download access to a file whose name includes your organization and the date the license was requested.
2. Download the license key file to the Administration Host. Place the file in the directory `/tmp` with the filename `vlicense.key`.

After you have installed Vertica, you will install the license key as described in *Installing Your License Key* (page 35).

Construct a Hardware Platform

Constructing a hardware platform for your Vertica database involves a number of decisions.

Contact **Technical Support** (on page 9) for assistance in this area. By analyzing your schema and samples of your data and queries, Vertica can recommend hardware configuration options. If you have already constructed a platform, **Technical Support** (on page 9) will make sure that your platform meets all requirements and is configured correctly.

Install Linux

The same version of Linux must be installed on all host machines within a cluster.

Supported for all purposes including production:

- Red Hat Enterprise Linux 4, 64 bit
- Red Hat Enterprise Linux 5, 64 bit
- SUSE Linux Enterprise Server 10, 64 bit

Supported for non-production (testing and evaluation) purposes only:

- Red Hat Enterprise Linux 4, 32 bit
- Red Hat Enterprise Linux 5, 32 bit
- SUSE Linux Enterprise Server 10, 32 bit

- Fedora Core 6, 32 bit
- Fedora Core 6, 64 bit

Not Supported

- VMware

You can install Vertica on VMware virtual machines running Red Hat Enterprise Linux 4, 32 bit or 64 bit. However, Vertica Systems, Inc. strongly suggests that you **do not use this platform for any sort of storage capacity or performance testing**.

Allocate Swap Space

Swapping is undesirable and causes performance to degrade. Vertica recommends that you allocate swap space as follows:

<u>RAM</u>	<u>Swap Space</u>
1 GB	2 GB
2 GB	4 GB
up to 32 GB	RAM + 2 GB
more than 32 GB	RAM or less

Do not place a swap file on a disk containing the Vertica data files. If a host has only two disks (boot and data), put the swap file on the boot disk.

Set Up Hostname Resolution

This procedure sets up the minimal hostname resolution required for a Vertica installation.

On each host machine that will become part of the database cluster:

1. Make sure that the **/etc/hosts** file includes all of the hosts that will become part of the cluster. For example, if the hosts are named `host01`, `host02`, `host03`, and `host04`:

```
# Do not remove the following line, or various programs
# that require network functionality will fail.
127.0.0.1          localhost.localdomain localhost
192.168.13.128    host01
192.168.13.129    host02
192.168.13.130    host03
192.168.13.131    host04
```

replacing the example IP addresses shown here with the real ones.

2. Make sure that the host identifies itself correctly. For example, on `host01`:

```
# /bin/hostname -f
localhost.localdomain
```

If the hostname is anything other than `host01`:

```
# /bin/hostname host01
```

See **Check Hostname Resolution** (page 43) in the **Manual Procedures** (page 43) for more information.

Verify Python

Verify that Python is available on all hosts.

```
# which python
/usr/bin/python
```

If Python is not installed, browse to the **Official Python Website** <http://www.python.org/> and install Python on all hosts.

Verify sudo

Verify that sudo is available on all hosts.

```
# which sudo
/usr/bin/sudo
```

If sudo is not installed, browse to the **Sudo Main Page** <http://www.gratisoft.us/sudo/> and install sudo on all hosts.

Set the Database Time Zone

Make sure that the Linux environment variable **TZ** is set to the appropriate value on each host. For example, edit `/root/.bashrc` and add:

```
export TZ=EST5EDT
```

The TZ environment variable sets the default value of the corresponding SQL TIMEZONE run-time parameter (see SET TIMEZONE).

The following time zone names are recognized by Vertica as valid settings for the TIMEZONE run-time parameter. Note that these names are conceptually as well as practically different from the names shown in Time Zone Abbreviations For Input: most of these names imply a local daylight-savings time rule, whereas the former names each represent just a fixed offset from UTC.

In many cases there are several equivalent names for the same zone. These are listed on the same line. The table is primarily sorted by the name of the principal city of the zone.

Time Zone
Africa (on page 49)
America (on page 51)

Antartica (on page 56)
Asia (on page 57)
Atlantic (on page 60)
Australia (on page 61)
CET
EET
Etc/GMT (on page 62)
Europe (on page 63)
Factory
GMT GMT+0 GMT-0 GMT0 Greenwich Etc/GMT Etc/GMT+0 Etc/GMT-0 Etc/GMT0 Etc/Greenwich
Indian (on page 65)
MET
Pacific (on page 66)
UCT Etc/UCT
UTC Universal Zulu Etc/UTC Etc/Universal Etc/Zulu
WET

In addition to the names listed in the table, Vertica will accept time zone names of the form *STDoffset* or *STDoffsetDST*, where *STD* is a zone abbreviation, *offset* is a numeric offset in hours west from UTC, and *DST* is an optional daylight-savings zone abbreviation, assumed to stand for one hour ahead of the given offset. For example, if `EST5EDT` were not already a recognized zone name, it would be accepted and would be functionally equivalent to USA East Coast time. When a daylight-savings zone name is present, it is assumed to be used according to USA time zone rules, so this feature is of limited use outside North America. One should also be wary that this provision can lead to silently accepting bogus input, since there is no check on the reasonableness of the zone abbreviations. For example, `SET TIMEZONE TO FOOBAR0` will work, leaving the system effectively using a rather peculiar abbreviation for GMT.

Set the Database Locale (Language)

1. Make sure that the Linux environment variable `LANG` is set to `en_US.UTF-8` on each host. For example, edit `/root/.bashrc` and add:

```
export LANG=en_US.UTF-8
```

2. Make sure that no other environment variable supersedes `LANG`. Vertica determines the database locale by consulting the Linux environment variables in the following order until one is found to be set:

1. `LC_ALL`

determines the values for all locale categories. The value of the `LC_ALL` environment variable takes precedence over any of the other environment variables starting with `LC_` (`LC_COLLATE`, `LC_CTYPE`, `LC_MESSAGES`, `LC_MONETARY`, `LC_NUMERIC`, `LC_TIME`) and the `LANG` environment variable.

2. `LC_CTYPE`

determines the interpretation of sequences of bytes of text data as characters (for example, single- as opposed to multi-byte characters), the classification of characters (for example, alpha, digit, graph) and the behaviour of character classes. Additional semantics of this variable, if any, are implementation-dependent.

3. `LANG`

determines the locale category for native language, local customs and coded character set in the absence of the `LC_ALL` and other `LC_*` (`LC_COLLATE`, `LC_CTYPE`, `LC_MESSAGES`, `LC_MONETARY`, `LC_NUMERIC`, `LC_TIME`) environment variables. This can be used by applications to determine the language to use for error messages and instructions, collating sequences, date formats, and so forth.

Make Sure That `/dev/pts` is Mounted

Make sure that `/dev/pts` is mounted.. Installing Vertica on a host that is missing the mount point `/dev/pts` may result in the following error when creating a database:

```
TIMEOUT ERROR: Could not login with SSH. Here is what SSH said:  
Last login: Sat Dec 15 18:05:35 2007 from node01
```

Remove Non-Essential Applications

For optimal performance, Vertica is designed to use all available resources on each host machine. Thus, Vertica Systems, Inc. recommends that you:

- remove or disable all non-essential applications from cluster hosts
- deploy Vertica as the only active process on each host (other than Linux processes)

Back Up Existing Databases

If you are doing an upgrade installation, back up the following for all existing databases:

- catalog directory
- data directory
- /opt/vertica/

Installing Vertica

This section describes how to install the Vertica software on a cluster. It assumes that you have already performed the tasks in the **Before You Install** (page 21) section of this document.

Upgrade Installations

If you have previously installed Vertica on any cluster host:

- Vertica **V1.0** and earlier must be **uninstalled**. Databases built with **V1.0** are not compatible with newer versions of Vertica. You must **rebuild** the database using a later version.
- Vertica **V1.1** can be upgraded to **V1.2**. Use the instructions in the V1.2 1-9 documentation.
- Vertica **V1.2** can be upgraded to **V1.3**. Use the instructions in the V1.3.16-0 documentation.
- Vertica **V1.3** can be upgraded to **2.0**. (Use the instructions below.)

Downgrade Installations

Downgrade installations are not supported.

Installation Procedure

Do not skip any part of this procedure. You must run `install_vertica` for all installations, including upgrades and single-node installations.

1. Use a Web browser to **download the Vertica rpm package** from http://www.vertica.com/v-zone/download_vertica. Make sure that the package you download **matches the operating system** on which you intend to install it, not the machine architecture. The actual package names may be different than those shown here.

<code>vertica_2.0.5-0.i386.RHEL4.rpm</code> <code>vertica_2.0.5-0.x86_64.RHEL4.rpm</code> <code>vertica_2.0.5-0.i386.RHEL5.rpm</code> <code>vertica_2.0.5-0.x86_64.RHEL5.rpm</code> <code>vertica_2.0.5-0.i386.SUSE10.rpm</code> <code>vertica_2.0.5-0.x86_64.SUSE10.rpm</code> <code>vertica_2.0.5-0.i386-FC6_32.rpm</code> <code>vertica_2.0.5-0.x86-FC6_64.rpm</code>	Notes: <ul style="list-style-type: none">• Only 64-bit packages are supported for production databases.• 32-bit packages are provided for testing and evaluation purposes only.
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1. If necessary, **copy the rpm package** to the host on which you intend to install it and use the host's **console device** or a **remote terminal** window (xterm, PuTTY, etc.) to perform the installation procedure.
2. If you have previously installed Vertica V1.3 on any of the hosts in the cluster, use the Administration Tools to **shut down any running database**. The database must stop normally. You cannot upgrade a database that requires recovery.
3. Choose a host machine and **log in as root** (or log in as another user and switch to root):

```
$ su - root
password: <root-password>
#
```

The host that you choose becomes the Administration Host for the purposes of using the Administration Tools.

4. **Run the rpm package installer.**

```
# rpm -Uvh pathname
```

where *pathname* is the Vertica package file you downloaded.

If the rpm installer reports multiple dependency problems, you are probably trying to install the wrong package. Make sure that the machine architecture (32-bit or 64-bit) of the package you downloaded matches the operating system.

```
Preparing...
##### [100%]
 1:vertica
##### [100%]
```

Vertica Database 2.0.5-0 successfully installed.

The documentation files (HTML and PDF) are installed in:
 /opt/vertica/doc/

To read the documentation:
<file:///opt/vertica/doc/HTML/Master/index.htm>

To try the Quick Start tutorial:
<file:///opt/vertica/doc/HTML/QuickStart/index.htm>

To download the latest documentation in zip or tar format:
http://www.vertica.com/v-zone/product_documentation

To complete installation and configuration of the cluster,
 run /opt/vertica/sbin/install_vertica

5. **Run the installation script** as shown:

```
# /opt/vertica/sbin/install_vertica -s host_list -r rpm_package -u
  dba_username
```

-s <i>host_list</i>	a comma-separated list of hostnames or IP addresses to include in the cluster; do not include space characters in the list. Examples: -s host01,host02,host03 -s 192.168.233.101,192.168.233.102,192.168.233.103 This parameter is required and has no default value.
-r <i>rpm_package</i>	the pathname of the rpm package that you installed in the previous step. Example: -r vertica_2.0.5-0.x86_64.RHEL5.rpm This parameter is required and has no default value.
-u <i>dba_username</i>	the name of the Database Administrator Linux account to create. Only this

	account can run the Administration Tools. If you omit the <code>-u</code> parameter, the default database administrator account name is <code>dbadmin</code> .
--	--

	This parameter is optional for new installations only. If upgrading, use the <code>-u</code> parameter to specify the same DBA account name that you used previously. Otherwise you may encounter problems later.
--	--

The complete set of **installation parameters** (see "install_vertica" on page 30) including optional parameters and example output are described in the next section.

6. Provide the **root password** when prompted. The password does not echo on the command line.

```
Vertica Database 2.0.5-0 Installation Tool
Please enter password for root@host01:password
```

7. Provide the **database administrator** account password when prompted:

```
Enter password for new UNIX user dbadmin:password
Retype new UNIX password for user dbadmin:password
```

The installation script creates a new Linux user account (**dbadmin** by default) with the password that you provide.

8. **Carefully examine any warnings** produced by `install_vertica` and correct the problems if possible. For example, insufficient RAM, insufficient Network throughput and too high readahead settings on filesystem may cause performance problems later on.

Ignore insufficient RAM warnings when installing on VMware.

9. **Optionally perform the steps** in the following sections:
 - **Installing the JDBC Driver (Optional)** (page 36)
 - **Installing the ODBC Driver (Optional)** (page 37)
 - **Install vsql Client Application on Non-Cluster Hosts (Optional)** (page 38)
10. **Disconnect from the Administration Host** as instructed by the script. This is required in order to:
 - set certain system parameters correctly
 - function as the Vertica database administrator

At this point, Linux root privileges are no longer needed. The remaining steps can be performed by the database administrator.

Exception: when creating a new database, the database administrator may wish to use different data and/or catalog locations than those created by the installation script. In that case, a Linux administrator may need to create those directories and change their ownership to the database administrator.

11. **Log in** to the Database Administrator account on the administration host.
12. **Install the license key** you downloaded previously as described in **Installing Your License Key** (page 35).
13. If you have not already done so, **proceed** to the Tutorial Procedure in the Quick Start. Otherwise, proceed to Configuring the Database in the Database Administrator's Guide.

install_vertica

The `install_vertica` script creates a cluster of nodes on which you can create a database.

Syntax

```
/opt/vertica/sbin/install_vertica
-s host_list
-r rpm_package
[ -u dba_username ]
[ -p dba_password ]
[ -l dba_home_directory ]
[ -d data_directory ]
[ -P root_password ]
```

Semantics

<i>host_list</i>	a comma-separated list of hostnames or IP addresses to include in the cluster; do not include space characters in the list. Example: -s host01,host02,host03 -s 192.168.233.101,192.168.233.102,192.168.233.103 This parameter is required and has no default value.
<i>rpm_package</i>	the name of the rpm package that contained this script .Example: -r vertica_2.0.5-0.x86_64.RHEL5.rpm This parameter is required and has no default value.
<i>dba_username</i>	the name of the Database Administrator Linux account to create. Only this account can run the Administration Tools. If you omit the <code>-u</code> parameter, the default database administrator account name is <code>dbadmin</code> . This parameter is optional for new installations only. If upgrading, use the <code>-u</code> parameter to specify the same DBA account name that you used previously. Otherwise you may encounter problems later.
<i>dba_password</i>	the password for the Database Administrator account; if not supplied, the script prompts for the password and does not echo the input
<i>dba_home_directory</i>	the home directory for the Database Administrator; default is <code>/home/dba_username</code>
<i>data_directory</i>	the default directory for database data and catalog files; default is <code>/home/dba_home_directory</code>
<i>root_password</i>	the root password to use by default for each cluster host; if not supplied, the script prompts for the password if and when necessary and does not echo the input

Notes

- Do not be concerned by the message `-- Checking ...Failed`. It indicates that `install_vertica` found and is correcting an incorrect configuration parameter.

Example

```

# /opt/vertica/sbin/install_vertica -s host01,host02,host03 -r vertica_1.3.15-7.i386.RHEL4.rpm
Vertica Database 1.3.15-7 Installation Tool Please enter password for root@host01:
root@host01: Installation not performed on host01, same version already installed
root@host01: -- Checking status of ntpd service -- ...Done
root@host01: -- Checking vm.min_free_kbytes parameter in /sbin/sysctl -- ...Failed
root@host01: Info! Parameter vm.min_free_kbytes is less than 4096
root@host01: Setting vm.min_free_kbytes to 4096 ...
root@host01: -- Checking maximum number of open file descriptors in /etc/security/limits.conf --
...Failed
root@host01: Info! The maximum number of open file descriptors is less than 65536
root@host01: Setting open filehandle limit to 65536 ...
root@host02: -- Checking status of ntpd service -- ...Done
root@host02: -- Checking vm.min_free_kbytes parameter in /sbin/sysctl -- ...Failed
root@host02: Info! Parameter vm.min_free_kbytes is less than 4096
root@host02: Setting vm.min_free_kbytes to 4096 ...
root@host02: -- Checking maximum number of open file descriptors in /etc/security/limits.conf --
...Failed
root@host02: Info! The maximum number of open file descriptors is less than 65536
root@host02: Setting open filehandle limit to 65536 ...
root@host03: -- Checking status of ntpd service -- ...Done
root@host03: -- Checking vm.min_free_kbytes parameter in /sbin/sysctl -- ...Failed
root@host03: Info! Parameter vm.min_free_kbytes is less than 4096
root@host03: Setting vm.min_free_kbytes to 4096 ...
root@host03: -- Checking maximum number of open file descriptors in /etc/security/limits.conf --
...Failed
root@host03: Info! The maximum number of open file descriptors is less than 65536
root@host03: Setting open filehandle limit to 65536 ...
root@host01: -- Checking dbadmin_ssh directory -- ...Done
root@host01: -- Generating SSH keys for user dbadmin -- ...Done
root@host01: -- Copying root@host01:dbadmin\_ssh\_keys.tgz file to /tmp/dbadmin_ssh_keys.tgz --
...Done
Enter password for new UNIX user dbadmin:
Retype new UNIX password for user dbadmin:
root@host01: -- Creating user dbadmin -- ...Done
root@host01: -- Checking /home/dbadmin directory -- ...Done
root@host01: -- Changing the owner of /home/dbadmin directory to dbadmin -- ...Done
root@host01: -- Write check for /home/dbadmin directory -- ...Done
root@host01: -- Copying /tmp/dbadmin_ssh_keys.tgz file to root@host01:dbadmin\_ssh\_keys.tgz --
...Done
root@host01: -- Installing ssh keys -- ...Done
root@host02: -- Creating user dbadmin -- ...Done
root@host02: -- Checking /home/dbadmin directory -- ...Done
root@host02: -- Changing the owner of /home/dbadmin directory to dbadmin -- ...Done
root@host02: -- Write check for /home/dbadmin directory -- ...Done
root@host02: -- Copying /tmp/dbadmin_ssh_keys.tgz file to root@host02:dbadmin\_ssh\_keys.tgz --
...Done
root@host02: -- Installing ssh keys -- ...Done
root@host03: -- Creating user dbadmin -- ...Done
root@host03: -- Checking /home/dbadmin directory -- ...Done
root@host03: -- Changing the owner of /home/dbadmin directory to dbadmin -- ...Done
root@host03: -- Write check for /home/dbadmin directory -- ...Done
root@host03: -- Copying /tmp/dbadmin_ssh_keys.tgz file to root@host03:dbadmin\_ssh\_keys.tgz --
...Done
root@host03: -- Installing ssh keys -- ...Done
==== Site Availability Test =====
All sites are available ... ok
==== Testing host01 =====
Site availability ... ok
Passwordless SSH access ... ok
Passwordless SSH access to other sites ... ok
Getting various information about the site ... ok
Python is installed ... ok
Enough RAM per CPUs ... ok
Getting information about the ports ... ok
Port availability for Spread ... ok

```

Installation Guide

```
Port availability for Vertica          ... ok
Gathering information about the network ... ok
Sanity of /etc/hosts                  ... ok
Hostname resolution                    ... ok
IP configuration                        ... ok
```

```
==== Testing host02 =====
Site availability                       ... ok
Passwordless SSH access                ... ok
Passwordless SSH access to other sites ... ok
Getting various information about the site ... ok
Python is installed                     ... ok
Enough RAM per CPUs                    ... ok
Getting information about the ports      ... ok
Port availability for Spread             ... ok
Port availability for Vertica           ... ok
Gathering information about the network  ... ok
Sanity of /etc/hosts                    ... ok
Hostname resolution                      ... ok
IP configuration                         ... ok
```

```
==== Testing host03 =====
Site availability                       ... ok
Passwordless SSH access                ... ok
Passwordless SSH access to other sites ... ok
Getting various information about the site ... ok
Python is installed                     ... ok
Enough RAM per CPUs                    ... ok
Getting information about the ports      ... ok
Port availability for Spread             ... ok
Port availability for Vertica           ... ok
Gathering information about the network  ... ok
Sanity of /etc/hosts                    ... ok
Hostname resolution                      ... ok
IP configuration                         ... ok
```

```
==== Consistency Test =====
IP and Netmask consistency              ... ok
All sites are on the same subnet        ... ok
LANG and TZ environment variables       ... ok
```

```
==== Network Test =====
Network communication                   ... ok
```

```
root@host03: Test of site host01 (ok)
root@host03: =====
root@host03:
root@host03: Test of site host02 (ok)
root@host03: =====
root@host03:
root@host03: Test of site host03 (ok)
root@host03: =====
root@host03:
root@host03: Consistency Test (ok)
root@host03: =====
root@host03:
root@host03: Info: The $TZ environment variable is not set on host01
root@host03: Info: The $TZ environment variable is not set on host02
root@host03: Info: The $TZ environment variable is not set on host03
root@host03:
root@host03: Network Test (ok)
root@host03: =====
root@host03:
root@host03: Network communication (ok)
root@host03: -----
root@host03:
root@host01: -- Setting up spread daemon -- ...Done
```



```
root@host01: -- Copying /opt/vertica/config/vspread.conf file to
root@host01: /opt/vertica/config/vspread.conf -- ...Done
root@host01: -- Checking /opt/vertica/config/clusters directory -- ...Done
root@host01: -- Checking /opt/vertica/config directory -- ...Done
root@host01: -- Checking /opt/vertica/config/configInfo directory -- ...Done
root@host01: -- Checking /opt/vertica/config/share directory -- ...Done
root@host01: -- Checking /opt/vertica/config/users directory -- ...Done
root@host01: -- Checking /opt/vertica/config/users/dbadmin directory -- ...Done
root@host01: -- Changing the owner of /opt/vertica/config/users/dbadmin directory to dbadmin --
...Done
root@host01: -- Write check for /opt/vertica/config/users/dbadmin directory -- ...Done
root@host01: -- Starting spread daemon -- ...Done
root@host01: Creating node node1_host01 definition for host host01 ...Done
root@host02: -- Setting up spread daemon -- ...Done
root@host02: -- Copying /opt/vertica/config/vspread.conf file to
root@host02: /opt/vertica/config/vspread.conf -- ...Done
root@host02: -- Checking /opt/vertica/config/clusters directory -- ...Done
root@host02: -- Checking /opt/vertica/config directory -- ...Done
root@host02: -- Checking /opt/vertica/config/configInfo directory -- ...Done
root@host02: -- Checking /opt/vertica/config/share directory -- ...Done
root@host02: -- Checking /opt/vertica/config/users directory -- ...Done
root@host02: -- Checking /opt/vertica/config/users/dbadmin directory -- ...Done
root@host02: -- Changing the owner of /opt/vertica/config/users/dbadmin directory to dbadmin --
...Done
root@host02: -- Write check for /opt/vertica/config/users/dbadmin directory -- ...Done
root@host02: -- Starting spread daemon -- ...Done
root@host02: Creating node node2_host02 definition for host host02 ...Done
root@host03: -- Setting up spread daemon -- ...Done
root@host03: -- Copying /opt/vertica/config/vspread.conf file to
root@host03: /opt/vertica/config/vspread.conf -- ...Done
root@host03: -- Checking /opt/vertica/config/clusters directory -- ...Done
root@host03: -- Checking /opt/vertica/config directory -- ...Done
root@host03: -- Checking /opt/vertica/config/configInfo directory -- ...Done
root@host03: -- Checking /opt/vertica/config/share directory -- ...Done
root@host03: -- Checking /opt/vertica/config/users directory -- ...Done
root@host03: -- Checking /opt/vertica/config/users/dbadmin directory -- ...Done
root@host03: -- Changing the owner of /opt/vertica/config/users/dbadmin directory to dbadmin --
...Done
root@host03: -- Write check for /opt/vertica/config/users/dbadmin directory -- ...Done
root@host03: -- Starting spread daemon -- ...Done
root@host03: Creating node node3_host03 definition for host host03 ...Done
root@host03: Verifying spread configuration
Installation complete.
```

To create a database:

1. run /opt/vertica/bin/adminTools as dbadmin
2. select Create Database from the Configuration menu

#

After You Install

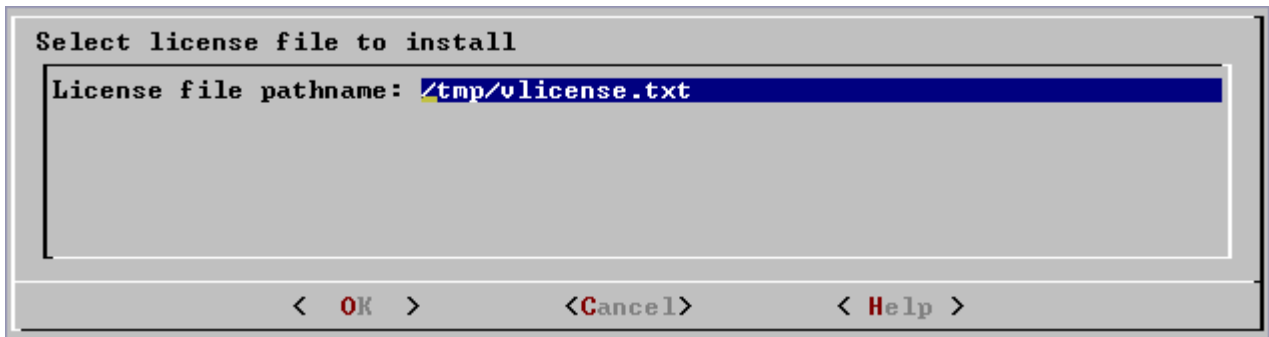
The tasks described in this section are optional and provided for your convenience. When you have completed this section, proceed to one of the following:

- Tutorial Procedure in the Quick Start
- Configuring the Database in the Database Administrator's Guide

Installing Your License Key

The first time you log in as the Database Administrator and run the Vertica Administration Tools, the user interface displays:

1. the EULA (license agreement). Type "accept" to proceed.
2. a form asking for the path to the license key file. Enter the **absolute pathname** of the file and press OK.

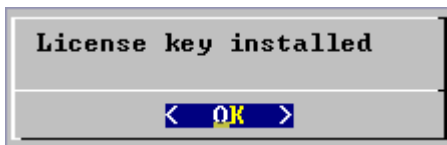


Select license file to install

License file pathname: /tmp/vlicense.txt

< OK > <Cancel> < Help >

Vertica copies the license key file to /opt/Vertica/config/vlicense.key.



License key installed

< OK >

Installing the JDBC Driver (Optional)

This section describes how to install the Vertica JDBC driver. For more information about the JDBC driver, refer to the Connecting With JDBC section of the SQL Programmer's Guide or to the documentation on the **PostgreSQL JDBC Driver** (<http://jdbc.postgresql.org/>) Web site.

1. Copy the jar file from its default location to a location on your client system that is within the CLASSPATH environment variable used by your JDBC client application. The default location of the jar file is:

```
/opt/vertica/client/JDBC/jars/vertica.jar
```

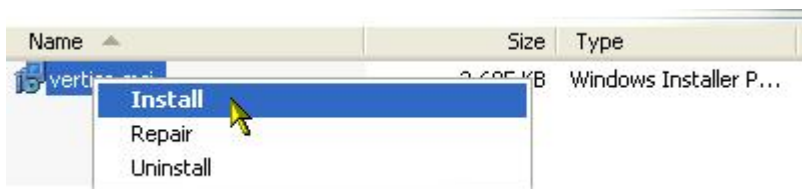
You may need root privileges to perform this step, depending on your client system configuration.

2. Make sure that the permissions on the jar file allow it to be read and executed by any user.

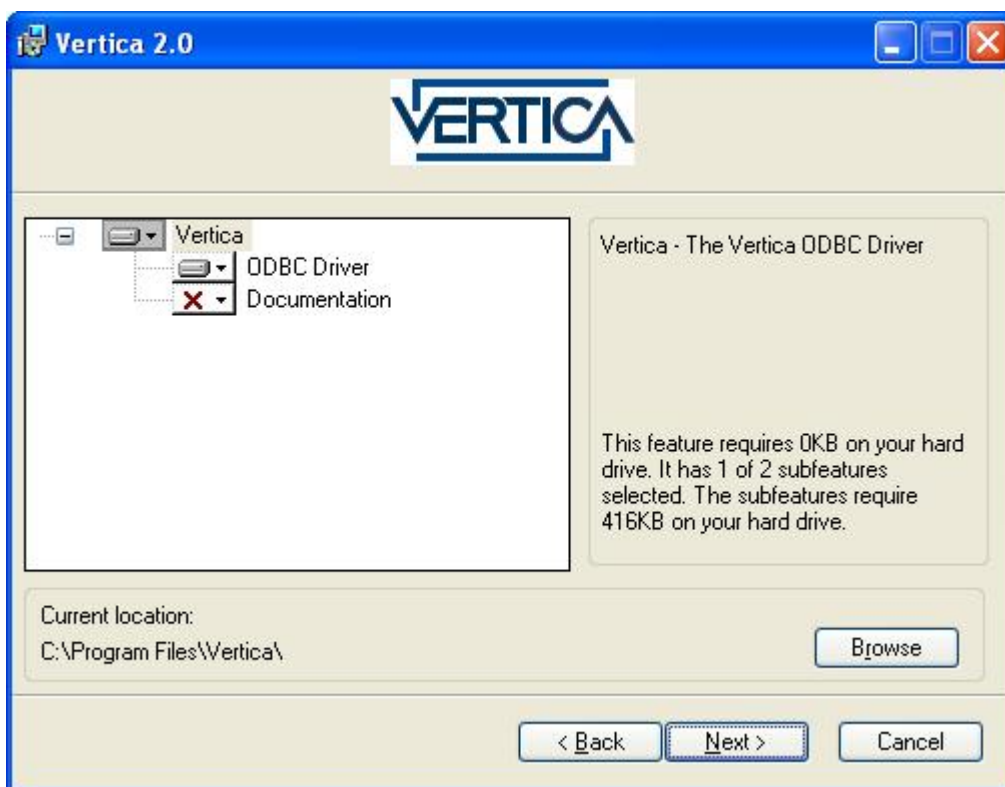
Installing the ODBC Driver (Optional)

This section describes how to install the Vertica ODBC driver. For more information about the ODBC driver, see Setting Up a Data Source Name in the SQL Programmer's Guide.

1. Log into a Windows account with Administrator privileges.
2. Download the Vertica ODBC Driver from http://www.vertica.com/v-zone/download_vertica to a temporary folder on your Windows system.
3. Unzip the file.
4. Using Windows Explorer, **right-click** the file **vertica.msi** and select **Install** from the pop-up menu.



5. Click **Next>**. The ODBC driver documentation is part of the Vertica documentation set and is not packaged with the driver.



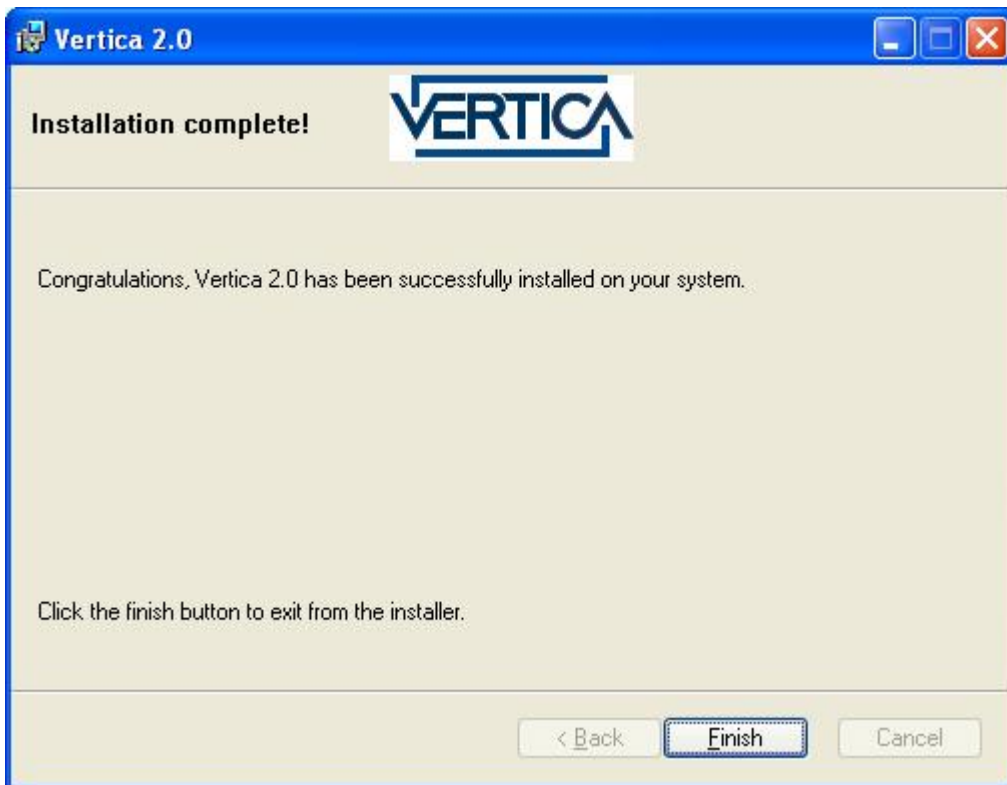
6. If you see the following error:

There is a problem with this Windows installed package.
A DLL required for this install to complete could not be run.
Contact your support personnel or package vendor.

Upgrade the **Windows Installer**

<http://www.microsoft.com/downloads/details.aspx?familyid=889482fc-5f56-4a38-b838-de776fd4138c&displaylang=en>.

7. In the installation complete dialog, click **Finish**.



Install vsql Client Application on Non-Cluster Hosts (Optional)

You can use the Vertica vsql executable image on a non-cluster host to connect to a Vertica database.

- If the non-cluster host is running the same operating system as the cluster, simply copy the image file to the remote system. For example:

```
$ scp host01:/opt/vertica/bin/vsql .  
$ ./vsql
```
- If the non-cluster host is running a different operating system, you must log in as root and install the Vertica rpm package on that host. For example:

```
# rpm -Uvh filename
```

where *filename* is one of the following packages. **Replace the build number** (for example 5-0) with the actual build number of the release you are installing.

<pre>vertica_2.0.5-0.i386.RHEL4.rpm vertica_2.0.5-0.x86_64.RHEL4.rpm vertica_2.0.5-0.i386.RHEL5.rpm vertica_2.0.5-0.x86_64.RHEL5.rpm vertica_2.0.5-0.i386.SUSE10.rpm vertica_2.0.5-0.x86_64.SUSE10.rpm vertica_2.0.5-0.i386-FC6_32.rpm vertica_2.0.5-0.x86-FC6_64.rpm</pre>	<p>Notes:</p> <ul style="list-style-type: none">• Fedora 4 Core packages are not supported.• 64-bit packages are required for production databases.• 32-bit packages are provided for testing and evaluation purposes only.
---	---

Notes

- Use the same Command Line Options that you would on a cluster host.
- Do you use more than two connections from the same host when bulk loading data.
- You cannot run vsql on a Cygwin bash shell (Windows). Use ssh to connect to a cluster host, then run vsql.

Uninstalling the Vertica Software

1. **For each host** in the cluster:

1. Choose a host machine and **log in as root** (or log in as another user and switch to root).

```
$ su - root
password: <root-password>
#
```

2. **Find the name** of the package that is installed:

```
# rpm -qa | grep vertica
```

3. **Remove the package:**

```
# rpm -e package
```

4. Optionally **delete the /opt/vertica/ directory** and all subdirectories:

```
# rm -rf /opt/vertica/
```

2. **For each client** system:

1. Delete the **JDBC driver** jar file.

2. Delete **ODBC driver data source names**.

3. Delete the **ODBC driver software**. On Windows, go to Start > Control Panel > Add or Remove Programs and look for "Vertica." Click Remove.

Manual Procedures

The procedures described in this section are performed automatically in the *Installing Vertica* (page 27) section. They are provided here **only to be used in case of installation problems** and/or when you are instructed to do so by *Technical Support* (on page 9). If did not encounter any installation problems, proceed to the Database Administrator's Guide for instructions on how to configure and operate a database.

Check Hostname Resolution

It is essential that the hostnames used in node definitions are correct. The output of the Linux **hostname** command (the fully qualified domain name) must be **identical** to that of the **ping** command (the hostname with which the machine identifies itself).

Invalid hostname resolution is a very common source of problems. Your Vertica database will not work unless the hostname resolution is correct.

Checking Hostname Resolution

For each host used as a node an a Vertica database:

1. Make sure that the `/etc/hosts` file contains an external IP address with a valid, fully qualified domain name and an optional short hostname. For example:

```
192.168.1.50      tristan.brittany.com tristan
```

2. Execute the **hostname -f** command. For example:

```
# /bin/hostname -f
tristan.brittany.com
```

3. **Ping** the host. For example:

```
# ping tristan.brittany.com
PING tristan.brittany.com (192.168.1.50) 56(84) bytes of data.
64 bytes from tristan.brittany.com (192.168.1.50): icmp_seq=0 ttl=64
time=0.086 ms
```

```
⋮
```

4. **Compare** the **hostname** command output (the fully qualified domain name) to the **ping** command output (the hostname with which the machine identifies itself). **These names must be identical.**

Setting the HOSTNAME Environment Variable

Some Linux installations require the HOSTNAME environment variable to be set correctly.

1. If the **HOSTNAME environment variable** is not defined, add the following line to your `/root/.profile` or `/root/.bashrc` file:

```
export HOSTNAME=`hostname`
```

2. If the **HOSTNAME environment variable** is already defined, make sure that it **matches the hostname** output:

```
# echo $HOSTNAME
tristan.brittany.com
```

If they do not match, change the value of HOSTNAME in `/root/.profile` or `/root/.bashrc`:

```
export HOSTNAME=`/bin/hostname -f`
```

Important Notes

- If you are using a host with **multiple network interfaces**, use the IP address that is connected to the other cluster hosts.
- Use a dedicated gigabit switch.
- Do not use DHCP **dynamically assigned IP addresses** for Vertica hosts. Use only static addresses or permanently leased DHCP addresses.
- Do not use the hostname **localhost** in a node definition.

Examples

In this example, the machines in the cluster are tristan, isolde and kurwenal. The Administration Tools are running on tristan.

1. Correct resolution:

```
# /bin/hostname -f
tristan.brittany.com
# ping tristan
Pinging tristan [192.168.0.50] with 32 bytes of data:
Reply from tristan.brittany.com: bytes=32 time<1ms TTL=128
```

Use the fully qualified domain name **tristan.brittany.com** in the cluster definition.

2. Correct resolution:

```
# ssh isolde hostname -f
isolde
# ping isolde
Pinging isolde [192.168.0.51] with 32 bytes of data:
Reply from isolde: bytes=32 time<1ms TTL=128
```

You can use the short hostname **isolde** in the cluster definition for convenience.

3. Incorrect resolution:

```
# ssh kurwenal hostname -f
kurwenal
# ping kurwenal
Pinging kurwenal [192.168.0.52] with 32 bytes of data:
Reply from 192.168.0.52: bytes=32 time<1ms TTL=128
```

The ping command output does not match the `/bin/hostname -f` output. Thus, the host machine **kurwenal** is not correctly configured and cannot be used in the cluster definition.

Check Subnet Masks

All hosts used in a Vertica database must have the same subnet mask. If this requirement is problematic, contact **Technical Support** (on page 9) for assistance.

Define the Loopback Address

Make sure that the `/etc/hosts` file exists and contains the loopback address **127.0.0.1** with only the name **localhost** in both fully qualified and unqualified forms. For example:

```
127.0.0.1          localhost.localdomain localhost
```

Do not use the loopback address `127.0.0.1` or the name `localhost` in a node definition.

Do not assign the cluster node hostname to `127.0.0.1`.

Enable Port 5433

Make sure port 5433 is TCP-enabled on all hosts for connections inside and outside the database. (If port 5433 cannot be used for this purpose, contact **Technical Support** (on page 9).) This includes making sure that all of the following are correctly configured or disabled.

- firewalls (not recommended for database hosts; see Firewall Configuration)
- SELinux (Security-Enhanced Linux)
- iptables

If it is consistent with your security policy, you can disable the Linux firewall and SELinux by running the command:

```
system-config-securitylevel
```

For More Information About SELinux

- **NSA's Page on SELinux** (<http://www.nsa.gov/selinux>)
- **Red Hat's Page on SELinux** (http://www.redhat.com/promo/security/?sc_cid=MSI_GSEL_25&s_kwcid=selinux|731967321)

For More Information About iptables

- **The netfilter.org "iptables" project** (<http://www.netfilter.org/projects/iptables/index.html>)
- **Iptables Tutorial 1.2.1** (<http://iptables-tutorial.frozentux.net/iptables-tutorial.html>)
- **LinuxGuruz Linux iptables HOWTO** (<http://www.linuxguruz.com/iptables/howto/iptables-HOWTO.html>)

Enable Secure Shell (SSH) Logins

The administrative account must be able to use Secure Shell (SSH) to log in (ssh) to all hosts without specifying a password. The shell script `install_vertica` does this automatically. This section describes how to do it manually if necessary.

1. If you do not already have SSH installed on all hosts, log in as root on each host and install it now. You can download a free version of the SSH connectivity tools from **OpenSSH** (<http://www.openssh.com/>).

2. Log in to the Vertica administrator account (dbadmin in this example).

3. Make your home directory (~) writable only by yourself. Choose one of:

```
# chmod 700 ~
```

or

```
# chmod 755 ~
```

where:

<u>700 Includes</u>	<u>755 Includes</u>
400 read by owner	400 read by owner
200 write by owner	200 write by owner
100 execute by owner	100 execute by owner
	040 read by group
	010 execute by group
	004 read by anybody (other)
	001 execute by anybody

4. Change to your home directory:

```
# cd ~
```

5. Generate a private key/ public key pair:

```
# ssh-keygen -t rsa
```

Generating public/private rsa key pair.

Enter file in which to save the key (/home/dbadmin/.ssh/id_rsa): ↵

Created directory '/home/dbadmin/.ssh'.

Enter passphrase (empty for no passphrase): ↵

Enter same passphrase again: ↵

Your identification has been saved in /home/dbadmin/.ssh/id_rsa.

Your public key has been saved in /home/dbadmin/.ssh/id_rsa.pub.

6. Make your .ssh directory readable and writable only by yourself:

```
# chmod 700 ~/.ssh
```

7. Change to the .ssh directory:

```
# cd ~/.ssh
```

8. Copy the file `id_rsa.pub` onto the file `authorized_keys2`.

- ```
cp id_rsa.pub authorized_keys2
```
9. Make the files in your `.ssh` directory readable and writable only by yourself:

```
chmod 600 ~/.ssh/*
```
  10. For each cluster host:

```
scp -r ~/.ssh <host>:.
```
  11. Connect to each cluster host. The first time you ssh to a new remote machine, you may get a message similar to the following:

```
$ ssh dev0
Warning: Permanently added 'dev0,192.168.1.92' (RSA) to the list of
known hosts.
```

This message appears only the first time you ssh to a particular remote host.

## Increase Free Memory

1. Add the following line to `/etc/sysctl.conf` (the kernel sysctl configuration file):

```
vm.min_free_kbytes = 4096
```
2. At the root command line prompt, enter:

```
echo 4096 > /proc/sys/vm/min_free_kbytes
```

## Increase the Maximum Number of Files Open

Vertica requires a large number of file handles. To avoid "too many files open" errors:

1. Check the current limit:

```
$ ulimit -n
```
2. If necessary, permanently increase this limit for all users by editing the file `/etc/security/limits.conf` and adding the lines:

```
* soft nofile 65536
* hard nofile 65536
```

The leading asterisk means that the setting applies to all users.
3. Reload the config file:

```
sysctl -p
```
4. Log out and log in again. The new shell will have the new ulimit setting.

### Note

If the nofile parameter is less than 32768, Vertica fails and logs the following message:

```
Not enough open file handles allowed (1024 available/32768 required); see
'ulimit -n'.
```

## Install libreadline.so.4

The Readline run-time library provides a set of functions that allow users to:

- edit command lines
- maintain a list of previously-entered command lines
- perform csh-like history expansion on previous commands.

To install libreadline:

1. Download libreadline.so.4:

- **32-bit version** [http://mirrors.kernel.org/fedora/core/3/x86\\_64/os/Fedora/RPMS/readline-4.3-13.i386.rpm](http://mirrors.kernel.org/fedora/core/3/x86_64/os/Fedora/RPMS/readline-4.3-13.i386.rpm)
- **64-bit version** [http://mirrors.kernel.org/fedora/core/3/x86\\_64/os/Fedora/RPMS/readline-4.3-13.x86\\_64.rpm](http://mirrors.kernel.org/fedora/core/3/x86_64/os/Fedora/RPMS/readline-4.3-13.x86_64.rpm)

2. Use rpm to install the package. For example:

```
$ rpm -Uvh readline-version-platform.rpm
```

where *version-platform* specifies the name of the package you downloaded.

## Set Up Time Synchronization

Use NTP or some other time synchronization mechanism to keep all hosts synchronized. Time variances can cause (inconsistent) query results when using Date/Time Functions.

For instructions, see:

- [http://kbase.redhat.com/faq/FAQ\\_43\\_755.shtm](http://kbase.redhat.com/faq/FAQ_43_755.shtm)  
[http://kbase.redhat.com/faq/FAQ\\_43\\_755.shtm](http://kbase.redhat.com/faq/FAQ_43_755.shtm)
- [http://kbase.redhat.com/faq/FAQ\\_43\\_2790.shtm](http://kbase.redhat.com/faq/FAQ_43_2790.shtm)  
[http://kbase.redhat.com/faq/FAQ\\_43\\_2790.shtm](http://kbase.redhat.com/faq/FAQ_43_2790.shtm)



# Appendix: Time Zones

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## Africa

|                      |
|----------------------|
| Africa/Abidjan       |
| Africa/Accra         |
| Africa/Addis_Ababa   |
| Africa/Algiers       |
| Africa/Asmera        |
| Africa/Bamako        |
| Africa/Bangui        |
| Africa/Banjul        |
| Africa/Bissau        |
| Africa/Blantyre      |
| Africa/Brazzaville   |
| Africa/Bujumbura     |
| Africa/Cairo Egypt   |
| Africa/Casablanca    |
| Africa/Ceuta         |
| Africa/Conakry       |
| Africa/Dakar         |
| Africa/Dar_es_Salaam |
| Africa/Djibouti      |
| Africa/Douala        |
| Africa/El_Aaiun      |

|                     |
|---------------------|
| Africa/Freetown     |
| Africa/Gaborone     |
| Africa/Harare       |
| Africa/Johannesburg |
| Africa/Kampala      |
| Africa/Khartoum     |
| Africa/Kigali       |
| Africa/Kinshasa     |
| Africa/Lagos        |
| Africa/Libreville   |
| Africa/Lome         |
| Africa/Luanda       |
| Africa/Lubumbashi   |
| Africa/Lusaka       |
| Africa/Malabo       |
| Africa/Maputo       |
| Africa/Maseru       |
| Africa/Mbabane      |
| Africa/Mogadishu    |
| Africa/Monrovia     |
| Africa/Nairobi      |
| Africa/Ndjamena     |
| Africa/Niamey       |
| Africa/Nouakchott   |

|                      |
|----------------------|
| Africa/Ouagadougou   |
| Africa/Porto-Novo    |
| Africa/Sao_Tome      |
| Africa/Timbuktu      |
| Africa/Tripoli Libya |
| Africa/Tunis         |
| Africa/Windhoek      |

## America

|                                             |
|---------------------------------------------|
| America/Adak America/Atka US/Aleutian       |
| America/Anchorage SystemV/YST9YDT US/Alaska |
| America/Anguilla                            |
| America/Antigua                             |
| America/Araguaina                           |
| America/Aruba                               |
| America/Asuncion                            |
| America/Bahia                               |
| America/Barbados                            |
| America/Belem                               |
| America/Belize                              |
| America/Boa_Vista                           |
| America/Bogota                              |
| America/Boise                               |

|                                                                               |
|-------------------------------------------------------------------------------|
| America/Buenos_Aires                                                          |
| America/Cambridge_Bay                                                         |
| America/Campo_Grande                                                          |
| America/Cancun                                                                |
| America/Caracas                                                               |
| America/Catamarca                                                             |
| America/Cayenne                                                               |
| America/Cayman                                                                |
| America/Chicago CST6CDT SystemV/CST6CDT<br>US/Central                         |
| America/Chihuahua                                                             |
| America/Cordoba America/Rosario                                               |
| America/Costa_Rica                                                            |
| America/Cuiaba                                                                |
| America/Curacao                                                               |
| America/Danmarkshavn                                                          |
| America/Dawson                                                                |
| America/Dawson_Creek                                                          |
| America/Denver MST7MDT SystemV/MST7MDT<br>US/Mountain America/Shiprock Navajo |
| America/Detroit US/Michigan                                                   |
| America/Dominica                                                              |
| America/Edmonton Canada/Mountain                                              |
| America/Eirunepe                                                              |
| America/El_Salvador                                                           |

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|--------------------------------------------------------|
| America/Ensenada America/Tijuana Mexico/BajaNorte      |
| America/Fortaleza                                      |
| America/Glace_Bay                                      |
| America/Godthab                                        |
| America/Goose_Bay                                      |
| America/Grand_Turk                                     |
| America/Grenada                                        |
| America/Guadeloupe                                     |
| America/Guatemala                                      |
| America/Guayaquil                                      |
| America/Guyana                                         |
| America/Halifax Canada/Atlantic SystemV//AST4ADT       |
| America/Havana Cuba                                    |
| America/Hermosillo                                     |
| America/Indiana/Indianapolis                           |
| America/Indianapolis                                   |
| America/Fort_Wayne EST SystemV//EST5 US/East-Indiana   |
| America/Indiana/Knox America/Knox_IN US/Indiana-Starke |
| America/Indiana/Marengo                                |
| America/Indiana/Vevay                                  |
| America/Inuvik                                         |
| America/Iqaluit                                        |
| America/Jamaica Jamaica                                |

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|---------------------------------------------------------------------------|
| America/Jujuy                                                             |
| America/Juneau                                                            |
| America/Kentucky/Louisville America/Louisville                            |
| America/Kentucky/Monticello                                               |
| America/La_Paz                                                            |
| America/Lima                                                              |
| America/Los_Angeles PST8PDT SystemV/PST8PDT<br>US/Pacific US/Pacific- New |
| America/Maceio                                                            |
| America/Managua                                                           |
| America/Manaus Brazil/West                                                |
| America/Martinique                                                        |
| America/Mazatlan Mexico/BajaSur                                           |
| America/Mendoza                                                           |
| America/Menominee                                                         |
| America/Merida                                                            |
| America/Mexico_City Mexico/General                                        |
| America/Miquelon                                                          |
| America/Monterrey                                                         |
| America/Montevideo                                                        |
| America/Montreal                                                          |
| America/Montserrat                                                        |
| America/Nassau                                                            |
| America/New_York EST5EDT SystemV/EST5EDT<br>US/Eastern                    |

|                                                                             |
|-----------------------------------------------------------------------------|
| America/Nipigon                                                             |
| America/Nome                                                                |
| America/Noronha Brazil/DeNoronha                                            |
| America/North_Dakota/Center                                                 |
| America/Panama                                                              |
| America/Pangnirtung                                                         |
| America/Paramaribo                                                          |
| America/Phoenix MST SystemV/MST7 US/Arizona                                 |
| America/Port-au-Prince                                                      |
| America/Port_of_Spain                                                       |
| America/Porto_Acre America/Rio_Branco Brazil/Acre                           |
| America/Porto_Velho                                                         |
| America/Puerto_Rico SystemV/AST4                                            |
| America/Rainy_River                                                         |
| America/Rankin_Inlet                                                        |
| America/Recife                                                              |
| America/Regina Canada/East-Saskatchewan<br>Canada/Saskatchewan SystemV/CST6 |
| America/Santiago Chile/Continental                                          |
| America/Santo_Domingo                                                       |
| America/Sao_Paulo Brazil/East                                               |
| America/Scoresbysund                                                        |
| America/St_Johns Canada/Newfoundland                                        |
| America/St_Kitts                                                            |

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| America/St_Lucia                 |
| America/St_Thomas America/Virgin |
| America/St_Vincent               |
| America/Swift_Current            |
| America/Tegucigalpa              |
| America/Thule                    |
| America/Thunder_Bay              |
| America/Toronto Canada/Eastern   |
| America/Tortola                  |
| America/Vancouver Canada/Pacific |
| America/Whitehorse Canada/Yukon  |
| America/Winnipeg Canada/Central  |
| America/Yakutat                  |
| America/Yellowknife              |

## Antartica

|                           |
|---------------------------|
| Antarctica/Casey          |
| Antarctica/Davis          |
| Antarctica/DumontDUrville |
| Antarctica/Mawson         |
| Antarctica/McMurdo        |
| Antarctica/South_Pole     |
| Antarctica/Palmer         |



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| Antarctica/Rothera |
| Antarctica/Syowa   |
| Antarctica/Vostok  |

## Asia

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| Asia/Aden                     |
| Asia/Almaty                   |
| Asia/Amman                    |
| Asia/Anadyr                   |
| Asia/Aqtau                    |
| Asia/Aqtobe                   |
| Asia/Ashgabat Asia/Ashkhabad  |
| Asia/Baghdad                  |
| Asia/Bahrain                  |
| Asia/Baku                     |
| Asia/Bangkok                  |
| Asia/Beirut                   |
| Asia/Bishkek                  |
| Asia/Brunei                   |
| Asia/Calcutta                 |
| Asia/Choibalsan               |
| Asia/Chongqing Asia/Chungking |
| Asia/Colombo                  |

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| Asia/Dacca Asia/Dhaka               |
| Asia/Damascus                       |
| Asia/Dili                           |
| Asia/Dubai                          |
| Asia/Dushanbe                       |
| Asia/Gaza                           |
| Asia/Harbin                         |
| Asia/Hong_Kong Hongkong             |
| Asia/Hovd                           |
| Asia/Irkutsk                        |
| Asia/Jakarta                        |
| Asia/Jayapura                       |
| Asia/Jerusalem Asia/Tel_Aviv Israel |
| Asia/Kabul                          |
| Asia/Kamchatka                      |
| Asia/Karachi                        |
| Asia/Kashgar                        |
| Asia/Katmandu                       |
| Asia/Krasnoyarsk                    |
| Asia/Kuala_Lumpur                   |
| Asia/Kuching                        |
| Asia/Kuwait                         |
| Asia/Macao Asia/Macau               |
| Asia/Magadan                        |

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| Asia/Makassar Asia/Ujung_Pandang |
| Asia/Manila                      |
| Asia/Muscat                      |
| Asia/Nicosia Europe/Nicosia      |
| Asia/Novosibirsk                 |
| Asia/Omsk                        |
| Asia/Oral                        |
| Asia/Phnom_Penh                  |
| Asia/Pontianak                   |
| Asia/Pyongyang                   |
| Asia/Qatar                       |
| Asia/Qyzylorda                   |
| Asia/Rangoon                     |
| Asia/Riyadh                      |
| Asia/Riyadh87 Mideast/Riyadh87   |
| Asia/Riyadh88 Mideast/Riyadh88   |
| Asia/Riyadh89 Mideast/Riyadh89   |
| Asia/Saigon                      |
| Asia/Sakhalin                    |
| Asia/Samarkand                   |
| Asia/Seoul ROK                   |
| Asia/Shanghai PRC                |
| Asia/Singapore Singapore         |
| Asia/Taipei ROC                  |

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| Asia/Tashkent                    |
| Asia/Tbilisi                     |
| Asia/Tehran Iran                 |
| Asia/Thimbu Asia/Thimphu         |
| Asia/Tokyo Japan                 |
| Asia/Ulaanbaatar Asia/Ulan_Bator |
| Asia/Urumqi                      |
| Asia/Vientiane                   |
| Asia/Vladivostok                 |
| Asia/Yakutsk                     |
| Asia/Yekaterinburg               |
| Asia/Yerevan                     |

## Atlantic

|                               |
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| Atlantic/Azores               |
| Atlantic/Bermuda              |
| Atlantic/Canary               |
| Atlantic/Cape_Verde           |
| Atlantic/Faeroe               |
| Atlantic/Madeira              |
| Atlantic/Reykjavik<br>Iceland |
| Atlantic/South_Georgia        |
| Atlantic/St_Helena            |

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| Atlantic/Stanley |
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## Australia

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| Australia/ACT |
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| Australia/Canberra |
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| Australia/NSW |
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| Australia/Sydney |
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| Australia/Adelaide |
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| Australia/South |
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| Australia/Brisbane |
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| Australia/Queensland |
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| Australia/Broken_Hill |
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| Australia/Yancowinna |
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| Australia/Darwin |
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| Australia/North |
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| Australia/Hobart |
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| Australia/Tasmania |
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| Australia/LHI |
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| Australia/Lord_Howe |
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| Australia/Lindeman |
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| Australia/Melbourne |
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| Australia/Victoria |
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| Australia/Perth Australia/West |
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## Etc/GMT

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| Etc/GMT+1  |
| Etc/GMT+2  |
| Etc/GMT+3  |
| Etc/GMT+4  |
| Etc/GMT+5  |
| Etc/GMT+6  |
| Etc/GMT+7  |
| Etc/GMT+8  |
| Etc/GMT+9  |
| Etc/GMT+10 |
| Etc/GMT+11 |
| Etc/GMT+12 |
| Etc/GMT-1  |
| Etc/GMT-2  |
| Etc/GMT-3  |
| Etc/GMT-4  |
| Etc/GMT-5  |
| Etc/GMT-6  |
| Etc/GMT-7  |
| Etc/GMT-8  |
| Etc/GMT-9  |
| Etc/GMT-10 |

|            |
|------------|
| Etc/GMT-11 |
| Etc/GMT-12 |
| Etc/GMT-13 |
| Etc/GMT-14 |

## Europe

|                                 |
|---------------------------------|
| Europe/Amsterdam                |
| Europe/Andorra                  |
| Europe/Athens                   |
| Europe/Belfast                  |
| Europe/Belgrade                 |
| Europe/Ljubljana                |
| Europe/Sarajevo                 |
| Europe/Skopje                   |
| Europe/Zagreb                   |
| Europe/Berlin                   |
| Europe/Brussels                 |
| Europe/Bucharest                |
| Europe/Budapest                 |
| Europe/Chisinau Europe/Tiraspol |
| Europe/Copenhagen               |
| Europe/Dublin Eire              |
| Europe/Gibraltar                |

|                                                          |
|----------------------------------------------------------|
| Europe/Helsinki                                          |
| Europe/Istanbul Asia/Istanbul Turkey                     |
| Europe/Kaliningrad                                       |
| Europe/Kiev                                              |
| Europe/Lisbon Portugal                                   |
| Europe/London GB GB-Eire                                 |
| Europe/Luxembourg                                        |
| Europe/Madrid                                            |
| Europe/Malta                                             |
| Europe/Minsk                                             |
| Europe/Monaco                                            |
| Europe/Moscow W-SU                                       |
| Europe/Oslo<br>Arctic/Longyearbyen<br>Atlantic/Jan_Mayen |
| Europe/Paris                                             |
| Europe/Prague Europe/Bratislava                          |
| Europe/Riga                                              |
| Europe/Rome Europe/San_Marino Europe/Vatican             |
| Europe/Samara                                            |
| Europe/Simferopol                                        |
| Europe/Sofia                                             |
| Europe/Stockholm                                         |
| Europe/Tallinn                                           |



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| Europe/Tirane        |
| Europe/Uzhgorod      |
| Europe/Vaduz         |
| Europe/Vienna        |
| Europe/Vilnius       |
| Europe/Warsaw Poland |
| Europe/Zaporozhye    |
| Europe/Zurich        |

## Indian

|                     |
|---------------------|
| Indian/Antananarivo |
| Indian/Chagos       |
| Indian/Christmas    |
| Indian/Cocos        |
| Indian/Comoro       |
| Indian/Kerguelen    |
| Indian/Mahe         |
| Indian/Maldives     |
| Indian/Mauritius    |
| Indian/Mayotte      |
| Indian/Reunion      |

## Pacific

|                                                 |
|-------------------------------------------------|
| Pacific/Apia                                    |
| Pacific/Auckland NZ                             |
| Pacific/Chatham NZ-CHAT                         |
| Pacific/Easter<br>Chile/EasterIsland            |
| Pacific/Efate                                   |
| Pacific/Enderbury                               |
| Pacific/Fakaofu                                 |
| Pacific/Fiji                                    |
| Pacific/Funafuti                                |
| Pacific/Galapagos                               |
| Pacific/Gambier SystemV/YST9                    |
| Pacific/Guadalcanal                             |
| Pacific/Guam                                    |
| Pacific/Honolulu HST SystemV/HST10<br>US/Hawaii |
| Pacific/Johnston                                |
| Pacific/Kiritimati                              |
| Pacific/Kosrae                                  |
| Pacific/Kwajalein Kwajalein                     |
| Pacific/Majuro                                  |
| Pacific/Marquesas                               |
| Pacific/Midway                                  |

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| Pacific/Nauru                 |
| Pacific/Niue                  |
| Pacific/Norfolk               |
| Pacific/Noumea                |
| Pacific/Pago_Pago             |
| Pacific/Samoa US/Samoa        |
| Pacific/Palau                 |
| Pacific/Pitcairn SystemV/PST8 |
| Pacific/Ponape                |
| Pacific/Port_Moresby          |
| Pacific/Rarotonga             |
| Pacific/Saipan                |
| Pacific/Tahiti                |
| Pacific/Tarawa                |
| Pacific/Tongatapu             |
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