FUJITSU

Fujitsu
Enterprise Postgres 17 SP2

Installation and Setup Guide for Server

Windows/Linux

September 2025

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Preface

Purpose of this document

The Fujitsu Enterprise Postgres database system extends the PostgreSQL features and runs on the Linux platform.

This document describes how to install and set up "Fujitsu Enterprise Postgres".

Intended readers

This document is intended for those who install and operate Fujitsu Enterprise Postgres.

Readers of this document are assumed to have general knowledge of:

- PostgreSQL
- SQL
- Linux

Structure of this document

This document is structured as follows:

Chapter 1 Overview of Installation

Describes the installation types and procedures

Chapter 2 Operating Environment

Describes the operating environment required to use Fujitsu Enterprise Postgres

Chapter 3 Installation

Describes how to perform a new installation of Fujitsu Enterprise Postgres

Chapter 4 Setup

Describes the setup to be performed after installation

Chapter 5 Uninstallation

Describes how to uninstall Fujitsu Enterprise Postgres

Appendix A Recommended WebAdmin Environments

Describes the recommended WebAdmin environment.

Appendix B Setting Up and Removing WebAdmin

Describes how to set up and remove WebAdmin

Appendix C WebAdmin Disallow User Inputs Containing Hazardous Characters

Describes characters that are not allowed in WebAdmin.

Appendix D Configuring Parameters

Describes Fujitsu Enterprise Postgres parameters.

Appendix E Estimating Database Disk Space Requirements

Describes how to estimate database disk space requirements

Appendix F Estimating Memory Requirements

Describes the formulas for estimating memory requirements

Appendix G Quantitative Limits

Describes the quantity range

Appendix H Configuring Kernel Parameters

Describes the settings for kernel parameters

Appendix I Determining the Preferred WebAdmin Configuration

Describes the two different configurations in which WebAdmin can be used and how to select the most suitable configuration

Appendix J System Configuration when using Pgpool-II

Describes the system configuration when using Pgpool-II.

Appendix K Supported contrib Modules and Extensions Provided by External Projects

Lists the PostgreSQL contrib modules and the extensions provided by external projects supported by Fujitsu Enterprise Postgres.

Appendix L Procedure when Modifying the JRE Installation

Describes the procedures to follow when modifying the JRE installation.

Appendix M Access to Key Management System Using Plug-in

Describes how to access key management systems using plug-ins.

Appendix N Deploying Virtual Machines by Cloning

Describes installing Fujitsu Enterprise Postgres on a virtual machine, cloning the virtual machine, and deploying a new virtual machine.

Export restrictions

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Contents

Chapter 1 Overview of Installation

This chapter provides an overview of Fujitsu Enterprise Postgres installation.

1.1 Features that can be Installed

Each Fujitsu Enterprise Postgres feature is installed on the machine that was used to build the database environment.

The following table shows the relationship between the product to be installed and the features that can be installed.

Feature that can be installed	Product name	
	AE	SE
Basic feature (server feature, client feature)	Y	Y

Y: Can be installed

1.2 Installation Types

The following installation types are available for Fujitsu Enterprise Postgres:

- New installation
- Reinstallation
- Multi-version installation

1.2.1 New Installation

In initial installation, Fujitsu Enterprise Postgres is installed for the first time.

1.2.2 Reinstallation

Perform reinstallation to repair installed program files that have become unusable for any reason.

1.2.3 Multi-Version Installation

Fujitsu Enterprise Postgres products can be installed on the same server if the product version (indicated by "*x*" in "*x* SP*z*") is different from that of any version of the product that is already installed.

1.3 Installation Procedure

The following installation procedures are available for Fujitsu Enterprise Postgres:

- Installation in interactive mode
- Installation in silent mode

Select the installation procedure that corresponds to your environment.

1.3.1 Installation in Interactive Mode

Interactive mode enables installation to be performed while the required information is entered interactively.

In the interactive mode installation, the installation state of Fujitsu Enterprise Postgres is determined automatically. Install Fujitsu Enterprise Postgres using one of the following installation types in accordance with the installation state:

- New installation
- Reinstallation

- Multi-version installation

1.3.2 Installation in Silent Mode

Silent mode enables installation to be performed without the need to enter any information interactively.

New installations and multi-version installations can be performed in silent mode.

1.4 Uninstallation

Uninstallation removes the system files of the installed Fujitsu Enterprise Postgres.

Chapter 2 Operating Environment

This chapter describes the operating environment required to use Fujitsu Enterprise Postgres.

See

Refer to "Operating Environment" in the Installation and Setup Guide for Client when installing the Fujitsu Enterprise Postgres client feature at the same time.

2.1 Required Operating System

One of the operating systems shown below is required in order to use Fujitsu Enterprise Postgres.

- RHEL8.6 or later minor version
- RHEL9.2 or later minor version
- SLES 15 SP4 or later minor version
  SLES cannot be used if performing failover operation integrated with PRIMECLUSTER.

2.1.1 Required Packages

Describes the required packages.

2.1.1.1 Packages Required for RHEL8

The following packages are required for operations on RHEL8.

Package name	Remarks
alsa-lib	-
audit-libs	-
bzip2-libs	Required when using pgBackRest.
cyrus-sasl-lib	-
gdb	Required to run FJQSS.
pcp-system-tools	Required when using parallel scan.
glibc	-
glibc.i686	-
iputils	Required for Mirroring Controller.
libnsl2	-
libicu	Provides collation support. Install 60.x.
libgcc	-
libmemcached	Required when using Pgpool-II.
libselinux	Required for sepgsql.
libstdc++	-
libtool-ltdl	Required when using ODBC drivers.
libzstd	-

Package name	Remarks
llvm	Versions 19.1.x, 18.1.x, 17.0.x, 16.0.x, 15.0.x, 14.0.x, or 13.0.x of llvm is required to run SQL with runtime compilation (just-in-time compilation). Install the package that contains libLLVM-19.so, libLLVM-18.so, libLLVM-17.so, llibLLVM-16.so,llibLLVM-15.so, llibLLVM-14.so, or libLLVM-13.so. For example, version 17.0.x of "llvm-libs" published with Application Streams includes libLLVM-17.so. By default, version 17.0.x is used. If you use a version other than 17.0.x, specify the version you want to use in the jit_provider parameter in postgresql.conf. For example, use llvmjit-vsn19 when using version 19.1.x. Fujitsu Enterprise Postgres uses runtime compilation by default.If you do not want to use runtime compilation, turn off the jit parameter in postgresql.conf.You do not need to install llvm if you turn off the jit parameter. If the jit parameter is on and llvm is not installed, an error may occur during SQL execution. For more information about runtime compilation, see "Just-in-Time Compilation (JIT)" in "PostgreSQL Documentation".
libcgroup-tools	Required when using parallel scan.
lz4-libs	-
ncurses-libs	-
net-tools	-
nss-softokn-freebl	-
pam	Required when using PAM authentication.
perl-libs	Required when using PL/Perl. Install 5.26.
protobuf-c	Required if using the Transparent Data Encryption feature when using a key management system as a keystore. Install 1.3.0.
python3	If you want to use PL/Python based on the Python 3 language, install 3.9.x. If you want to use semantic text search and automatic vectorization, install 3.11.x. If you want to take advantage of both PL/python features as well as semantic text search and automatic vectorization, install 3.11.x.
redhat-lsb	-
rsync	Required when using Pgpool-II.
sudo	-
sysstat	Required when using FJQSS. Set up the sar command after installation.
tcl	Required when using PL/Tcl. Install 8.6.
unzip	-
xz-libs	-

Package name	Remarks
zlib	-

2.1.1.2 Packages Required for RHEL9

The following packages are required for operations on RHEL9.

Package name	Remarks
alsa-lib	-
audit-libs	-
bzip2-libs	Required when using pgBackRest.
cyrus-sasl-lib	-
gdb	Required to run FJQSS.
pcp-system-tools	Required when using parallel scan.
glibc	-
glibc.i686	-
iputils	Required for Mirroring Controller.
libnsl2	-
libicu	Provides collation support. Install 67.x.
libgcc	-
libmemcached-awesome	Required when using Pgpool-II.
libselinux	Required for sepgsql.
libstdc++	-
libtool-ltdl	Required when using ODBC drivers.
libzstd	-
llvm	Versions 19.1.x, 18.1.x, 17.0.x, 16.0.x, or 15.0.x of llvm is required to run SQL with runtime compilation (just-in-time compilation). Install the package that contains libLLVM-19.so, llibLLVM-18.so, libLLVM-17.so, llibLLVM-16.so, or llibLLVM-15.so. For example, version 17.0.x of "llvm-libs " published with Application Streams includes libLLVM-17.so. By default, version 17.0.x is used. If you use a version other than 17.0.x, specify the version you want to use in the jit_provider parameter in postgresql.conf. For example, use llvmjit-vsn19 when using version 19.1.x. Fujitsu Enterprise Postgres is configured to use runtime compilation by default. If you do not want to use runtime compilation, turn off the jit parameter in postgresql.conf. If you turn off the jit parameter, you do not need to install llvm. If the jit parameter is on and llvm is not installed, an error may occur during SQL execution. For more information about runtime compilation, see "Just-in-Time Compilation (JIT) " in the PostgreSQL Documentation.
lz4-libs	-

Package name	Remarks
ncurses-libs	-
net-tools	-
nss-softokn-freebl	-
pam	Required when using PAM authentication.
perl-libs	Required when using PL/Perl. Install 5.32.
protobuf-c	Required if using the Transparent Data Encryption feature when using a key management system as a keystore. Install 1.3.3.
python3	If you want to use PL/Python based on the Python 3 language, install 3.9.x. If you want to use semantic text search and automatic vectorization, install 3.11.x. If you want to take advantage of both PL/python features as well as semantic text search and automatic vectorization, install 3.11.x.
rsync	Required when using Pgpool-II.
sudo	-
sysstat	Required when using FJQSS. Set up the sar command after installation.
tcl	Required when using PL/Tcl. Install 8.6.
unzip	-
xz-libs	-
zlib	-

2.1.1.3 Packages Required for SLES 15

The following packages are required for operations on SLES 15.

Package name	Remarks
dstat	Required when using parallel scan.
gdb	-
glibc	-
glibc-32bit	-
iputils	Required for Mirroring Controller.
JRE 8	Required when using the installer, database multiplexing, and WebAdmin. The following JREs are available: - Oracle JRE Use the 64-bit version. - OpenJDK Past the Java TCK (Technology Compatibility Kit)
libasound2	-
libaudit1	-
libbz2-1	Required when using pgBackRest.

Package name	Remarks
libfreebl3	-
libicu-suse65_1	Provides collation support. Install 65.
libgcc	-
libltdl7	Required when using ODBC drivers.
liblz4-1	-
liblzma5	-
libmemcached	Required when using Pgpool-II.
libncurses5	-
libprotobuf-c1	Required if using the Transparent Data Encryption feature when using a key management system as a keystore. Install 1.3.2.
libstdc++6	-
libstdc++6-32bit	Required for silent installation.
libz1	-
libzstd1	-
llvm	Version 15.0.x of llvm is required to run SQL with runtime compilation (just-in-time compilation). Install the package that contains libLLVM.so.15. For example, the "libLLVM15" published in SUSE includes libLLVM.so.15. Fujitsu Enterprise Postgres uses runtime compilation by default.If you do not want to use runtime compilation, turn off the jit parameter in postgresql.conf.You do not need to install llvm if you turn off the jit parameter. If the jit parameter is on and llvm is not installed, an error may occur during SQL execution. For more information about runtime compilation, see "Just-in-Time Compilation (JIT)" in "PostgreSQL Documentation".
libLLVM15	Install 15.0.x.
net-tools	-
pam	Required when using PAM authentication.
perl	Required when using PL/Perl. Install 5.26.
python3	If you want to use PL/Python based on the Python 3 language, install 3.6.x. If you want to use semantic text search and automatic vectorization, install 3.11.x. If you want to take advantage of both PL/python features as well as semantic text search and automatic vectorization, install 3.11.x.
rsync	Required when using Pgpool-II.
sudo	-
sysstat	Set up the sar command after installation.
tcl	Required when using PL/Tcl. Install 8.6.
unzip	-

2.2 Related Software

The following table lists the software required to use Fujitsu Enterprise Postgres.

Table 2.1 Related software

No.	Product name	Version	Fujitsu Enterprise Postgres product name		Remarks
			AE	SE	
1	PRIMECLUSTER (*1)	4.7A00 or later (*1)	Y	Y	Mandatory when performing failover operation integrated with PRIMECLUSTER.
2	Oracle Call Interface (OCI) libraries	19c or later	Y	Y	Required when using oracle_fdw.
3	Amazon Web Services Command Line Interface (AWS CLI)	2.x or later	Y	Y	Required for monitoring database operations using Amazon CloudWatch.

*1: The applicable products are shown below:

- PRIMECLUSTER Enterprise Edition
- PRIMECLUSTER HA Server

If you want to use the semantic text search and automatic vectorization, you need the following Python packages:

Install to a location other than the default Python package installation destination (purelib) and set the environment variable PYTHONPATH.

Example of verifying the default Python package installation destination (purelib)

```
# python -c "import sysconfig;print(sysconfig.get_path('purelib'))"
/usr/local/lib/python3.11/site-packages
```

Example of installing Python packages using the pip command

```
pip install <package-name>==<version> -t <python package-install-destination>
```

Setting PYTHONPATH

```
export PYTHONPATH=<python package-install-destination>:$PYTHONPATH
```

Package name	Remarks
anthropic	Install 0.44.0.
backoff	Install 2.2.1.
boto3	Install 1.35 or higher and 2.0 or lower.
click	Install 8.0 or higher and 9.0 or lower.
cohere	Install 5.13.11.
datadog_lambda	Install 6.9 or higher and 7.0 or lower.
datasets	Install 3.1.0.
google-cloud-aiplatform	Install 1.78.0 or higher and 2.0 or lower.
langchain-openai	Install 0.1 or higher and 1.0 or lower.

Package name	Remarks
langchain-text-splitters	Install 0.3.5 or higher and 1.0 or lower.
litellm	Install 1.58.2.
ollama	Required when using Ollama as the embedded provider. Install 0.4.5.
openai	Required when using OpenAI as the embedded provider. Install 1.56.0.
pgvector	Python library for handling the pgvector data type, separate from the pgvector Fujitsu Enterprise Postgres extension. Install 0.3 or higher and 1.0 or lower.
pydantic	Install 2.0 or higher and 3.0 or lower.
python-dotenv	Install 1.0 or higher and 2.0 or lower.
pytimeparse	Install 1.1 or higher and 2.0 or lower.
structlog	Install 24.0 or higher and 25.0 or lower.
tiktoken	Install 0.7 or higher and 1.0 or lower.
typing_extensions	Install 4.0 or higher and 5.0 or lower.
voyageai	Required when using VoyageAI as the embedded provider. Install 0.3.1.

The following table lists client that can be connected to the Fujitsu Enterprise Postgres server feature.

Table 2.2 Connectable client

OS	Product name
Windows Linux	Fujitsu Enterprise Postgres Client 17 or later

The following table lists server assistant that can be connected to the Fujitsu Enterprise Postgres server feature.

Table 2.3 Connectable server assistant

OS	Product name
Linux Windows	Fujitsu Enterprise Postgres Server Assistant 17 or later

2.3 Excluded Software

This section describes excluded software.

Fujitsu Enterprise Postgres

Fujitsu Enterprise Postgres cannot be installed if all the following conditions are met:

- The product version (indicated by "*x*" in "*x* SP*z*") of the product to be installed is the same as that of the installed product
- The editions are different

Example

In the following cases, Fujitsu Enterprise Postgres cannot be installed as an exclusive product:

- The installed product is Fujitsu Enterprise Postgres Standard Edition (64bit) 17
- The product to be installed is Fujitsu Enterprise Postgres Advanced Edition (64bit) 17 SP2

Other products

There are no exclusive products.

2.4 Required Patches

There are no required patches.

2.5 Hardware Environment

The following hardware is required to use Fujitsu Enterprise Postgres.

Memory

At least 512 MB of memory is required.

2.6 Disk Space Required for Installation

The following table shows the disk space requirements for new installation of Fujitsu Enterprise Postgres. If necessary, increase the size of the file system.

RHEL

Directory	Required disk space (Unit: MB)
/etc	1 + 1 (*1)
/var	1 + 2 (*1) +1 (*2)
/opt	300 (*1) +1 (*2)
Installation destination of the server	1120
Installation destination of WebAdmin	800
Installation destination of the client (64-bit)	220
Installation destination of Pgpool-II	35
Installation destination of pgBackRest	40

*1: Required for the installation of the Uninstall (middleware) tool.

*2: Required for the installation of FJQSS.

SLES

Directory	Required disk space (Unit: MB)
/etc	1 + 1 (*1)
/var	1 + 2 (*1) +1 (*2)
/opt	10 (*1) +1 (*2)
Installation destination of the server	300
Installation destination of WebAdmin	390
Installation destination of the client (64-bit)	190
Installation destination of Pgpool-II	35
Installation destination of pgBackRest	40

*1: Required for the installation of the Uninstall (middleware) tool.

*2: Required for the installation of FJQSS.

2.7 Supported System Environment

This section describes the supported system environment.

2.7.1 TCP/IP Protocol

Fujitsu Enterprise Postgres supports version 4 and 6 (IPv4 and IPv6) of TCP/IP protocols.

Do not use link-local addresses if TCP/IP protocol version 6 addresses are used.

2.7.2 File System

All file systems with a POSIX-compliant interface are supported.

However, for stable system operation, the disk where the database is deployed must use a highly reliable file system. Consider this aspect when selecting the file system to be used.

2.8 PostgreSQL Version Used for Fujitsu Enterprise Postgres

Fujitsu Enterprise Postgres is based on PostgreSQL 17.

2.9 Notes on Using Streaming Replication

To use streaming replication, build the primary server and all standby servers using the same Fujitsu Enterprise Postgres version. The same version refers to *x* SP*z* x, which is represented as the product version.

Streaming replication cannot be used in combination with Open Source PostgreSQL.

2.10 Key Management System Requirements

Describes the requirements for a key management system.

2.10.1 To Connect to a key Management System Using the KMIP Protocol

If you use a key management system as a keystore to use the Transparent Data Encryption feature, the following conditions must be met.

Protocol

Key management systems must use the Key Management Interoperability Protocol (KMIP) Version 1.4 protocol.

Encryption Key

The encryption key used must be able to be created or brought into the KMIP server under the following conditions.

- AES 256 bit symmetric key

  A Managed Object that meets the following criteria:

  - Cryptographic Algorithm : AES
  - Cryptographic Length : 256

- Key not wrapped

Operation

The following operations using the KMIP protocol must be supported:

- Get operation

  Encryption keys can be returned in Key Format Type: Raw format.

Client authentication

You must be able to authenticate and authorize clients in the following ways:

- The registered client certificate can authenticate the client and authorize access to the encryption key.

Quantitative Limits

Fujitsu Enterprise Postgres can receive a maximum response size of 8192 bytes from a key management system. Any further response results in an error.

If the private key file used for the client certificate is encrypted, the maximum length of the passphrase used for encryption is 1023 bytes.

2.10.2 To Connect to a Key Management System Using a Plug-in

If you are using a key management system that requires a connection using a protocol other than KMIP, you will need an adapter that converts the request from the Fujitsu Enterprise Postgres into a request format that the key management system can accept.

By preparing the adapter and registering it as a plug-in to the Fujitsu Enterprise Postgres, you can use the key management system as a keystore.

The adapter must be implemented to meet the requirements specified by the Fujitsu Enterprise Postgres.

The key management system must be capable of meeting the requirements of the adapter.

See "Appendix M Access to Key Management System Using Plug-in" for adapter requirements.

Quantitative Limits

The maximum length of the secret, used for example to pass passwords and other information to plug-ins, is 4095 bytes.

Chapter 3 Installation

This chapter explains each of the installation procedures of Fujitsu Enterprise Postgres.

Note

If you have antivirus software installed, the server may crash, fail to start, or stop responding, during installation or when starting up after installation. Set scan exception settings for the installation directory and resource allocation directory so that the files in these directories are not scanned for viruses.

Point

In this chapter, "< x >" in the path indicates the version ("SPz" is output when the product level is upgraded).

3.1 Pre-installation Tasks

Check the system environment below before installing Fujitsu Enterprise Postgres.

Check the disk space

Ensure that there is sufficient disk space to install Fujitsu Enterprise Postgres.

Refer to "2.6 Disk Space Required for Installation" for information on the required disk space.

Reconfigure the disk partition if disk space is insufficient.

Set JAVA_HOME (SLES only)

Ensure that JRE 8 is installed, and export the JAVA_HOME environment variable.

```
#export JAVA_HOME="Jre8InstallDir"
```

Refer to "Appendix L Procedure when Modifying the JRE Installation" for information on modifying JRE after installation.

Executable Users

Installation and uninstallation is performed by superuser.

On the system, run the following command to become superuser.

```
$ su -
Password:******
```

Check the installed products and determine the installation method

Using the operation shown below, start Uninstall (middleware), and check the installed products.

Example

```
# /opt/FJSVcir/cimanager.sh -c
Loading Uninstaller...


Currently installed products
1. productName
2. productName
3. productName
4. productName
5: productName
```

```
Type [number] to select the software you want to uninstall.
[number,q]
=>q



Exiting Uninstaller.
```

If Fujitsu Enterprise Postgres is already installed, determine which installation method to use:

- Reinstallation
- Multi-version installation

Remove applied updates(For Reinstallation)

Use the following procedure to remove applied fixes.

If you install the product without removing the fix, you will apply the same version of the fix with the same fix number, resulting in an error that has already been applied. Remove the fix and then reinstall.

1. Checking the environment variable LD_LIBRARY_PATH

   If the installation directory/lib is set in the environment variable LD_LIBRARY_PATH for the running user, remove the installation directory/lib from LD_LIBRARY_PATH.

2. Display the applied updates

   Execute the following command to display the applied updates:

   ```
   # /opt/FJSVfupde/bin/uam showup
   ```

3. Remove the updates

   Execute the command below to remove the updates. If an update with the same update number was applied more than once, the updates are removed in order, starting from the highest version number.

   ```
   # /opt/FJSVfupde/bin/uam remove -i update-number
   ```

Determine the preferred WebAdmin configuration

Starting with Fujitsu Enterprise Postgres 9.5, WebAdmin can be installed in two configurations:

- Single-server
- Multiserver

See

Refer to "Appendix I Determining the Preferred WebAdmin Configuration" for details.

Determining the Pgpool-II System Configuration

The system configuration when using Pgpool-II is as follows:

- Place on database server
- Place on application server
- Place on dedicated server

See

Refer to "Appendix J System Configuration when using Pgpool-II".

3.2 Installation in Interactive Mode

Describes an interactive installation.

Available Characters

The following characters can be used as input values:

```
Alphanumeric characters, hyphens, commas and forward slashes
```

For a new or multi-version installation

In an interactive installation, default values are set for the installation information, but you can change the following settings:

- Installation directory
- WebAdmin setup information, if WebAdmin is selected

  To change the port number, confirm that it is an unused port number between 1024 and 32767.

For Reinstallation

Back up the following folders that contain WebAdmin instance management information:

webAdminInstallFolder/data/fepwa

Follow the procedure below to perform the backup.

1. Stop the WebAdmin server. Refer to "B.1.4 Stopping the Web Server Feature of WebAdmin" for details.
2. Back up the following folder:

   webAdminInstallFolder/data/fepwa

Replace the above folder with the backed up folder when the reinstallation is complete.

Installation Instructions

Install according to the following procedure:

You can set up WebAdmin during installation, but if you want WebAdmin to use the HTTPS protocol and perform client authentication, you must set it up again using the WebAdminSetup command. After the installation is complete, refer to "B.1 Setting Up WebAdmin" to set up WenAdmin again.

1. Stop applications and programs

If the installation method is the following, all applications and programs that use the product must be stopped:

- Reinstallation

Before starting the installation, stop the following:

- Applications that use the product
- Connection Manager
- Instance
- Web server feature of WebAdmin

  Execute the WebAdminStop command to stop the Web server feature of WebAdmin.

  Example

  If WebAdmin is installed in /opt/fsepv<*x*>webadmin:

```
# cd /opt/fsepv<x>webadmin/sbin
# ./WebAdminStop
```

- Mirroring Controller

  Execute the mc_ctl command with the stop mode option specified and stop the Mirroring Controller.

  Example

  ```
  $ mc_ctl stop -M /mcdir/inst1
  ```

- pgBadger
- Pgpool-II
- pgBackRest

2. Mount the DVD drive

Insert the server program DVD into the DVD drive, and run the command given below.

Example

```
# mount -t iso9660 -r -o loop /dev/dvd /media/dvd
```

Here /dev/dvd is the device name for the DVD drive (which may vary depending on your environment), and /media/dvd is the mount point (which may need to be created before calling the command).

If the DVD was mounted automatically using the automatic mount daemon (autofs), "noexec" is set as the mount option, so the installer may fail to start. In this case, use the mount command to remount the DVD correctly, and then run the installation. Note that the mount options of a mounted DVD can be checked by executing the mount command without any arguments.

3. Run the installation

Execute the following command:

Example

```
# cd /media/dvd
# ./install.sh
```

In the example above, /media/dvd is the DVD mount point.

4. Select the product for installation

The list of installation target products is displayed.
Type the number for the product to be installed, or "all", and press Enter.

Information

- The Fujitsu Enterprise Postgres server component and WebAdmin can be installed on the same machine by selecting the "Fujitsu Enterprise Postgres server component" and the "WebAdmin component".
- Pgpool-II to be installed on the same server as the database server, you can install it on the same machine by selecting "Fujitsu Enterprise Postgres Server Component" and "Pgpool-II component". Pgpool-II to be installed on the same server as the application server, or on a dedicated server that is different from the database server and application server, see "Appendix J System Configuration when using Pgpool-II".
- If the selected product has been installed, a window for selecting reinstallation or multi-version installation is displayed for each product. Follow the on-screen instructions to select the installation method.

5. Check the settings

The window for checking the installation information is displayed.
Type "y" and press Enter to start the installation.
To change the settings, type "c", press Enter, and follow the on-screen instructions. This option is not displayed if there is no information that can be modified.

If you have not set up WebAdmin during installation, refer to "Appendix B Setting Up and Removing WebAdmin" for details.

6. Check the changed settings

If the installation information has been modified, the new installation information is displayed.
Type "y" and press Enter to start the installation.
To change the settings again, type "c" and press Enter.

7. Display the installation status

When the installation is started, the installation status is displayed.

Note that even if WebAdmin setup fails, the process will continue.

If the following message is displayed, manually execute WebAdmin setup after installation is completed.
Refer to "B.1 Setting Up WebAdmin" for information on the WebAdmin setup procedure.

```
Starting setup.

Setting up WebAdmin.

ERROR: WebAdmin setup failed.
```

8. Finish the installation

When the installation is complete, a message is displayed showing the status.
If installation was successful, a message like the one shown below is displayed:

```
Installed successfully.
```

If an error occurs during the installation, read the error message and remove the cause of the error, and then reexecute the install.sh command.

3.3 Installation in Silent Mode

Installation in silent mode can be performed only when the installation method is one of the following:

- New installation
- Multi-version installation

See

Refer to the Fujitsu Enterprise Postgres product website for information on installation in silent mode, such as the installation parameters and error messages.

Installation Instructions

The installation procedure is described below.

You can set up WebAdmin during installation, but if you want WebAdmin to use the HTTPS protocol and perform client authentication, you must set it up again using the WebAdminSetup command. After the installation is complete, refer to "B.1 Setting Up WebAdmin" to set up WenAdmin again.

1. Mount the DVD drive

Insert the server program DVD into the DVD drive, and run the command given below.

Example

```
# mount -t iso9660 -r -o loop /dev/dvd /media/dvd
```

Here /dev/dvd is the device name for the DVD drive (which may vary depending on your environment), and /media/dvd is the mount point (which may need to be created before calling the command).

If the DVD was mounted automatically using the automatic mount daemon (autofs), "noexec" is set as the mount option, so the installer may fail to start. In this case, use the mount command to remount the DVD correctly, and then run the installation. Note that the mount options of a mounted DVD can be checked by executing the mount command without any arguments.

2. Create an installation parameters CSV file

Consider the features that will be required for system operations, and then create an installation parameters CSV file that uses the following specification format.

```
sectionName, parameterName, value
sectionName, parameterName, value
    :
```

Information

The template for the installation parameters CSV file is "*mountPoint*/sample/sample.csv".

3. Run the installation

Execute the following command:

Example

```
# cd /media/dvd
# ./silent.sh /home/work/inspara.csv
```

In the example above, /media/dvd is the DVD mount point, and /home/work/inspara.csv is the installation parameter CSV.

If the installer ends in an error, a message is output to the log file and return values are returned.

Chapter 4 Setup

This chapter describes the setup procedures to be performed after installation completes.

4.1 Operating Method Types and Selection

This section describes how to operate Fujitsu Enterprise Postgres.

There are two methods of managing Fujitsu Enterprise Postgres operations.

- Simple operation management using a WebAdmin (web-based GUI tool)

  Suitable when using frequently used basic settings and operations for operation management.

  This method allows you to perform simple daily tasks such as starting the system before beginning business, and stopping the system when business is over, using an intuitive operation.

- Advanced operation management using server commands

  Operations that use Fujitsu Enterprise Postgres or PostgreSQL server commands or server applications.

  When operating in a system that is automated by operation management middleware (Systemwalker Centric Manager, for example), this method allows you to use more detailed settings and operations and perform higher level operation management.

  Refer to Reference and the PostgreSQL Documentation for information on server commands and server applications.

Select one that suits your purposes.

How WebAdmin and Server Commands Work

Here are the differences between using WebAdmin and server commands:

Operation		Operation with the WebAdmin	Operation with commands
Setup	Creating an instance	The server machine capacity, and the optimum parameter for operations using WebAdmin, are set automatically. Instances that you create and manage in WebAdmin are registered in the WebAdmin administrative information, so you must delete the instance from WebAdmin.	The configuration file is edited directly using the initdb command.
	Creating a standby instance	WebAdmin performs a base backup of the source instance and creates a standby instance.	A standby instance is created using the pg_basebackup command.
	Changing the configuration files	You can change the values in the configuration file on the WebAdmin screen.	The configuration file is edited directly.
Starting and stopping an instance		You can start and stop with one click from the WebAdmin screen.	The pg_ctl command is used.
Creating a database		This is defined using pgAdmin of the GUI tool, or using the psql command or the application after specifying the DDL statement.	
Backing up the database		WebAdmin, or the pgx_dmpall command, is used. It cannot be used interchangeably with operation using server commands or server applications. If	It is recommended that the pgx_dmpall command be used. Recovery to the latest database can be performed.

Operation		Operation with the WebAdmin	Operation with commands
		used, WebAdmin will not be able to properly manage the instance. If you are backing up by using the copy command with the pgx_dmpall command, select the command operation method.	
Database recovery		You can recover using a backup taken with WebAdmin or the pgx_dmpall command.	To use the backup that was performed using the pgx_dmpall command, the pgx_rcvall command is used.
Monitoring	Database errors	The status in the WebAdmin window can be checked. (*1)	The messages that are output to the database server log are monitored (*1)
	Disk space	The status in the WebAdmin window can be checked. A warning will be displayed if the free space falls below 20%. (*1)	This is monitored using the df command of the operating system, for example. (*1)
	Connection status	This can be checked using pgAdmin of the GUI tool, or referencing pg_stat_activity of the standard statistics view from psql or the application.	

*1: This can be used together with system log monitoring using operations management middleware (Systemwalker Centric Manager, for example).

Refer to "Periodic Operations" and "Actions when an Error Occurs" in the Operation Guide for information on monitoring and database recovery.

4.2 Preparations for Setup

This section describes the preparation required before setting up Fujitsu Enterprise Postgres.

4.2.1 Creating an Instance Administrator

Decide which OS user account will be assigned the instance administrator role. You can assign it to a new user or to an existing one, but you cannot assign it to the OS superuser (root).

When operating with WebAdmin, if you change the password for the OS user account, use ALTER ROLE WITH PASSWORD to change the instance administrator password as well.

The following example shows an OS user account with the name "fsepuser" being assigned the instance administrator role.

Example

```
# useradd fsepuser
# passwd fsepuser
```

4.2.2 Preparing Directories for Resource Deployment

Prepare the directories required when creating instances.

Considerations when deploying resources

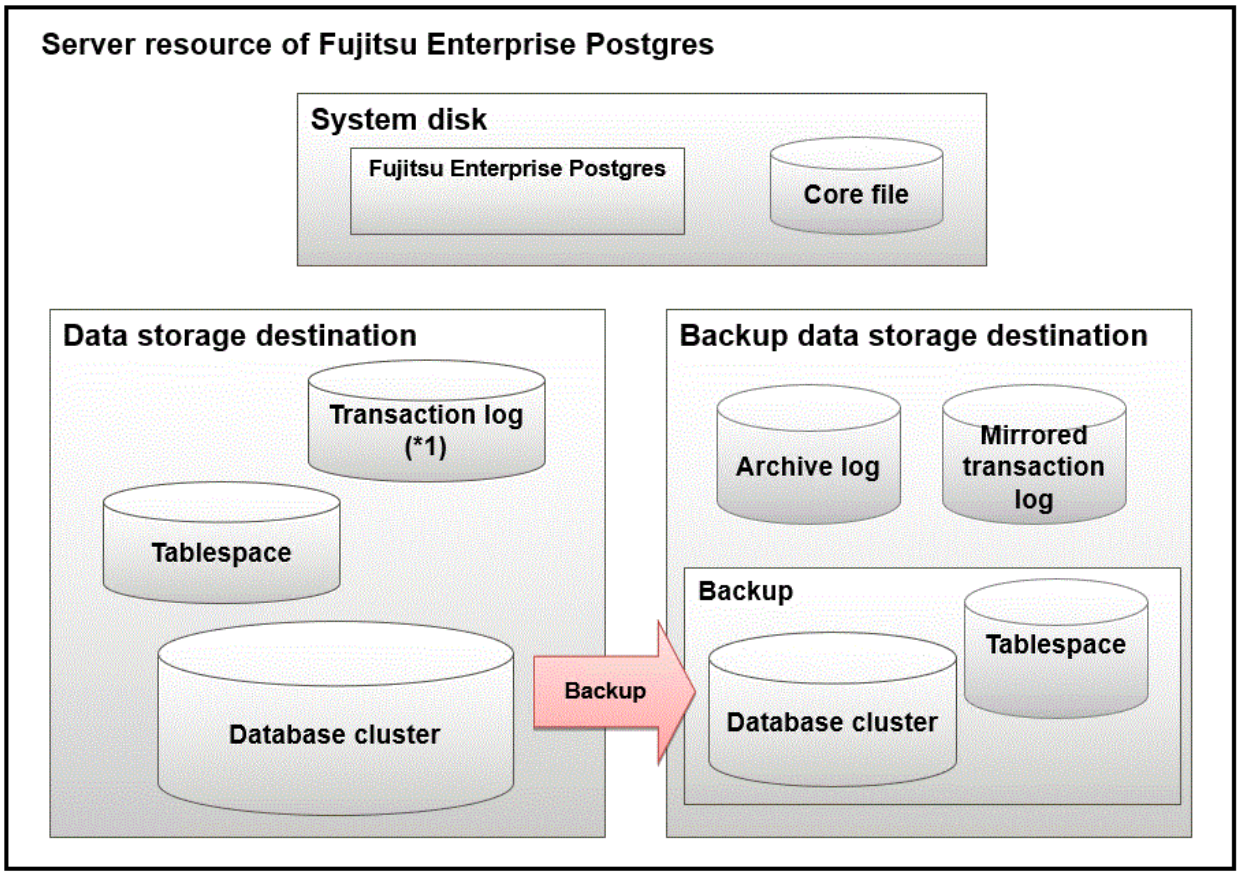
The disk configuration on the resource deployment destination is important, because it affects not only recovery following disk corruption, but normal operation as well. The points for determining the disk configuration are as follows:

1. If the backup data storage destination and the data storage destination are both lost, it will not be possible to recover the data, so deploy them to separate disks.
2. To shorten the recovery time following a single disk fault, deploy the system disk and data storage destination to separate disks.
3. The backup data storage destination requires at least double the capacity of the data storage destination, so deploy it to the disk with the most space available.
4. When large amounts of data are updated, the write-to load for the data storage destination, transaction log storage destination, and backup data storage destination (mirrored transaction log) will also be great. For this reason, deploy them to separate disks, out of consideration for performance.

Information

If you choose to place the archive log and mirrored transaction log (mirrored WAL) on a disk that is separate from the backup data storage destination, keep the following points in mind:

- Recovery requires not only the backup data, but also the archive log and mirrored transaction log (mirrored WAL). Therefore, make sure that these items can be stored together.
- Note that the permissions and mount state are the same at the time of the recovery as they were at the time of the backup. Make the archive log and mirrored transaction log (mirrored WAL) available before starting the recovery.



*1: To distribute the I/O load, place the transaction log on a different disk from the data storage destination.

Resource	Role
Database cluster	The area where the database is stored. It is a collection of databases managed by an instance.
Tablespace	Stores table files and index files in a separate area from the database cluster. Specify a space other than that under the database cluster.
Transaction log	Stores log information in preparation for a crash recovery or rollback. This is the same as the WAL (Write Ahead Log).
Archive log	Stores log information for recovery
Mirrored transaction log (mirrored WAL)	Enables a database cluster to be restored to the state immediately before an error even if both the database cluster and transaction log fail when performing backup/recovery operations using the pgx_dmpall command or WebAdmin.
Corefile	Fujitsu Enterprise Postgres process corefile output when an error occurs with a Fujitsu Enterprise Postgres process.

Examples of disk deployment

The following are examples of disk deployment:

Number of disks	Disk	Deployment
3	System disk	Fujitsu Enterprise Postgres program
		Corefile
	Connected physical disk	Data storage destination, transaction log storage destination
	Connected physical disk	Backup data storage destination
2	System disk	Fujitsu Enterprise Postgres program
		Corefile
		Data storage destination, transaction log storage destination
	Connected physical disk	Backup data storage destination

Preparing directories

You cannot use directories mounted over the network.
Examples include NFS (Network File System) and CIFS (Common Internet File System).
Do not use these directories unless you are creating tablespaces on a storage device on your network.

The directories to be prepared depend on the way that you create the instances.

Using WebAdmin

For WebAdmin, WebAdmin automatically creates the directory during instance creation.

Directory	Description
Data storage destination	Specify in the GUI.
Backup data storage destination	Specify in the GUI. Place them on a disk different from the data storage destination.
Transaction log storage destination	Specify in the GUI. The default is to create in a directory in the data storage destination. When

Directory	Description
	it is necessary to distribute the I/O load for the database data and the transaction log, consider putting the transaction log storage destination on a different disk from the data storage destination
Corefile output destination	WebAdmin generates it automatically, so no specification is required. For more information about directories, refer to "Directory for Core File Output when Using WebAdmin".

Directory for Core File Output when Using WebAdmin

The corefile path is as follows:

```
/var/tmp/fsep_productVersion_WA_architecture/instanceAdminUser_instanceNamePortNumber/core
```

product version

Contains the version of the [Server Product Type] that WebAdmin specifies when creating an instance.

If you manage multiple versions, the fsep_version directory is created for as many versions as you manage.

instanceAdminUser

Contains the user name of the OS.

PortNumber

Contains the port number of the database server specified when the instance was created.

Example:

```
/var/tmp/fsep_170_WA_64/naomi_myinst27599/core
```

To change the output destination, configure the core_directory and the core_contents parameters in postgresql.conf. Refer to "Parameters" in the Operation Guide for information on the settings for these parameters.

Note that resources placed in /var/tmp that have not been accessed for 30 days or more will be deleted by the default settings of the operating system. Consider excluding them from deletion targets or changing the output destination in the operating system settings.

Using the initdb Command

For the inidb command, prepare the directory in advance.

The directories to prepare in advance are:

Directory to be prepared	Required / Optional
Data storage destination	Required
Backup data storage destination	Optional
Transaction log storage destination	Optional
Corefile output destination	Optional

4.2.3 Estimating Resources

Estimate the resources to be used on the Fujitsu Enterprise Postgres.

Refer to "Appendix E Estimating Database Disk Space Requirements" for information on estimating database disk space requirements.

Refer to "Parameters automatically set by WebAdmin according to the amount of memory" when creating multiple instances with WebAdmin.

Refer to "Appendix F Estimating Memory Requirements" when creating instances with the initdb command, to estimate memory usage.

4.2.4 Configuring Corefile Names

If a process crashes, a corefile for the process will be generated by the operating system. If a corefile is generated with the same name as an existing corefile generated for a different process, the newly-generated corefile will overwrite the previously dumped corefile. To prevent this, configure a unique corefile name for each crash by appending the process ID, program name, and datetime.

Corefile names can be configured using the "kernel.core_pattern" and "kernel.core_uses_pid" kernel parameters.
Refer to the "man page" in "core(5)" for information on how to use these parameters.

Note that with regard to the location for storing corefiles, the operating system settings take precedence over the core_directory parameter of postgresql.conf.

If you specify systemd-coredump as the core_pattern, the core file is not placed in the location specified by the core_directory parameter.See the systemd-coredump (8) man page for the location of core files.

Use coredumpctl to retrieve core files.For more information about using coredumpctl, see the coredumpctl (1) man page.

4.3 Creating Instances

There are two methods that can be used to create an instance:

- 4.3.1 Using WebAdmin
- 4.3.2 Using the initdb Command

4.3.1 Using WebAdmin

This section describes how to create an instance using WebAdmin.

WebAdmin must be set up correctly before it can be used. Refer to "B.1 Setting Up WebAdmin" for details. Additionally, if WebAdmin needs to be configured to use an external repository database, refer to "B.3 Using an External Repository for WebAdmin" for details.

4.3.1.1 Before Using WebAdmin

Learn what you need to know before using WebAdmin.

Recommended Browser

- Microsoft Edge

WebAdmin will work with other browsers, such as Firefox and Chrome, however, the look and feel may be different.

Configure your browser to allow cookies and pop-up requests from the server on which Fujitsu Enterprise Postgres is installed. Refer to "Appendix A Recommended WebAdmin Environments" for information on how to change the pop-up request settings and other recommended settings.

Notes on operations

- It will not work correctly if you operate the same instance from multiple WebAdmin screens at the same time.
- If you want to manage multiple versions of an instance, operate with the latest version of WebAdmin.
- It is recommended not to use the browser [Back] and [Forward] navigation buttons, the [Refresh] button, and context-sensitive menus, including equivalent keyboard shortcuts.
- Do not copy and paste or bookmark the URL of the WebAdmin login screen and skip directly.

Considerations for Using Transparent Data Encryption

After you create an instance in WebAdmin, follow the documentation for each feature in the Operation Guide for additional setup tasks.

About the PostgreSQL Configuration File Relationship

When creating or importing an instance in WebAdmin, set the log_directory parameter in postgresql.conf to '/var/tmp/fsep_version/instanceAdminUser_instanceNamePortNumber/log'.

Note

Note that resources placed in /var/tmp that have not been accessed for 30 days or more will be deleted by the default settings of the operating system. Therefore, consider excluding instances created using WebAdmin from deletion targets in the operating system settings if you need to stop those instances for a long time.

4.3.1.2 Logging in to WebAdmin

This section describes how to log in to WebAdmin.

Startup URL for WebAdmin

In the browser address bar, type the startup URL of the WebAdmin window in the following format:

```
http://hostNameOrIpAddress:portNumber/
```

- *hostNameOrIpAddress*: Host name or IP address of the server where WebAdmin is installed.
- *portNumber*: Port number of WebAdmin. The default port number is 27515.

The startup screen is displayed. From this window you can log in to WebAdmin or access the product documentation.

Logging in to WebAdmin

Click [Launch WebAdmin] in the startup URL window to start WebAdmin and display the login window. Enter the instance administrator user ID (operating system user account name) and password, and log in to WebAdmin. User credential (instance administrator user ID and password) should not contain hazardous characters. Refer to "Appendix C WebAdmin Disallow User Inputs Containing Hazardous Characters".

If you set the account lock for login failure, login failure from WebAdmin might lock the account and prevent you from logging in to the OS. Check the account lock settings in advance.

4.3.1.3 Creating an Instance

This section describes how to create an instance.

Information

- WebAdmin creates an instance configuration file, postgresql.conf, and sets kernel parameters to the optimal values for this configuration. Refer to "Appendix D Configuring Parameters" and "Appendix H Configuring Kernel Parameters" for more information.
- WebAdmin automatically sets the memory usage assuming you create one instance per machine. If you are creating multiple instances on a single machine, refer to "Parameters automatically set by WebAdmin according to the amount of memory" to adjust the memory usage after the instance is created.

1. Start WebAdmin, and log in to the database server.
2. In the [Instances] tab, click  .
3. Enter the information for the instance to be created.

   Enter the following items:

[Host name] and [Operating system credential] should not contain hazardous characters. Refer to "Appendix C WebAdmin Disallow User Inputs Containing Hazardous Characters".

- [Configuration type]: Whether to create a standalone instance or an instance that is part of a cluster.
- [Server product type]: Sets which of the following instances to create:
  - Fujitsu Enterprise Postgres 9.5 Instances
  - Fujitsu Enterprise Postgres 9.6 Instances
  - Fujitsu Enterprise Postgres 10 Instances
  - Fujitsu Enterprise Postgres 11 Instances
  - Fujitsu Enterprise Postgres 12 Instances
  - Fujitsu Enterprise Postgres 13 Instances
  - Fujitsu Enterprise Postgres 14 Instances
  - Fujitsu Enterprise Postgres 15 Instances
  - Fujitsu Enterprise Postgres 16 Instances
  - Fujitsu Enterprise Postgres 17 Instances

  The default is "Fujitsu Enterprise Postgres 17".
- [Location]: Whether to create the instance in the server that the current user is logged into, or in a remote server. The default is "Local", which will create the instance in the server machine where WebAdmin is currently running.
- [Instance name]: Name of the database instance to manage

  The name must meet the conditions below:
  - Maximum of 16 characters
  - The first character must be an ASCII alphabetic character
  - The other characters must be ASCII alphanumeric characters
- [Instance port]: Port number of the database server
- [Data storage path]: Directory where the database data will be stored
- [Backup]: Whether to enable or disable the WebAdmin backup feature. The default is "Enabled". Select "Disabled" to disable all backup and restore functionality for the instance. If "Enabled" is selected, enter the following item:
  - [Backup storage path]: Directory where the database backup will be stored
- [Transaction log path]: Directory where the transaction log will be stored
- [Encoding]: Database encoding system
- [WAL file size]: Allow the WAL file size to be set when creating an instance. The default is 16 MB if the field is blank. The size specified must be a power of 2 between 1 and 1024. This option is not available for standby instances.

If "Remote" is selected for [Location], enter the following additional items:

- [Host name]: Name of the host where the instance is to be created
- [Operating system credential]: Operating system user name and password for the remote machine where the instance is to be created
- [Remote WebAdmin port for standalone]: Port in which WebAdmin is accessible in the remote machine

4. Click  to create the instance.

   If the instance is created successfully, a message indicating the same will be displayed.

5. The instance will be started when it is created successfully.

6. Back up the basic information that was set

   Back up the WebAdmin management information periodically to ensure operational continuity when a fault occurs on the system disk. Follow the procedure below to perform the backup.

   a. Stop the WebAdmin server. Refer to "B.1.4 Stopping the Web Server Feature of WebAdmin" for details.

   b. Back up the following directory:

      webAdminInstallDir/data/fepwa

   Note that if you are using an external database as your WebAdmin repository, you must also back up the following:

   - *webAdminInstallDir*/data/remotemetadb.conf
   - Use the database features to back up external databases (if they are created on the system disk).

4.3.1.4 Changing Instance Settings

You can change the information that is set when an instance is created.

Change the following settings to suit the operating and management environment for Fujitsu Enterprise Postgres.

Note that this cannot be changed for instances of FUJITSU Enterprise Postgres 9.5.

- Instance configuration
  - Character encoding
  - Communication
  - SQL options
  - Memory
  - Streaming replication
- Changing client authentication information
- Editing instance information

Information

- These settings are the same as the parameters that can be set in the files shown below. Refer to "Appendix D Configuring Parameters" for information on the equivalence relationship between the item name and the parameter.
  - postgresql.conf
  - pg_hba.conf
- When [Instance name] or [Instance port] is modified, the log_directory and core_directory parameters in postgresql.conf are updated. Also, the specified directories are created if they do not exist. Refer to “4.3.1.5 Importing Instances” for information on the format of these directories.

4.3.1.4.1 Instance configuration

1. Start WebAdmin and log in to the database server.
2. In the [Instances] tab, click  .
3. Click  to change the configuration.
4. Click  to save your changes.

See

Select a client-side encoding system that can be converted to/from the database encoding system. Refer to "Automatic Character Set Conversion Between Server and Client" in "Server Administration" in the PostgreSQL Documentation for information on the encoding system combinations that can be converted.

4.3.1.4.2 Changing client authentication information

1. Start WebAdmin and log in to the database server.
2. In the [Instances] tab, click  .

   Click  to register new authentication information.

   To change authentication information, select the information, and then click  .

   To delete authentication information, select the information, and then click  .

Notes on changing client authentication information

When creating the instance, do not delete the entry below, because it is a connection required for WebAdmin to monitor the operational status of the database:
Type=local, Database=all, User=all, and Method=md5

4.3.1.4.3 Editing instance information

Use the [Edit instance] page to modify the following items for an instance:

- Instance name
- Port number
- Backup storage path

1. In the [Instances] tab, click  . The [Edit instance] page is displayed.
2. Modify the relevant items.

   If [Backup storage path] is changed, [Backup management] is enabled. Select the required option:

   - Retain existing backup: Create a backup in [Backup storage path] and retain the existing backup in its original location.
   - Copy existing backup to new path: Copy the existing backup to [Backup storage path]. A new backup will not be created. The existing backup will be retained in its original location.
   - Move existing backup to new path: Move the existing backup to [Backup storage path]. A new backup will not be created.
   - Remove existing backup: Create a backup in [Backup storage path]. The existing backup will be removed.
3. Click  to save your changes.

4.3.1.5 Importing Instances

Instances can be created using WebAdmin, or via the command line using the initdb command. Instances created using the initdb command (command line instances) can be managed using WebAdmin, however, they must first be imported into WebAdmin.

You cannot import instances that use the Mirroring Controller.

Advance Preparation

- If the following file contains records that span multiple lines, change the record to a single line before importing.
  - pg_hba.conf
  - pg_ident.conf

- You must make the following changes to the parameters in postgresql.conf prior to importing the instance in WebAdmin.

Parameter	Requirements
port	The port parameter should be uncommented.

- Delete the values specified for the following parameters. Also, if you have changed the value of the parameter (where the file is stored) from the default, move the file to the data storage directory before importing it.
  - hba_file parameter (pg_hba.conf)
  - ident_file parameter (pg_ident.conf)

Import

This section explains how to import command line instances into WebAdmin.

1. In the [Instances] tab, click  . The [Import instance] page is displayed.
2. Enter the information for the instance being imported. Refer to "4.3.1.3 Creating an Instance" for information on the items that need to be entered.
3. Click  to import the instance.

Information

The log_directory and core_directory parameters in postgresql.conf are updated during import. Also, the specified directories are created if they do not exist.
The format of these directories is as follows:

```
log_directory: '/var/tmp/fsep_version/instanceAdminUser_instanceNamePortNumber/log'
core_directory: '/var/tmp/fsep_version/instanceAdminUser_instanceNamePortNumber/core'

    version: product version_WA_architecture
    instanceAdminUser: operating system user name
    PortNumber: port number specified when creating the instance
```

Examples:
log_directory: '/var/tmp/fsep_170_WA_64/naomi_myinst27599/log'
core_directory: '/var/tmp/fsep_170_WA_64/naomi_myinst27599/core'

4.3.2 Using the initdb Command

This section describes the procedure to create an instance using the initdb command.

Instances created using the initdb command (command line instances) can be managed using WebAdmin, however, they must first be imported into WebAdmin. Refer to "4.3.1.5 Importing Instances" for details.

4.3.2.1 Editing Kernel Parameters

Refer to "Appendix H Configuring Kernel Parameters" prior to editing these settings.

After the settings are complete, check the command specifications of the relevant operating system and restart the system if required.

4.3.2.2 Creating an Instance

Create an instance, with the database cluster storage destination specified in the PGDATA environment variable or in the -D option. Furthermore, the user that executed the initdb command becomes the instance administrator.

See

Refer to "initdb" in "Reference" in the PostgreSQL Documentation for information on the initdb command.

The procedure to create an instance is described below.

1. Use the OS user account that you want as the instance administrator.

   Connect with the server using the OS user account that you want as the instance administrator.

   You cannot use the OS superuser (root).

   The following example shows the OS superuser connected to the server being changed to the OS user account "fsepuser".

   Example

   ```
   # su fsepuser
   ```

2. Configure the environment variables

   Configure the environment variables in the server with the newly created instance.

   Set the following environment variables:

   - PATH environment variables

     Add the installation directory "/bin".

   - MANPATH environment variables

     Add the installation directory "/share/man".

   Example

   The following example configures environment variables when the installation directory is "/opt/fsepv<*x*>server64".

   Note that "<*x*>" indicates the product version.

   sh, bash

   ```
   $ PATH=/opt/fsepv<x>server64/bin:$PATH ; export PATH
   $ MANPATH=/opt/fsepv<x>server64/share/man:$MANPATH ; export MANPATH
   ```

   csh, tcsh

   ```
   $ setenv PATH /opt/fsepv<x>server64/bin:$PATH
   $ setenv MANPATH /opt/fsepv<x>server64/share/man:$MANPATH
   ```

3. Create a database cluster

   Create the database cluster with the initdb command, specifying the storage destination directory.

   Specify the transaction log storage destination and the locale setting option as required.

   If creating multiple instances, ensure that there is no duplication of directories that store database clusters.

   Example

   ```
   $ initdb -D /database/inst1 --waldir=/transaction/inst1 --lc-collate="C" --lc-ctype="C" --
   encoding=UTF8
   ```

   - In some features, instance names are requested, and those names are required to uniquely identify the instance within the system. These features allow names that conform to WebAdmin naming conventions, so refer to the following points when determining the names:

     - Maximum of 16 characters
     - The first character must be ASCII alphabetic character
     - The other characters must be ASCII alphanumeric characters

- Specify "C" or "POSIX" for collation and character category. Performance deteriorates if you specify a value other than "C" or "POSIX", although the behavior will follow the rules for particular languages, countries and regions. Furthermore, this may need to be revised when running applications on systems with different locales.
  For example, specify as follows:

  ```
  initdb --locale="C" --lc-messages="C"
  initdb --lc-collate="C" --lc-ctype="C"
  ```

- Specify the same string in the LANG environment variable of the terminal that starts Fujitsu Enterprise Postgres as was specified in lc-messages of initdb (lc_messages of postgresql.conf). If the same string is not specified, messages displayed on the terminal that was started, as well as messages output to the log file specified in the -l option of the pg_ctl command or the postgres command used for startup, may not be output correctly.
- Specify an encoding system other than SQL_ASCII for the database. If SQL_ASCII is used, there is no guarantee that the encryption system for data in the database will be consistent, depending on the application used to insert the data.

Refer to "Locale Support" in "Localization" in "Server Administration" in the PostgreSQL Documentation for information on locales.

4. Set port number.

   Specify a port number in the port parameter of postgresql.conf. Ensure that the specified port number is not already used for other software. If creating multiple instances, ensure that there is no duplication of port numbers.

   If a port number is not specified, "27500" is selected.

   Register the specified port numbers in the /etc/services file if WebAdmin is used to create other instances. WebAdmin uses the /etc/services file to check if port numbers specified as available candidates have been duplicated.

   Register any name as the service name.

5. Set the corefile output destination.

   Specify the output destination of the corefile, which can later be used to collect information for investigation, by setting the core_directory and core_contents parameters of postgresql.conf.

Refer to "Parameters" in the Operation Guide for information on the settings for these parameters.

6. Set the backup storage destination.

   Specify the backup data storage destination and other backup settings when backup is to be performed as a provision against database errors.

Refer to "Backup Methods" in the Operation Guide for information on specifying backup settings.

7. Start an instance.

   Start with the start mode of the pg_ctl command.

   Example

   ```
   $ pg_ctl start -D /database/inst1
   ```

   If either of the following conditions are met, the message "FATAL:the database system is starting up(11189)" may be output. This message is output by the pg_ctl command to check if the instance has started successfully. Therefore, ignore this message if there are no other applications, commands, or processes that connect to the database.

   - An application, command, or process connects to the database while the instance is starting

- An instance was started without the -W option specified

If the -W option is specified, the command will return without waiting for the instance to start. Therefore, it may be unclear as to whether instance startup was successful or failed.

See

Refer to "pg_ctl" in "Reference" in the PostgreSQL Documentation for information on the pg_ctl command.

4.4 Configuring Remote Connections

This section describes the settings required when connecting remotely to Fujitsu Enterprise Postgres from a database application or a client command.

4.4.1 When an Instance was Created with WebAdmin

Settings related to connection

The default is to accept connections from remote computers to the database.

Change "listen_addresses" in postgresql.conf to modify the default behavior.

Refer to "Appendix D Configuring Parameters" for information on postgresql.conf.

Client Authentication Information settings

The following content is set by default when WebAdmin is used to create an instance.

- Authentication of remote connections from local machines is performed.

When changing Client Authentication Information, select [Client Authentication] from [Setting], and then change the settings.

4.4.2 When an Instance was Created with the initdb Command

Connection settings

The default setting only permits local connections from the client to the database. Remote connections are not accepted.

Change "listen_addresses" in postgresql.conf to perform remote connection.

All remote connections will be allowed when changed as shown below.

Example

```
listen_addresses = '*'
```

Also, configure the parameters shown below in accordance with the applications and number of client command connections.

Parameter name	Parameter description
superuser_reserved_connections	Number of connections reserved for database maintenance, for example backup or index rebuilding. If you need to simultaneously perform a large number of processes that exceed the default value, change this value accordingly.
max_connections	Set the value as: *numberOfSimultaneousConnectionsToInstance* + superuser_reserved_connections

Client authentication information settings

When trying to connect from a client to a database, settings are required to determine whether the instance permits connections from the client - if it does, then it is possible to make settings to determine if authentication is required.

See

Refer to "The pg_hba.conf File" in "Server Administration" in the PostgreSQL Documentation for details.

4.5 Other Settings

This section describes settings that are useful for operations.

4.5.1 Error Log Settings

This section explains the settings necessary to monitor errors in applications and operations, and to make discovering the causes easier.

Make error log settings only when instances are created with the initdb command.

When creating instances with WebAdmin, these settings are already made and hence do not need to be set.

Furthermore, some parameters are used by WebAdmin, and if changed, may cause WebAdmin to no longer work properly. Refer to "Appendix D Configuring Parameters" for details.

Edit the following parameters in postgresql.conf:

Parameter name	Parameter description	How to enable the settings
syslog_ident	Used to specify labels to attach to messages, so that these can be identified when output to the system log if more than one Fujitsu Enterprise Postgres is used.	reload option of the pg_ctl mode
logging_collector	Specify "on" to ensure that messages are output by Fujitsu Enterprise Postgres to the server log file. The server log file is created in the log directory in the database cluster.	restart option of the pg_ctl mode
log_destination	Specify "stderr,syslog" to output messages from Fujitsu Enterprise Postgres to the screen and either the system log or the event log.	reload option of the pg_ctl mode
log_line_prefix	Specify information to be added at the start of messages output by an instance. This information is useful for automatic monitoring of messages. You can output the SQLSTATE value, output time, executing host, application name, and user ID. Refer to "What To Log" in the PostgreSQL Documentation for details. Example: log_line_prefix = '%e: %t [%p]: [%l-1] user = %u,db = %d,remote = %r app = %a '	reload option of the pg_ctl mode

Point

- Set the output destination for the system log to the server log so that it cannot be viewed by administrators of other instances. Application errors are output to the system log or server log. The output destination directory for the system log and server log should have access permissions set so that they cannot be viewed by people other than the instance administrator.
- If you want fewer application errors being output to the system log, refer to "When To Log" and "What To Log" in the PostgreSQL Documentation for information on how to reduce the output messages.
- If you want to separate errors output from other software, refer to "Where To Log" in the PostgreSQL Documentation to change the output destination to the server log file rather than the system log.

4.5.2 Configuring Automatic Start and Stop of an Instance

You can automatically start or stop an instance when the operating system on the database server is started or stopped.

Use the following procedure to configure automatic start and stop of an instance.

Note that, if an instance is started in a failover operation, the cluster system will control the start or stop, therefore this feature should not be used. Also, when performing database multiplexing, refer to "Enabling Automatic Start and Stop of Mirroring Controller and Multiplexed Instances" in the Cluster Operation Guide (Database Multiplexing).

Note that "<*x*>" in paths indicates the product version.

1. Create a unit file

   Copy the unit file sample stored in the directory below, and revise it to match the target instance.

   ```
   fujitsuEnterprisePostgresInstallDir/share/fsepsvoi.service.sample
   ```

   Example

   In the following example, the installation directory is "/opt/fsepv<*x*>server64", and the instance name is "inst1".

   ```
   # cp /opt/fsepv<x>server64/share/fsepsvoi.service.sample /usr/lib/systemd/system/
   fsepsvoi_inst1.service
   ```

   Revise the underlined portions of the options below in the unit file.

   If necessary, correct the time correction, wait for the network environment to open, etc.

Section	Option	Specified value	Description
Unit	Description	Fujitsu Enterprise Postgres ***instanceName***	Specifies the feature overview. Specifies the name of the target instance. (*1)
Service	ExecStart	/bin/bash -c '***installDir***/bin/pgx_symstd start ***installDir dataStorageDestinationDir*** '	Command to be executed when the service is started.
	ExecStop	/bin/bash -c '***installDir***/bin/pgx_symstd stop ***installDir dataStorageDestinationDir*** '	Command to be executed when the service is stopped.
	ExecReload	/bin/bash -c '***installDir***/bin/pgx_symstd reload ***installDir dataStorageDestinationDir*** '	Command to be executed when the service is reloaded
	User	**User**	OS user account of the instance administrator.
	Group	**Group**	Group to which the instance administrator user belongs.

   *1: The instance name should be as follows:

   If WebAdmin is used to create the instance: *instanceName*

   If the initdb command is used to create the instance: *nameThatIdentifiesTheInstance*
   The naming conventions for the instance name or for identifying the instance are as follows:

   - Up to 16 bytes
   - The first character must be an ASCII alphabetic character
   - The other characters must be ASCII alphanumeric characters

2. Enable automatic start and stop

   As the OS superuser, use the systemctl command to enable automatic start and stop.

   Example

   ```
   # systemctl enable fsepsvoi_inst1.service
   ```

4.5.3 Settings when Using the Features Compatible with Oracle Databases

To use the features compatible with Oracle databases, create a new instance and execute the following command for the "postgres" and "template1" databases:

```
CREATE EXTENSION oracle_compatible;
```

Features compatible with Oracle databases are defined as user-defined functions in the "public" schema created by default when database clusters are created, so they can be available for all users without the need for special settings.

For this reason, ensure that "public" (without the double quotation marks) is included in the list of schema search paths specified in the search_path parameter.

There are also considerations for use the features compatible with Oracle databases. Refer to " Precautions when Using the Features Compatible with Oracle Databases" in the Application Development Guide for details.

4.5.4 LDAP Authentication File Settings

The LDAP authentication file refers to the following OS standard default file

/etc/openldap/ldap.conf

If you wish to use a different file, specify the LDAP authentication file you wish to set in an environment variable such as LDAPCONF, and then restart the Postgres instance. Refer to the OpenLDAP documentation for detailed configuration details.

4.5.5 Setting the server keytab file for GSSAPI authentication

When setting the server keytab file for GSSAPI authentication, be sure to set the "krb_server_keyfile" parameter, as the default value in postgresql.conf (FILE:/usr/local/pgsql/etc/krb5.keytab) will not take effect.

4.5.6 Settings for Using Legacy OpenSSL Providers

If you use a legacy OpenSSL provider, create an OpenSSL configuration file and set the parameters in postgresql.conf.

OpenSSL configuration file

Create an OpenSSL configuration file in any directory for legacy providers to use.

Example

```
openssl_conf = openssl_init

[openssl_init]
providers = provider_sect

[provider_sect]
default = default_sect
legacy = legacy_sect

[default_sect]
activate = 1

[legacy_sect]
activate = 1
```

Parameters

- openssl_conf

  Specify the OpenSSL configuration file created above.

  #### Example

  ```
  openssl_conf = '/path/to/openssl.conf'
  ```

- openssl_modules

  Specifies the installation directory for the server product that contains the additional OpenSSL modules.

  Example

  ```
  openssl_modules = '/opt/fsepv<x>server64/lib/ossl-modules'
  ```

  "< x >" indicates the product version.

See

Refer to "Parameters" in the Operation Guide for information for parameters.

4.6 Integration with Message-Monitoring Software

To monitor messages output by Fujitsu Enterprise Postgres using software, configure the product to monitor SQLSTATE, instead of the message text - this is because the latter may change when Fujitsu Enterprise Postgres is upgraded.

Configure Fujitsu Enterprise Postgres to output messages in a format that can be read by the message-monitoring software by specifying "%e" in the log_line_prefix parameter of postgresql.conf to output the SQLSTATE value.

A setting example is shown below - it outputs the output time, executing host, application name, and user ID, in addition to the SQLSTATE value.

Example

```
log_line_prefix = '%e: %t [%p]: [%l-1] user = %u,db = %d,remote = %r app = %a '
```

See

Refer to "What To Log" in the PostgreSQL Documentation for information on how to configure the settings.

4.7 Setting Up and Removing OSS

This section explains how to set up OSS supported by Fujitsu Enterprise Postgres.

If you want to use OSS supported by Fujitsu Enterprise Postgres, follow the setup procedure.

If you decide not to use the OSS supported by Fujitsu Enterprise Postgres, follow the removing procedure.

To build and use OSS obtained from the web, etc., instead of OSS supported by Fujitsu Enterprise Postgres, see "4.7.15 Build with PGXS".

Information

- In this section, the applicable database that enables the features of each OSS is described as "postgres".
- Execute CREATE EXTENSION for the "template1" database also, so that each OSS can be used by default when creating a new database.

Refer to "OSS Supported by Fujitsu Enterprise Postgres" in the General Description for information on OSS other than those described below.

4.7.1 oracle_fdw

This feature is available only when the server command is used. It is not available for instances created with WebAdmin.

4.7.1.1 Setting Up oracle_fdw

1. Add the path of the OCI library to the environment variable.
   Add the installation path of the OCI library to the LD_LIBRARY_PATH environment variable.

2. As superuser, run the following command:

```
$ su -
Password:******
# cp -r /opt/fsepv<x>server64/OSS/oracle_fdw/* /opt/fsepv<x>server64
```

3. If a file named libclntsh.so.11.1 does not exist in your OCI library, create a symbolic link with the name libclntsh.so.11.1 to libclntsh.so.xx.1 (xx is the version of the OCI library).

```
# ln -s libclntsh.so.xx.1 libclntsh.so.11.1
```

4. Restart Fujitsu Enterprise Postgres.

5. Execute CREATE EXTENSION for the database that will use this feature.
   Use the psql command to connect to the "postgres" database.

```
postgres=# CREATE EXTENSION oracle_fdw;
CREATE EXTENSION
```

Information

- If the OCI library is not installed on the server, install it using the Oracle client or Oracle Instant Client.
  Refer to the relevant Oracle manual for information on the installation procedure.
- If the version of the OCI library is updated, change the path of the OCI library in the LD_LIBRARY_PATH environment variable to the updated path. Also, re-create the symbolic link named libclntsh.so.11.1 if necessary.

4.7.1.2 Removing oracle_fdw

1. Execute DROP EXTENSION for the database that will use this feature.
   Use the psql command to connect to the "postgres" database.

```
postgres=# DROP EXTENSION oracle_fdw CASCADE;
DROP EXTENSION
```

2. As superuser, run the following command:

```
$ su -
Password:******
# rm -rf /opt/fsepv<x>server64/filesCopiedDuringSetup
```

Information

The files copied during setup can be checked below.

```
# find /opt/fsepv<x>server64/OSS/oracle_fdw
```

4.7.2 pg_bigm

4.7.2.1 Setting Up pg_bigm

1. Set the postgresql.conf file parameters.
   Add "pg_bigm" to the shared_preload_libraries parameter.

2. As superuser, run the following command:

```
$ su -
Password:******
# cp -r /opt/fsepv<x>server64/OSS/pg_bigm/* /opt/fsepv<x>server64
```

3. Restart Fujitsu Enterprise Postgres.

4. Execute CREATE EXTENSION for the database that will use this feature.
   Use the psql command to connect to the "postgres" database.

```
postgres=# CREATE EXTENSION pg_bigm;
CREATE EXTENSION
```

4.7.2.2 Removing pg_bigm

1. Execute DROP EXTENSION for the database that will use this feature.
   Use the psql command to connect to the "postgres" database.

```
postgres=# DROP EXTENSION pg_bigm CASCADE;
DROP EXTENSION
```

2. Set the postgresql.conf file parameters.
   Delete "pg_bigm" to the shared_preload_libraries parameter.

3. Restart Fujitsu Enterprise Postgres.

4. As superuser, run the following command:

```
$ su -
Password:******
# rm -rf /opt/fsepv<x>server64/filesCopiedDuringSetup
```

Information

The files copied during setup can be checked below.

```
# find /opt/fsepv<x>server64/OSS/pg_bigm
```

4.7.3 pg_hint_plan

4.7.3.1 Setting Up pg_hint_plan

1. Set the postgresql.conf file parameters.
   Add "pg_hint_plan" to the "shared_preload_libraries" parameter.

2. As superuser, run the following command:

```
$ su -
Password:******
# cp -r /opt/fsepv<x>server64/OSS/pg_hint_plan/* /opt/fsepv<x>server64
```

3. Restart Fujitsu Enterprise Postgres.

4. Run CREATE EXTENSION for the database that uses this feature.
   The target database is described as "postgres" here.
   Use the psql command to connect to the "postgres" database.

```
postgres=# CREATE EXTENSION pg_hint_plan;
CREATE EXTENSION
```

See

Refer to "Enhanced Query Plan Stability" in the Operation Guide for details.

4.7.3.2 Removing pg_hint_plan

Unsetting pg_hint_plan will cause hints registered in the hint_plan.hints table to be lost. Therefore, if you might later use pg_hint_plan again, back up each database's hint_plan.hints table with pg_dump before unsetting it up.

1. Execute DROP EXTENSION for the database that will use this feature.
   Use the psql command to connect to the "postgres" database.

```
postgres=# DROP EXTENSION pg_hint_plan CASCADE;
DROP EXTENSION
```

2. Set the postgresql.conf file parameters.
   Delete "pg_hint_plan" to the shared_preload_libraries parameter.
3. Restart Fujitsu Enterprise Postgres.
4. As superuser, run the following command:

```
$ su -
Password:******
# rm -rf /opt/fsepv<x>server64/filesCopiedDuringSetup
```

Information

The files copied during setup can be checked below.

```
# find /opt/fsepv<x>server64/OSS/pg_hint_plan
```

4.7.4 pg_dbms_stats

4.7.4.1 Setting Up pg_dbms_stats

1. Set the postgresql.conf file parameter.
   Add "pg_dbms_stats" to the "shared_preload_libraries" parameter.
2. As superuser, run the following command:

```
$ su -
Password:******
# cp -r /opt/fsepv<x>server64/OSS/pg_dbms_stats/* /opt/fsepv<x>server64
```

3. Restart Fujitsu Enterprise Postgres.
4. Run CREATE EXTENSION for the database that will use this feature.
   The target database is described as "postgres" here.
   Use the psql command to connect to the "postgres" database.

```
postgres=# CREATE EXTENSION pg_dbms_stats;
CREATE EXTENSION
```

See

Refer to "Enhanced Query Plan Stability" in the Operation Guide for details.

4.7.4.2 Removing pg_dbms_stats

Unsetting pg_dbms_stats causes statistics managed by pg_dbms_stats to be lost. Therefore, if you plan to use pg_dbms_stats again later, back up each table in each database's dbms_stats schema in binary format, as shown below, and then perform unsetup.

```
postgres > # COPY <dbms_stats Schema's table name> TO '<Filename>' FORMAT binary;
```

1. Execute DROP EXTENSION for the database that will use this feature.
   Use the psql command to connect to the "postgres" database.

   ```
   postgres=# DROP EXTENSION pg_dbms_stats CASCADE;
   DROP EXTENSION
   ```

2. Set the postgresql.conf file parameters.
   Delete "pg_dbms_stats" to the shared_preload_libraries parameter.

3. Restart Fujitsu Enterprise Postgres.

4. As superuser, run the following command:

   ```
   $ su -
   Password:******
   # rm -rf /opt/fsepv<x>server64/filesCopiedDuringSetup
   ```

   Information

   The files copied during setup can be checked below.

   ```
   # find /opt/fsepv<x>server64/OSS/pg_dbms_stats
   ```

4.7.5 pg_repack

4.7.5.1 Setting Up pg_repack

1. As superuser, run the following command:

   ```
   $ su -
   Password:******
   # cp -r /opt/fsepv<x>server64/OSS/pg_repack/* /opt/fsepv<x>server64
   ```

2. Execute CREATE EXTENSION for the database that will use this feature.
   Use the psql command to connect to the "postgres" database.

   ```
   postgres=# CREATE EXTENSION pg_repack;
   CREATE EXTENSION
   ```

4.7.5.2 Removing pg_repack

1. Execute DROP EXTENSION for the database that will use this feature.
   Use the psql command to connect to the "postgres" database.

   ```
   postgres=# DROP EXTENSION pg_repack CASCADE;
   DROP EXTENSION
   ```

2. As superuser, run the following command:

   ```
   $ su -
   Password:******
   # rm -rf /opt/fsepv<x>server64/filesCopiedDuringSetup
   ```

Information

The files copied during setup can be checked below.

```
# find /opt/fsepv<x>server64/OSS/pg_repack
```

4.7.6 pg_rman

This feature is available only when the server command is used. It is not available for instances created with WebAdmin.

4.7.6.1 Setting Up pg_rman

1. As superuser, run the following command:

```
$ su -
Password:******
# cp -r /opt/fsepv<x>server64/OSS/pg_rman/* /opt/fsepv<x>server64
```

2. Restart Fujitsu Enterprise Postgres.

Information

Before initialization of the backup catalog, it is recommended to set the parameters below in postgresql.conf. Refer to the pg_rman manual (http://ossc-db.github.io/pg_rman/index-ja.html) for details.

- log_directory
- archive_mode
- archive_command

4.7.6.2 Removing pg_rman

1. As superuser, run the following command:

```
$ su -
Password:******
# rm -rf /opt/fsepv<x>server64/filesCopiedDuringSetup
```

Information

The files copied during setup can be checked below.

```
# find /opt/fsepv<x>server64/OSS/pg_rman
```

2. Restart Fujitsu Enterprise Postgres.

4.7.7 pg_statsinfo

This feature is available only when the server command is used. It is not available for instances created with WebAdmin.

4.7.7.1 Setting Up pg_statsinfo

1. Set the postgresql.conf file parameters.
   - Add "pg_statsinfo" to the shared_preload_libraries parameter.
   - Specify the log file name for the log_filename parameter.

- Specify "on" to the logging_collecto parameter.
- Add "csvlog" to the log_destination parameter.
- Delete "stderr" to the log_destination parameter.

For the parameters "logging_collector" and "log_destination", pg_statsinfo will change the settings in the postmaster process as above without rewriting postgresql.conf, even if you do not make the above changes.
Explicit rewriting is recommended because the configuration file and behavior will not match.

2. Perform the following setup as a superuser:

   Install the pg_statsinfo module:

```
# cp -r /opt/fsepv<x>server64/OSS/pg_statsinfo/* /opt/fsepv<x>server64
```

   Create the directories needed for pg_statsinfo to work.
   This directory is where the files for managing process IDs for pg_statsinfo processes are stored.
   The minimum required permissions for the directory are 700.
   Set the owner of the directory to the instance administrator user.
   This example sets the OS user “fsepuser” as the instance administrator.

```
# mkdir /run/pg_statsinfo
# chmod 700 /run/pg_statsinfo
# chown fsepuser:fsepuser /run/pg_statsinfo
```

   The directory created above is deleted when the OS stops.
   You can configure the above directories to be created automatically on reboot by running the following command:

```
# cat << EOF > /usr/lib/tmpfiles.d/pg_statsinfo-<x>.conf
d /run/pg_statsinfo 0755 fsepuser fsepuser -
EOF
```

3. Restart Fujitsu Enterprise Postgres.

Information

There are the following differences in postgresql.conf parameter settings required for statistics collection between OSS pg_statsinfo v16 and pg_statsinfo shipped with Fujitsu Enterprise Postgres:

OSS: You must specify "C" for the lc_messages parameter.

Fujitsu Enterprise Postgres: The lc_messages parameter can be any message locale supported by PostgreSQL.

4.7.7.2 Removing pg_statsinfo

1. Set the postgresql.conf file parameters.
   - Delete "pg_statsinfo" to the shared_preload_libraries parameter.
   - Delete the log file name for the log_filename parameter.
   - Specify "off" to the logging_collecto parameter.
   - Delete "csvlog" to the log_destination parameter.
   - Add "stderr" to the log_destination parameter.
2. Restart Fujitsu Enterprise Postgres.
3. As superuser, run the following command:

```
$ su -
Password:******
# rm -rf /opt/fsepv<x>server64/filesCopiedDuringSetup
```

```
# rm -rf /run/pg_statsinfo
# rm -rf /usr/lib/tmpfiles.d/pg_statsinfo-<x>.conf
```

Information

The files copied during setup can be checked below.

```
# find /opt/fsepv<x>server64/OSS/pg_statsinfo
```

4.7.8 pgBadger

4.7.8.1 Setting Up pgBadger

1. Set the postgresql.conf file parameters.
   Set the parameters so that the information required for analysis is output to the server log.
   Refer to "Documentation" in the pgBadger website (https://pgbadger.darold.net/) for details.
   The pgBadger material is stored under /opt/fsepv<x>server64/OSS/pgbadger.

2. Restart Fujitsu Enterprise Postgres.

4.7.8.2 Removing pgBadger

1. Set the postgresql.conf file parameters.
   Restores information you specified during Setup.

2. Restart Fujitsu Enterprise Postgres.

4.7.9 Pgpool-II

The online recovery feature of Pgpool-II is available only when the server command is used. It is not available for instances created with WebAdmin.

4.7.9.1 Setting Up Pgpool-II

1. As superuser, run the following command:

```
$ su -
Password:******
# cp -r /opt/fsepv<x>server64/OSS/Pgpool-II/* /opt/fsepv<x>server64
```

2. Execute CREATE EXTENSION for the database that will use this feature.
   Use the psql command to connect to the "postgres" database.

```
postgres=# CREATE EXTENSION pgpool_recovery;
CREATE EXTENSION
```

3. Set the postgresql.conf file parameters.
   Specify the path to pg_ctl for the pgpool.pg_ctl parameter.

4. Restart Fujitsu Enterprise Postgres.

4.7.9.2 Removing Pgpool-II

1. Execute DROP EXTENSION for the database that will use this feature.
   Use the psql command to connect to the "postgres" database.

```
postgres=# DROP EXTENSION pgpool_recovery CASCADE;
DROP EXTENSION
```

2. As superuser, run the following command:

```
$ su -
Password:******
# rm -rf /opt/fsepv<x>server64/filesCopiedDuringSetup
```

Information

The files copied during setup can be checked below.

```
# find /opt/fsepv<x>server64/OSS/Pgpool-II
```

3. Set the postgresql.conf file parameters.
   Delete the pg_ctl path for the pgpool.pg_ctl parameter.
4. Restart Fujitsu Enterprise Postgres.

4.7.10 pgBackRest

This feature is available only when the server command is used. It is not available for instances created with WebAdmin.

The pg_rman, pgx_dmpall, and pgx_rcvall commands cannot be used when using pgBackRest because of conflicting shell commands to set archive_command.

4.7.10.1 Setting Up pgBackRest

1. Install pgBackRest.

   To use the pgbackrest command on the same host as the Fujitsu Enterprise Postgres server, install pgBackRest using the server program DVD. If you want to use the pgbackrest command on a different host than the Fujitsu Enterprise Postgres server, install pgBackRest using the client program DVD.

2. Set the environment variable PATH for pgBackRest.

   The pgBackRest material is stored under /opt/fsepv<x>pgbackrest. Set the environment variable PATH to the storage location/bin of the pgBackRest material to be used.

```
$ export PATH=/opt/fsepv<x>pgbackrest/bin:$PATH
```

3. Perform pgBackRest setup.

   Refer to " User Guides " in the pgBackRest website (https://pgbackrest.org/) for details.

4.7.10.2 Removing pgBackRest

1. Sets parameters in the postgresql.conf file.

   Reverses the information specified during setup

2. Restart Fujitsu Enterprise Postgres.
3. If it was set to perform periodic backups, unset it.

4.7.10.3 Servers to which pgBackRest can connect

The following table lists server that pgBackRest can connected to.

Table 4.1 Connectable server

OS	Product name
Linux	- Fujitsu Enterprise Postgres Advanced Edition 17, 17 SP1, or 17 SP2 - Fujitsu Enterprise Postgres Standard Edition 17, 17 SP1, or 17 SP2

4.7.11 pgvector

Note that while OSS is named "pgvector", the binaries and the extensions themselves are named "vector".

It is not possible to data masking data added by pgvector using data masking features.

When using in-memory features, data types and functions added in pgvector cannot be accelerated.

4.7.11.1 Setting Up pgvector

1. As superuser, run the following command:

```
$ su -
Password:******
# cp -r /opt/fsepv<x>server64/OSS/pgvector/* /opt/fsepv<x>server64
```

2. Execute CREATE EXTENSION for the database that will use this feature.
   Use the psql command to connect to the "postgres" database.

```
postgres=# CREATE EXTENSION vector;
CREATE EXTENSION
```

4.7.11.2 Removing pgvector

1. Execute DROP EXTENSION for the database that will use this feature.
   Use the psql command to connect to the "postgres" database.

```
postgres=# DROP EXTENSION vector CASCADE;
DROP EXTENSION
```

2. As superuser, run the following command:

```
$ su -
Password:******
# rm -rf /opt/fsepv<x>server64/filesCopiedDuringSetup
```

Information

The files copied during setup can be checked below.

```
# find /opt/fsepv<x>server64/OSS/pgvector
```

4.7.12 pgvectorscale

Note that while OSS is named "pgvectorscale", the binaries and the extensions themselves are named "vectorscale".

4.7.12.1 Setting Up pgvectorscale

1. As superuser, run the following command:
   Since pgvectorscale depends on pgvector, it copies pgvector as well.

```
$ su -
Password:******
# cp -r /opt/fsepv<x>server64/OSS/pgvector/* /opt/fsepv<x>server64
# cp -r /opt/fsepv<x>server64/OSS/pgvectorscale/* /opt/fsepv<x>server64
```

2. Execute CREATE EXTENSION for the database that will use this feature.
   Adding the CASCADE option will also CREATE EXTENSION any dependent pgvectors.
   Use the psql command to connect to the "postgres" database.

```
postgres=# CREATE EXTENSION IF NOT EXISTS vectorscale CASCADE;
CREATE EXTENSION
```

4.7.12.2 Removing pgvectorscale

1. Execute DROP EXTENSION for the database that will use this feature.
   Use the psql command to connect to the "postgres" database.

```
postgres=# DROP EXTENSION vectorscale;
DROP EXTENSION
```

2. As superuser, run the following command:

```
$ su -
Password:******
# rm -rf /opt/fsepv<x>server64/filesCopiedDuringSetup
```

Information

The files copied during setup can be checked below.

```
# find /opt/fsepv<x>server64/OSS/pgvectorscale
```

4.7.13 Apache AGE

4.7.13.1 Setting Up Apache AGE

1. As superuser, run the following command:

```
$ su -
Password:******
# cp -r /opt/fsepv<x>server64/OSS/age/* /opt/fsepv<x>server64
```

2. Execute CREATE EXTENSION for the database that will use this feature.
   Use the psql command to connect to the "postgres" database.

```
postgres=# CREATE EXTENSION age;
CREATE EXTENSION
```

3. To use Apache AGE, execute a LOAD statement for each session, or add "age" to session_preload_libraries parameter in postgresql.conf file.

```
postgres=# LOAD 'age';
LOAD
```

4.7.13.2 Removing Apache AGE

1. Execute DROP EXTENSION for the database that will use this feature.
   Use the psql command to connect to the "postgres" database.

```
postgres=# DROP EXTENSION age;
DROP EXTENSION
```

2. Set the postgresql.conf file parameters.
   Delete "age" to the session_preload_libraries parameter.

3. Restart Fujitsu Enterprise Postgres.
4. As superuser, run the following command:

```
$ su -
Password:******
# rm -rf /opt/fsepv<x>server64/filesCopiedDuringSetup
```

Information

The files copied during setup can be checked below.

```
# find /opt/fsepv<x>server64/OSS/age
```

4.7.14 pg_cron

4.7.14.1 Setting Up pg_cron

1. Set the postgresql.conf file parameter.
   Add "pg_cron" to the "shared_preload_libraries" parameter.
   When using streaming replication, the primary and standby servers must be on the same port number. If you cannot set the same port number, you will need to enable background workers in pg_cron.
   Specify "on" to the cron.use_background_workers parameter.
   Increase the max_worker_processes parameter as needed. In addition to one resident process of pg_cron, max_worker_processes must be increased depending on the number of concurrently running jobs.
2. As superuser, run the following command:

```
$ su -
Password:******
# cp -r /opt/fsepv<x>server64/OSS/pg_cron /* /opt/fsepv<x>server64
```

3. Restart Fujitsu Enterprise Postgres.
4. Run CREATE EXTENSION for the database that will use this feature.
   The target database is described as "postgres" here.
   Use the psql command to connect to the "postgres" database.

```
postgres=# CREATE EXTENSION pg_cron;
CREATE EXTENSION
```

4.7.14.2 Removing pg_cron

1. Execute DROP EXTENSION for the database that will use this feature.
   Use the psql command to connect to the "postgres" database.

```
postgres=# DROP EXTENSION pg_cron CASCADE;
DROP EXTENSION
```

2. Set the postgresql.conf file parameters.
   Delete "pg_cron" to the shared_preload_libraries parameter.
   Specify "off" to the cron.use_background_workers parameter.
   Returns the value of the max_worker_processes parameter.
3. Restart Fujitsu Enterprise Postgres.

4. As superuser, run the following command:

```
$ su -
Password:******
# rm -rf /opt/fsepv<x>server64/filesCopiedDuringSetup
```

Information

The files copied during setup can be checked below.

```
# find /opt/fsepv<x>server64/OSS/pg_cron
```

4.7.15 Build with PGXS

Many PostgreSQL extensions are built using a build base for extensions called PGXS. Building with PGXS also generates files related to llvm. Depending on which version of llvm you are using, follow these steps:

PGXS builds also set DT_RUNPATH to the built binaries. See "4.7.15.4 Setting DT_RUNPATH" for more information.

4.7.15.1 Using the Default Version of llvm

The default version of llvm is described in "2.1 Required Operating System". If you want to use the default version of llvm, use the OSS documentation to build and install OSS.

4.7.15.2 Using a Non-Default Version of llvm

1. As superuser, copy the Makefile.global corresponding to the version of llvm you want to use. The following is an example of using llvm. Makefile.global is overwritten when an emergency fix is applied or removed from Fujitsu Enterpise Postgres, this procedure should be performed each time a build is performed.

```
$ su -
Password:******
# cp /opt/fsepv<x>server64/lib/pgxs/src/Makefile.global-vsn<The version of llvm> /opt/
fsepv<x>server64/lib/pgxs/src/Makefile.global
```

2. Follow the OSS documentation to build and install OSS.
3. As superuser, run the following command:. The following is an example of using llvm:.

```
$ su -
Password:******
# mv /opt/fsepv<x>server64/lib/bitcode/<OSS name>* /opt/fsepv<x>server64/lib/bitcode-vsn<The
version of llvm>/
```

4.7.15.3 Without llvm

If you do not use llvm, use the with _ llvm = no option when performing the build, as shown below. For other options, follow the OSS documentation.

```
# make USE_PGXS=1 with_llvm=no
```

4.7.15.4 Setting DT_RUNPATH

The default values for DT_RUNPATH are <Fujitsu Enterprise Postgres installation directory in the build environment>/lib, and $ORIGIN /../ lib.

If your build and production environments have the same Fujitsu Enterprise Postgres installation directory, you can run the built program without setting the environment variable LD_LIBRARY_PATH to <*Fujitsu Enterprise Postgres installationdirectory in the operating environment*>/lib.

If the installation directories of Fujitsu Enterprise Postgres for the build and production environments cannot be in the same location, or the production installation directory cannot be pre-determined, you can run a program built without <*Fujitsu Enterprise Postgres installationdirectory in the operating environment*>/lib in the LD_LIBRARY_PATH by doing the following:

Set the DT_RUNPATH attribute to any path.

In your production environment, create a symbolic link to <*Fujitsu Enterprise Postgres installationdirectory in the operating environment*>/lib in the appropriate path.

To do this, set the DT_RUNPATH attribute in the environment variable PG_LDFLAGS(*1).

If this is not possible, set LD_LIBRARY_PATH to <*Fujitsu Enterprise Postgres installationdirectory in the operating environment*>/lib when you run the program.

For notes on setting the environment variable LD_LIBRARY_PATH, see "When DT_RUNPATH cannot be set" in "How to Build and Run an Application that Uses Shared Libraries" in the Application Development Guide.

*1:For more information about the PG_LDFLAGS environment variable, see "Extension Building Infrastructure" in the PostgreSQL Documentation. For example, "make USE_PGXS = 1 PG_LDFLAGS =" -Wl, -rpath, '$$ORIGIN /../ libdummy', --enable-new-dtags ".

4.7.16 Build without PGXS

For extensions that do not utilize PGXS, but utilize the interface of Fujitsu Enterprise Postgres, build to explicitly set DT_RUNPATH, or set LD_LIBRARY_PATH to <Fujitsu Enterprise Postgres installation directory>/lib at runtime.

For information about how to set DT_RUNPATH, refer to "Setting DT_RUNPATH for Applications" in the Application Development Guide.

For notes on using LD_LIBRARY_PATH without setting DT_RUNPATH, refer to "When DT_RUNPATH cannot be set" in "How to Build and Run an Application that Uses Shared Libraries" in the Application Development Guide.

4.8 Deleting Instances

This section explains how to delete an instance.

- 4.8.1 Using WebAdmin
- 4.8.2 Using Server Commands

When automatic start and stop of an instance is set

Execute the following command to disable it, and then unregister it.

```
systemctl disable nameOfUnitFileThatPerformsAutomaticStartAndStop
rm /usr/lib/systemd/system/nameOfUnitFileThatPerformsAutomaticStartAndStop
```

Example

```
# systemctl disable fsepsvoi_inst1.service
# rm /usr/lib/systemd/system/fsepsvoi_inst1.service
```

4.8.1 Using WebAdmin

This section explains how to delete an instance using WebAdmin. Always use WebAdmin to delete instances that were created or imported using WebAdmin. Because WebAdmin managementinformation cannot be deleted, WebAdmin will determine that the instance is abnormal.

Use the following procedure to delete an instance.

1. Stop the instance

   In the [Instances] tab, select the instance to stop and click  .

2. Back up files.

   Before deleting the instance, back up any required files under the data storage destination, the backup data storage destination, and the transaction log storage destination.

3. Delete the instance

   In the [Instances] tab, select the instance to delete and click  .

Deleting Unnecessary Directories

Deleting an instance deletes only the following lowest-level directories. If they are not required, delete them manually.

- Data storage destination
- Backup data storage destination
- Transaction log storage destination (if different from the data storage destination)

4.8.2 Using Server Commands

This section explains how to delete an instance using server commands.

Use the following procedure to delete an instance.

1. Stop the instance

   Execute the stop mode of the pg_ctl command.

   An example is shown below:

   Example

   ```
   $ pg_ctl stop -D /data/inst1
   ```

2. Back up files.

   Before deleting the instance, back up any required files under the data storage destination, the backup data storage destination, and the transaction log storage destination.

3. Delete the instance

   Use a standard UNIX tool (the rm command) to delete the following directories:

   - Data storage destination
   - Backup data storage destination
   - Transaction log storage destination (if a directory different from the data storage directory was specified)

Chapter 5 Uninstallation

This chapter describes the procedure for uninstalling Fujitsu Enterprise Postgres.

5.1 Pre-uninstallation Tasks

Before uninstalling Fujitsu Enterprise Postgres, do the following:

When user files are placed in the installation directory

When you perform uninstallation, all files and directories under the installation directory are deleted. If necessary, back up the files before uninstalling them.

When SLES

On SLES, before uninstallation, ensure that JRE 8 is installed, and export the JAVA_HOME environment variable.

```
#export JAVA_HOME="Jre8InstallDir"
```

When WebAdmin is used for operation

To reinstall Fujitsu Enterprise Postgres after it was uninstalled, and reuse an instance that was already created so that it can be managed from WebAdmin, back up the directory shown below in which the WebAdmin instance management information had been defined before uninstalling Fujitsu Enterprise Postgres, and then restore the backed up directory to its original location once Fujitsu Enterprise Postgres has been reinstalled.

Follow the procedure below to perform the backup.

1. Stop the WebAdmin server.
   Refer to "B.1.4 Stopping the Web Server Feature of WebAdmin" for details.
2. Back up the following directory:

   ```
   webAdminInstallDir/data/fepwa
   ```

When using HTTPS or HTTPS client authentication with WebAdmin

All the certificates placed in "keystore" directory will be removed when uninstalling WebAdmin. Back up these certificates and its configuration file in advance if required.

```
webAdminInstallDir/tomcat/keystore
webAdminInstallDir/tomcat/conf/server.xml
```

They are backed up because the keystore contains certificates, and server.xml contains information for the keystorePass, keyAlias, and trustorePass attributes.

5.2 Uninstallation in Interactive Mode

Uninstall according to the following procedure:

If an error occurs while the product is being uninstalled, refer to "Uninstall (middleware) Messages" in the Fujitsu Enterprise Postgres product website, and take the required action.

1. Delete the operation information

If the Fujitsu Enterprise Postgres operation information has been registered in the operating system or another middleware product, for example, then it must be deleted. Cases in which deletion is required are as follows:

- For a cluster system using failover operation integrated with PRIMECLUSTER, stop the cluster applications and delete the cluster application resources and Fujitsu Enterprise Postgres resources. Refer to the Cluster Operation Guide (PRIMECLUSTER) and PRIMECLUSTER Installation and Administration Guide for details.

- If you have set automatic start and stop of the instance, execute the following commands to disable the script and cancel registration.

  ```
  systemctl disable nameOfUnitFileThatPerformsAutomaticStartAndStop
  rm /usr/lib/systemd/system/nameOfUnitFileThatPerformsAutomaticStartAndStop
  ```

  Example

  ```
  # systemctl disable fsepsvoi_inst1.service
  # rm /usr/lib/systemd/system/fsepsvoi_inst1.service
  ```

2. Stop applications and programs

Before starting the uninstallation, stop the following:

- Applications that use the product
- Connection Manager
- Instance

  Using WebAdmin

  In the [Instances] tab, select the instance to stop and click  .

  Using server commands

  Execute the pg_ctl command in stop mode.

  ```
  $ /opt/fsepv<x>server64/bin/pg_ctl stop -D /database/inst1
  ```

- Web server feature of WebAdmin

  Execute the WebAdminStop command to stop the Web server feature of WebAdmin.

  Example

  If WebAdmin is installed in /opt/fsepv<*x*>webadmin:

  ```
  # cd /opt/fsepv<x>webadmin/sbin
  # ./WebAdminStop
  ```

- Mirroring Controller

  Execute the mc_ctl command with the stop mode option specified and stop the Mirroring Controller.

  Example

  ```
  $ mc_ctl stop -M /mcdir/inst1
  ```

- pgBadger
- Pgpool-II
- pgBackRest

3. Start the Uninstall (middleware)

Execute the following command:

```
# /opt/FJSVcir/cimanager.sh -c
```

4. Select the software

Type the number for the product to be uninstalled, and press Enter.

5. Start the uninstallation

To start the uninstallation, type "y" and press Enter.

To display the list of products again, type "b" and press Enter.

6. Finish the uninstallation

Upon successful completion, the window below is displayed.

The installation directory may remain after uninstallation. If it is not required, delete it.

```
Uninstalling...

productName is being uninstalled now.
    100% ##############################


The following products have been uninstalled successfully:
    productName

Uninstallation of "productName" has completed successfully.



Exiting Uninstaller.
```

5.3 Uninstallation in Silent Mode

Uninstall according to the following procedure:

Refer to the Fujitsu Enterprise Postgres product website for information on uninstallation in silent mode, such as the error messages.

1. Delete the operation information

If the Fujitsu Enterprise Postgres operation information has been registered in the operating system or another middleware product, for example, then it must be deleted. Cases in which deletion is required are as follows:

- For a cluster system using failover operation integrated with PRIMECLUSTER, stop the cluster applications and delete the cluster applications resources and Fujitsu Enterprise Postgres resources. Refer to the Cluster Operation Guide (PRIMECLUSTER) and PRIMECLUSTER Installation and Administration Guide for details.
- If you have set automatic start and stop of the instance, execute the following commands to disable the script and cancel registration.

  ```
  systemctl disable nameOfUnitFileThatPerformsAutomaticStartAndStop
  rm /usr/lib/systemd/system/nameOfUnitFileThatPerformsAutomaticStartAndStop
  ```

  Example

  ```
  # systemctl disable fsepsvoi_inst1.service
  # rm /usr/lib/systemd/system/fsepsvoi_inst1.service
  ```

2. Stop applications and programs

Before starting the uninstallation, stop the following:

- Applications that use the product
- Connection Manager
- Instance

  Using WebAdmin

  In the [Instances] tab, select the instance to stop and click  .

  Using server commands

  Execute the pg_ctl command with the stop mode option specified.

  ```
  $ /opt/fsepv<x>server64/bin/pg_ctl stop -D /database/inst1
  ```

- Web server feature of WebAdmin

  Execute the WebAdminStop command to stop the Web server feature of WebAdmin.

  Example

  If WebAdmin is installed in /opt/fsepv<*x*>webadmin:

  ```
  # cd /opt/fsepv<x>webadmin/sbin
  # ./WebAdminStop
  ```

- Mirroring Controller

  Execute the mc_ctl command with the stop mode option specified and stop the Mirroring Controller.

  Example

  ```
  $ mc_ctl stop -M /mcdir/inst1
  ```

- pgBadger
- Pgpool-II
- pgBackRest

3. Run the uninstallation

Execute the command below.

The installation directory may remain after uninstallation. If it is not required, delete it.

Example

```
# /opt/fsepv<x>server64/setup/suninst.sh
```

In the example above, /opt/fsepv<*x*>server64/setup is the name of the installation directory in which the server product is installed.

```
# /opt/fsepv<x>webadmin/setup/suninst.sh
```

In the example above, /opt/fsepv<*x*>webadmin/setup is the name of the installation directory in which the WebAdmin is installed.

```
# /opt/fsepv<x>pgpool-II/setup/suninst.sh
```

In the example above, /opt/fsepv<*x*>pgpool-II/setup is the name of the installation directory in which the Pgpool-II is installed.

```
# /opt/fsepv<x>pgbackrest/setup/suninst.sh
```

In the example above, /opt/fsepv<x>pgbackrest/setup is the name of the installation directory in which the pgBackRest is installed.

Appendix A Recommended WebAdmin Environments

This appendix describes the recommended WebAdmin environment. The following explanation is based on the assumption that Microsoft Edge is used unless otherwise stated.

Note

The displayed screen varies depending on your environment, so check and set according to the screen.

A.1 Recommended Browser Settings

- Use a display resolution of 1280 x 768 or higher, and 256 colors or more.
- Select [Setting] >>[Appearance] >> [Font size] >> [Medium (Recommended)].
- Select [Setting] >>[Appearance] >> [Zoom] >> [100%].

A.2 How to Set Up the Pop-up Blocker

If the Pop-up Blocker is enabled, use the procedure below to configure settings to allow pop-ups from the server where Fujitsu Enterprise Postgres is installed.

1. Click [Setting] >> [Cookie and site permissions] >> [All Permissions] >> [Pop-ups and redirects].
   If the [Block (Recommended)] switch is not on (blue), the pop-up blocker is not working, and no further action is required.
2. Under [Pop-ups and Redirects], click the [Allow] >> [Add] button.
3. In [Add Site], in [Site], enter the address of the server where you installed Fujitsu Enterprise Postgres and click the [Add] button.
4. Close Microsoft Edge.

Appendix B Setting Up and Removing WebAdmin

This appendix describes how to set up and remove WebAdmin.

Note that "<*x*>" in paths indicates the product version.

B.1 Setting Up WebAdmin

This section explains how to set up WebAdmin.

B.1.1 Setting Up WebAdmin

In the case of a re-setup, the existing server.xml is overwritten with the default values. Therefore, back up the information in server.xml beforehand and update it manually after setting up WebAdmin.
No action is required because the certificate is not overwritten during re-setup.

Follow the procedure below to set up WebAdmin.

1. Change to the superuser

   Acquire superuser privileges on the system.

   Example

   ```
   $ su -
   Password:******
   ```

2. Run Setup

   Run the WebAdminSetup command.

   Example

   If WebAdmin is installed in /opt/fsepv<*x*>webadmin:

   ```
   # cd /opt/fsepv<x>webadmin/sbin
   # ./WebAdminSetup
   ```

3. Specifying Setup Items

   Specify the following:

   Refer to the "/etc/services" file and only change to a different port number if there is overlap with a port number from another service.

   Make a note of the port number for the Web server, because it will be required for starting the WebAdmin window.

Item
HTTPS usage Do you want to use HTTPS (secure communication)? [y,n,q] (default: n)
Web server port number Enter port number of Web Server (default: 27515):
(Can be set only when HTTPS is used.) HTTPS Client Authentication usage Do you want to use HTTPS Client Authentication? [y,n,q] (default: n)
WebAdmin internal port number Enter Internal port number for WebAdmin (default: 27516):
WebAdmin automatic start Start WebAdmin automatically when system starting? [y,n] (default: y)

HTTPS usage

Specify whether to use HTTPS, for secure communication with the WebAdmin (and to be used internally by the WebAdmin).

To facilitate HTTPS deployment, WebAdmin automatically creates a self-signed server certificate. This certificate should only be used for testing purposes, such as connection verification, and should be replaced with an appropriate CA-signed certificate in production.

Refer to "B.1.2 Certificate Settings For Secure Connection Support" for detail certificate settings.

Point

If you continue to use the self-signed server certificate that WebAdmin created, your browser displays a warning screen when you access the WebAdmin page because you can access WebAdmin but the certificate is not signed by a known and trusted CA.

Web server port number

Specify a numeric value from 1024 to 32767 for the port number to be used for communication between the Web browser and the Web server.

The Web server port number will be registered as a port number with the following service name in the "/etc/services" file.

fsep_170_WA_64_WebAdmin_Port1

HTTPS Client Authentication usage

Specify whether to use HTTPS Client Authentication, to ensure that only authenticated clients can use the WebAdmin.

To facilitate the deployment of HTTPS client authentication, WebAdmin automatically creates two self-signed client certificates.

One is for browser-to-server authentication. and one for server-to-server authentication.

Server to server authentication is required because WebAdmins can have multiple server configurations and communicate between them. Refer to "Appendix I Determining the Preferred WebAdmin Configuration".

These certificate should only be used for testing purposes, such as connection verification, and should be replaced with an appropriate CA-signed certificate in production.

Refer to "B.1.2 Certificate Settings For Secure Connection Support" for detail certificate settings.

Point

If client authentication is selected, client certificate for browser must be registered in user's browser before accessing to WebAdmin. Otherwise, WebAdmin will not be accessible.

WebAdmin internal port number

Specify a numeric value from 1024 to 32767 for the port number to be used for communication between the Web server and the WebAdmin runtime environment.

The WebAdmin internal port number will be registered as a port number with the following service name in the /etc/services file.

fsep_170_WA_64_WebAdmin_Port2

WebAdmin automatic start

Select whether or not to start WebAdmin when the machine is started.

Note

- Unused port numbers
  Irrespective of the information specified in the "/etc/services" file, unused port numbers in the OS and other products can sometimes be automatically numbered and then used, or port numbers specified in environment files within products may also be used. Check the port numbers used by the OS and other products, and ensure that these are not duplicated.

- Access restrictions
  Prevent unauthorized access and maintain security by using a firewall product, or the packet filtering feature of a router device, to restrict access to the server IP address and the various specified port numbers.

- Port access permissions
  If a port is blocked (access permissions have not been granted) by a firewall, enable use of the port by granting access. Refer to the vendor document for information on how to grant port access permissions.
  Consider the security risks carefully when opening ports.

- Changing port numbers
  When using WebAdmin in multiserver mode, it is recommended not to change WebAdmin ports after creating instances. Otherwise, the created instances may not be accessible through WebAdmin after the port is changed.

- Building in a Multi-Server Environment
  Configure your environment so that all servers have the same settings for using HTTPS and using HTTPS client authentication.

B.1.2 Certificate Settings For Secure Connection Support

Describes how to support secure connections.

You must replace the certificate used for HTTPS and client authentication with a CA-signed certificate. To determine if it has been replaced, check the certificate in the "keystore" to ensure that it has been replaced with a CA-signed certificate.

Certificate Storage Directory

If you specify Use HTTPS or Use HTTPS Client Authentication during setup, a new subdirectory "keystore" for storing certificates is added to the WebAdmin Tomcat installation directory.

Example: If WebAdmin is installed in /opt/fsepv<x>webadmin:

```
Tomcat installation directory (/opt/fsepv<x>webadmin/tomcat/)
├─── bin
├─── Building.txt
├─── conf
├─── CONTRIBUTING.md
├─── keystore
│    ├─── keystore.p12            → For HTTPS
│    ├─── clientbrowser.p12       → For client authentication
│    ├─── clientkeystore.p12      → For client authentication
│    ├─── truststore.p12          → For client authentication
│    ├─── clientkeystore.conf     → For client authentication
├─── ...
```

Certificate Configuration

To configure a certificate:

1. Prepare CA-signed certificates

Certificate	Summary
keystore.p12 (private and public keys included)	One server certificate for HTTPS. Used for data encryption.
clientbrowser.p12 (private key included)	One client certificate to authenticate the browser between the browser and the server. It is registered in the user's browser. The number of certificates generated corresponds to the number of clients (browsers) accessing WebAdmin.
clientkeystore.p12 (private key included)	One client certificate for server-to-server authentication. Used internally by WebAdmin.

Certificate	Summary
truststore.p12 (clientbrowser.p12 and clientkeystore.p12)	Imported public keys for all client certificates.

2. Place certificates in keystore directory

Single-server configuration

1. Place keystore.p12, truststore.p12 and clientkeystore.p12 files in "keystore" directory
2. Import clientbrowser.p12 into your browser.
   If you use multiple clients (browsers), import the certificate into each browser.

Multi-server configuration

1. Place keystore.p12, truststore.p12 and clientkeystore.p12 files in "keystore" directory
2. Import clientbrowser.p12 into your browser.
   If you use multiple clients (browsers), import the certificate into each browser.
3. Import the public key corresponding to the private key in clientkeystore.p12 into truststore.p12 on the other server you want to connect to.

3. Update certificate information in server.xml and clientkeystore.conf files

- **keystore.p12 and truststore.p12**

  Populate server.xml with the information from keystore.p12 and truststore.p12.

  The server.xml file is located under/opt/fsepv<x>webadmin/tomcat/conf.

  HTTPS

  Set the keystorePass and keyAlias attributes to the password and alias for keystore.p12.

  server.xml (/opt/fsepv<x>webadmin/tomcat/conf)

```
<Connector port="27515" sslProtocol="TLS"
    protocol="org.apache.coyote.http11.Http11NioProtocol"
    maxThreads="150" SSLEnabled="true" scheme="https" secure="true"
    clientAuth="false" keystoreType="PKCS12"
    keystoreFile="/opt/fsepv<x>webadmin/tomcat/keystore/keystore.p12"
    keystorePass="password" keyAlias="alias" />
```

  HTTPS and client authentication

  Set the keystorePass and keyAlias attributes to the password and alias for keystore.p12.

  Set the truststorePass attribute to the password for truststore.p12.

  server.xml (/opt/fsepv<x>webadmin/tomcat/conf)

```
<Connector port="27515" sslProtocol="TLS"
    protocol="org.apache.coyote.http11.Http11NioProtocol"
    maxThreads="150" SSLEnabled="true" scheme="https" secure="true"
    clientAuth="true" keystoreType="PKCS12"
    keystoreFile="/opt/fsepv<x>webadmin/tomcat/keystore/keystore.p12"
    keystorePass="password" keyAlias="alias"
    truststoreType="PKCS12"
    truststoreFile="/opt/fsepv<x>webadmin/tomcat/keystore/truststore.p12"
    truststorePass="password" />
```

- **clientkeystore.p12**

  Populate clientkeystore.conf with the information from clientkeystore.p12.

  clientkeystore.conf file is generated by WebAdmin and its filename cannot be modified.

HTTPS and client authentication

Sets the client certificate information for server authentication.

Set the password for the private key imported into clientkeystore.p12 and the password and alias for clientkeystore.p12.

clientkeystore.conf (/opt/fsepv<x>webadmin/tomcat/keystore/)

```
clientkeystore.key.pass=password
clientkeystore.store.pass=password
clientkeystore.alias=alias
```

4. Back up

Back up the certificates and server.xml file.

Point

When you uninstall WebAdmin, all certificates in the keystore directory are deleted. Also, when you reinstall WebAdmin, the server.xml file is overwritten with the default settings. Back up your data in case of incorrect operation.

5. Restart WebAdmin

Stop WebAdmin and start it again.

Refer to "B.1.4 Stopping the Web Server Feature of WebAdmin" and "B.1.3 Starting the Web Server Feature of WebAdmin" for detailed instructions.

Point

If certificates or connection failures occur, refer to the Tomcat log directory (/opt/fsepv<x>webadmin/tomcat/logs/) for detailed error messages.

B.1.3 Starting the Web Server Feature of WebAdmin

Follow the procedure below to start the Web server feature of WebAdmin.

1. Change to the superuser

   Acquire superuser privileges on the system.

   Example

   ```
   $ su -
   Password:******
   ```

2. Start the Web server feature of WebAdmin

   Execute the WebAdminStart command to start the Web server feature of WebAdmin.

   Example

   If WebAdmin is installed in /opt/fsepv<*x*>webadmin:

   ```
   # cd /opt/fsepv<x>webadmin/sbin
   # ./WebAdminStart
   ```

B.1.4 Stopping the Web Server Feature of WebAdmin

Follow the procedure below to stop the Web server feature of WebAdmin.

1. Change to the superuser

   Acquire superuser privileges on the system.

Example

```
$ su -
Password:******
```

2. Stop the Web server feature of WebAdmin

   Execute the WebAdminStop command to stop the Web server feature of WebAdmin.

   Example

   If WebAdmin is installed in /opt/fsepv<*x*>webadmin:

```
# cd /opt/fsepv<x>webadmin/sbin
# ./WebAdminStop
```

Note

- For efficient operation of WebAdmin, it is recommended that the Web server feature be stopped only during a scheduled maintenance period.
- When WebAdmin is used to create and manage instances in a multiserver configuration, the Web server feature must be started and running on all servers at the same time.

B.2 Removing WebAdmin

This section explains how to remove WebAdmin.

This removal procedure stops WebAdmin and ensures that it no longer starts automatically when the machine is restarted.

1. Change to the superuser

   Acquire superuser privileges on the system.

   Example

```
$ su -
Password:******
```

2. Remove WebAdmin setup

   Execute the WebAdminSetup command to remove WebAdmin setup.

   Example

   If WebAdmin is installed in /opt/fsepv<*x*>webadmin:

```
# cd /opt/fsepv<x>webadmin/sbin
# ./WebAdminSetup -d
```

B.3 Using an External Repository for WebAdmin

WebAdmin can be configured to use an external database, where it can store the various metadata information it uses. WebAdmin will use this database as a repository to store the information it uses to manage all the created instances. This can be a Fujitsu Enterprise Postgres database.

Using an external database as a WebAdmin repository provides you with more flexibility in managing WebAdmin. This repository can be managed, backed up and restored as needed using pgAdmin or command line tools, allowing users to have greater flexibility and control.

Follow the procedure below to set up the repository.

1. Start WebAdmin, and log in to the database server.
2. Click the [Settings] tab, and then click  in the [WebAdmin repository configuration] section.

3. Enter the following items:

   - [Host name]: Host name of the database server
   - [Port]: Port number of the database server
   - [Database name]: Name of the database
   - [User name]: User name to access the database
   - [Password]: Password of the database user

   Note

   - Database type
     It is recommended to use a Fujitsu Enterprise Postgres database as a repository. A compatible PostgreSQL database can also be used as an alternative.
   - It is recommended to click [Test connection] to ensure that the details entered are valid and WebAdmin is able to connect to the target database.
   - Host name, Database name, User name, Password should not contain hazardous characters. Refer to "Appendix C WebAdmin Disallow User Inputs Containing Hazardous Characters".

4. Click to register the repository details.

Note

- Once the repository is set up, it can be changed any number of times by the user logged into WebAdmin. When a repository is changed:
  - It is recommended to preload the backup into this database.
  - If the data is not preloaded, WebAdmin will create a new repository.
- The database repository can be set up even after WebAdmin was already used to create instances. In that scenario, the instances already created are retained and can continue to be operated on.
- If the instance used as a repository is stopped, WebAdmin will be unusable. For this reason, it is recommended to be familiar with starting an instance from the command line. If the instance is stopped for any reason, start it from the command line and WebAdmin will be usable again.

B.4 Using the WebAdmin Auto-Refresh Feature

The WebAdmin auto-refresh feature automatically refreshes the operating status of all instances in the Instance list at the specified interval. It also refreshes the details of the selected instance. You can use the auto-refresh feature to prevent timeouts.

Follow the procedure below to configure the auto-refresh options.

1. Click the [Settings] tab, and then click in the [User preferences] section.
2. Enter the following items:
   - [Auto-refresh instance]: To use the auto-refresh feature, select "Enabled". The default is "Disabled".
   - [Refresh interval (seconds)]: Number of seconds between each refresh. This is a countdown timer, which is reset every time the instance status is refreshed by any operation. Specify a value from 30 to 3600 (seconds). The default is 30.
3. Click to save the auto-refresh settings.

Point

- Auto-refresh will run only if the [Instances] page is displayed and no user-initiated operation is in progress.

- A text indicator, which is independent of auto-refresh, is displayed at the top of the Instance list. It is dynamically updated to display when the page was last refreshed.

Appendix C WebAdmin Disallow User Inputs Containing Hazardous Characters

WebAdmin considers the following as hazardous characters, which are not allowed in user inputs.

```
| (pipe sign)

& (ampersand sign)

; (semicolon sign)

$ (dollar sign)

% (percent sign)

@ (at sign)

' (single apostrophe)

" (quotation mark)

\' (backslash-escaped apostrophe)

\" (backslash-escaped quotation mark)

<> (triangular parenthesis)

() (parenthesis)

+ (plus sign)

CR (Carriage return, ASCII 0x0d)

LF (Line feed, ASCII 0x0a)

, (comma sign)

\ (backslash)
```

Appendix D Configuring Parameters

WebAdmin operates and manages databases according to the contents of the following configuration files:

- postgresql.conf

  Contains various items of information that define the operating environment of Fujitsu Enterprise Postgres.

- pg_hba.conf

  Contains various items of information related to client authentication.

These configuration files are deployed to a data storage destination. Data is written to them when the instance is created by WebAdmin and when settings are changed, and data is read from them when the instance is started and when information from the [Setting] menu is displayed.

See

Refer to "Server Configuration" and "Client Authentication" in "Server Administration" in the PostgreSQL Documentation for information on the parameters.

Note

WebAdmin checks for port number and backup storage path anomalies when various operations are performed. An anomaly occurs when the value of [Port number] and/or [Backup storage path] in WebAdmin is different from the value of the corresponding parameter in postgresql.conf. Refer to "Anomaly Detection and Resolution" in the Operation Guide for details.

postgresql.conf

Parameters that can be changed in WebAdmin

The postgresql.conf parameters that can be changed in WebAdmin are shown below:

Section	WebAdmin item	postgresql.conf file parameter
Instance Configuration		
Character encoding	Character set	client_encoding
	Message locale	lc_messages
Communication	Max connections	max_connections
SQL options	Transform NULL format	transform_null_equals
	Date output format	DateStyle (*1)
	Interval output format	IntervalStyle
	Number of digits for floating values	extra_float_digits
	Transaction isolation levels	default_transaction_isolation
	Currency format	lc_monetary
	Date and time format	lc_time
	Numerical value format	lc_numeric
Memory	Sort memory (KB)	work_mem
	Shared buffers (KB)	shared_buffers
Streaming replication	WAL level	wal_level
	Maximum WAL senders	max_wal_senders

Section	WebAdmin item	postgresql.conf file parameter
	WAL save size (MB)	wal_keep_size
	Hot standby	hot_standby
	Synchronous standby names	synchronous_standby_names
	WAL receiver timeout (ms)	wal_receiver_timeout
Edit instance		
	Instance name	n/a
	Instance port	port
	Backup storage path	backup_destination

*1: If you specify "Postgres" as the output format, dates will be output in the "12-17-1997" format, not the "Wed Dec 17 1997" format used in the PostgreSQL Documentation.

Information

- Calculate the maximum number of connections using the formula below:

```
maximumNumberOfConnections = maximumNumberOfConnectionsFromApplications + 3 (*1)
```

*1: 3 is the default number of connections required by the system.
Calculate the maximum number of connections using the following formula when changing superuser_reserved_connections (connections reserved for use by the superuser) in postgresql.conf.

```
maximumNumberOfConnections = maximumNumberOfConnectionsFromApplications +
superuser_reserved_connections
```

- Also check if the memory used exceeds the memory installed (refer to "Parameters automatically set by WebAdmin according to the amount of memory").
- When modifying "Shared buffers" or "Max connections", edit the kernel parameter. Refer to "Appendix H Configuring Kernel Parameters", and "Managing Kernel Resources" in "Server Administration" in the PostgreSQL Documentation for details.

Parameters set by WebAdmin

The following postgresql.conf parameters are set by WebAdmin during instance startup (they will be ignored even if specified in postgresql.conf):

Parameter	Value
listen_addresses	*
log_destination	'stderr,syslog'
logging_collector	on
log_line_prefix	'%e: %t [%p]: [%l-1] user = %u,db = %d,remote = %r app = %a '
log_filename (*1) (*2)	'logfile-%a.log'
log_file_mode	0600
log_truncate_on_rotation	on
log_rotation_age	1d

*1: The server logs are split into files based on the day of the week, and are rotated after each week.

*2: If the date changes while the instance is stopped, old logs are not deleted and continue to exist.
Manually delete old logs that are no longer required to release disk space.

Parameters automatically set by WebAdmin according to the amount of memory

The postgresql.conf parameters automatically set according to the amount of installed memory, during the creation of instances by WebAdmin, are shown below:

Parameter	Value
shared_buffers	30% of the machine's installed memory
work_mem	30% of the machine's installed memory / max_connections / 2
effective_cache_size	75% of the machine's installed memory
maintenance_work_mem	10% of the machine's installed memory / (1 + autovacuum_max_workers) (*1)

*1: The value will be capped at 2097151 KB.

When determining the values to be configured in the above parameters, you must take into account any anticipated increases in access volume or effects on performance during business operations, such as the number of applications and commands that will access the instance, and the content of processes. Also, note that in addition to Fujitsu Enterprise Postgres, other software may be running on the actual database server. You will need to determine the degree of priority for the database and other software, as well as the memory allocation size.

WebAdmin automatically configures complex parameter settings such as those mentioned above, based on the size of the internal memory of the machine. This enables maximum leverage of the machine memory to facilitate resistance against fluctuations during business operations.

Accordingly, the effects of the above-mentioned factors must be estimated and taken into account when determining and configuring parameter values, so that memory resources can be effectively allocated among other software or instances, and so that adverse effects can be mutually avoided. Refer to "Memory" in "Resource Consumption", and "Planner Cost Constants" in "Query Planning", under "Server Administration" in the PostgreSQL Documentation for information on parameter values and required considerations.

Parameter values can be modified using the WebAdmin [Setting] menu, or edited directly using a text editor.

If adding an instance, determine the parameter values, including for existing instances, and make changes accordingly.

See

Kernel parameters need to be tuned according to the parameters being changed. Refer to "Appendix H Configuring Kernel Parameters", and "Managing Kernel Resources" in "Server Administration" in the PostgreSQL Documentation for information on tuning kernel parameters.

Note

- You can edit postgresql.conf directly with a text editor. However, do not edit the following parameters. If you edit incorrectly, WebAdmin will not work correctly.
  - archive_mode
  - archive_command
  - wal_level
  - log_line_prefix
  - log_destination
  - logging_collector
  - log_directory
  - log_file_mode
  - log_filename

    - log_truncate_on_rotation
    - log_rotation_age

- If you edit postgresql.conf directly, the records should be single line. WebAdmin will not work correctly if the record spans multiple lines.
- If you change superuser_reserved_connections, set the value you want to change plus the number of connections required by WebAdmin of 3.

pg_hba.conf

Refer to "Client Authentication" in "Server Administration" in the PostgreSQL Documentation for information on content that can be configured in pg_hba.conf.

- Configure the instance administrator permissions in the "local" connection format settings. WebAdmin may not work properly if permissions are not configured.
- You can also edit pg_hba.conf directly. However, do not modify items that cannot be configured in WebAdmin. WebAdmin does not work correctly.
- If you edit pg_hba.conf directly, the records should be single line. WebAdmin will not work correctly if the record spans multiple lines.

Appendix E Estimating Database Disk Space Requirements

This appendix describes how to estimate database disk space requirements.

E.1 Estimating Table Size Requirements

The following tables provide the formulas for estimating table size requirements.

Table E.1 Estimation formula when the record length is 2032 bytes or less

Item	Estimation formula (bytes)
(1) Record length	27(*1) + NULL map + OID + column data NULL map: Number of columns / 8 (*2) OID: 4 Column data: Sum of column lengths *1: Record header section *2: Round the result up to the next integer. - Because the column data is placed in boundaries of 8 bytes, you need to make an adjustment so that the sum of the record header section, NULL map and OID is a multiple of 8. For example, if the calculated length is 27 + 1 / 8 (rounded up) + 0 = 28 bytes, add 4 to make the length 32 bytes. - Because the data of each column is placed in boundaries of the defined data type, take the boundary of each data type into account for the length of the column data. For example, the length of the column data in the table below will not be the sum of the data types, which is 37 bytes, but will instead be 64 bytes following boundary adjustment. Definition: create table tb1(c1 char(1), c2 bigint, c3 int, c4 box) Estimation: CHAR type 1 byte + boundary adjustment of 7 bytes for BIGINT type 8 bytes + BIGINT type 8 bytes + INT type 4 bytes + boundary adjustment of 12 bytes for BOX type 32 bytes + BOX type 32 bytes = 64 bytes - Because each record is placed in boundaries of 8 bytes, you need to make an adjustment so that the length of the column data is a multiple of 8. - If the calculated record length exceeds 2,032 bytes, the variable length data in the record might be compressed automatically. If so, use the estimation formulas in "Table E.2 Estimation formula when the record length exceeds 2032 bytes" to estimate the table size.
(2) Page size requirement	8192 (*1) × fillfactor (*2) - 24 (*3) *1: Page length (8192) *2: Value of the fillfactor specified in the table definitions (if omitted, 100%) *3: Page header (24) - The calculated (2) page size requirement will be rounded down to the nearest integer.
(3) Number of records per page	(2) Page size requirement / ((1) record length + 4 (*1)) *1: Pointer length (4) - The result will be rounded down to the nearest integer.

Item	Estimation formula (bytes)
(4) Number of pages required for storing records	Total number of records / (3) number of records per page - The result will be rounded up to the next integer.
(5) Amount of space	(4) Number of pages required for storing records x page length x safety factor (*1) *1: Specify 2.0 or higher. - This is the safety factor assumed if vacuuming is performed for garbage collection in tables and indexes.

Table E.2 Estimation formula when the record length exceeds 2032 bytes

Item	Estimation formula (bytes)
(5) Amount of space	Total number of records x (1) record length x safety factor (*1) *1: Specify 2.0 or higher. - This is the safety factor assumed if vacuuming is performed for garbage collection in tables and indexes.

E.2 Estimating Index Size Requirements

This section provides the formulas for estimating index size requirements.

Fujitsu Enterprise Postgres provides six index types: B-tree, Hash, GiST, GIN, SP-GiST, and VCI. If you do not specify the index type in the CREATE INDEX statement, a B-tree index is generated.

The following describes how to estimate a B-tree index. Refer to "E.7 Estimating VCI Disk Space Requirements" for information on how to estimate VCI.

A B-tree index is saved as a fixed-size page of 8 KB. The page types are meta, root, leaf, internal, deleted, and empty. Since leaf pages usually account for the highest proportion of space required, you need to calculate the requirements for these only.

Table E.3 Estimation formula when the key data length is 512 bytes or less

Item	Estimation formula (bytes)
(1) Entry length	8 (*1) + key data length (*2) *1: Entry header *2: The key data length depends on its data type (refer to "E.3 Sizes of Data Types" for details). Because each entry is placed in boundaries of 8 bytes, you need to make an adjustment so that the length of the key data is a multiple of 8. For example, if the calculated length is 28 bytes, add 4 to make the length 32 bytes. - If the key data length exceeds 512 bytes, key data may be automatically compressed. In this case, use the estimation formula given in "Table E.4 Estimation formula when the key data length exceeds 512 bytes" to estimate the key data length.
(2) Page size requirement	8192 (*1) × fillfactor (*2) - 24 (*3) - 16 (*4) *1: Page length (8192) *2: Value of the fillfactor specified in the index definitions (if omitted, 90%) In the case of indexes of primary key constraints and unique constraints, the value of the fillfactor specified for each constraint in the table definitions (if omitted, 90%) *3: Page header (24) *4: Special data (16)

Item	Estimation formula (bytes)
	- The calculated (2) page size requirement will be rounded down to the nearest integer.
(3) Number of entries per page	(2) Page size requirement / ((1) entry length + 4 (*1)) *1: Pointer length - Result of (3) number of entries per page will be rounded down to the nearest integer.
(4) Number of pages required for storing indexes	Total number of records / (3) number of entries per page - Result of (4) number of pages required for storing indexes will be rounded up to the nearest integer.
(5) Space requirement	(4) Number of pages required for storing indexes x 8192 (*1) / usage rate (*2) *1: Page length *2: Specify 0.7 or lower.

Table E.4 Estimation formula when the key data length exceeds 512 bytes

Item	Estimation formula (bytes)
(5) Space requirement	Total number of records x key data length x compression ratio (*1) / usage rate (*2) *1: The compression ratio depends on the data value, so specify 1. *2: Specify 0.7 or lower as the usage rate.

E.3 Sizes of Data Types

This section lists the sizes of the data types.

E.3.1 Sizes of Fixed-Length Data Types

The following table lists the sizes of fixed-length data types.

Data type	Size (bytes)
SMALLINT (INT2)	2
INTEGER (INT4)	4
BIGINT (INT8)	8
REAL	4
DOUBLE PRECISION	8
SERIAL (SERIAL4)	4
BIGSERIAL (SERIAL8)	8
MONEY	8
FLOAT	8
FLOAT (1-24)	4
FLOAT (25-53)	8
TIMESTAMP WITHOUT TIME ZONE	8
TIMESTAMP WITH TIME ZONE	8
DATE	4
TIME WITHOUT TIME ZONE	8
TIME WITH TIME ZONE	12

Data type	Size (bytes)
INTERVAL	12
BOOLEAN	1
CIDR	IPv4: 7 IPv6: 19
INET	IPv4: 7 IPv6: 19
MACADDR	6
MACADDR8	8
POINT	16
LINE	32
LSEG	32
BOX	32
CIRCLE	24

E.3.2 Sizes of Variable-Length Data Types

The following table lists the sizes of variable-length data types.

Data type	Size (bytes)	Remarks
path	Length of size portion + 12 + 16 x number of vertices	1) When carrying out division, round to the next integer. 2) If the real data length is less than 127, then the length of the size portion is 1 byte, otherwise it is 4 bytes. 3) The number of bytes per character depends on the character set (refer to "E.3.4 Number of Bytes per Character" for details).
polygon	Length of size portion + 36 + 16 x number of vertices	
decimal	Length of size portion + 2 + (integer precision / 4 + decimal precision / 4) x 2	
numeric		
bytea	Length of size portion + real data length	
character varying(*n*), varchar(*n*)	Length of size portion + number of characters x number of bytes per character	
character(*n*), char(*n*)	Length of size portion + *n* x number of bytes per character	
text	Length of size portion + number of characters x number of bytes per character	

E.3.3 Sizes of Array Data Types

The following table lists the sizes of array data types.

Data type	Size (bytes)	Remarks
Array	Length of size portion + 12 + 8 x number of dimensions + data size of each item	If the real data length is less than 127, then the length of the size portion is 1 byte, otherwise it is 4 bytes. - Example of estimation when array data is "ARRAY[[1,2,3],[1,2,3]]" Number of dimensions: 2 INTEGER data size: 4 Total size = 1+12+8x2+6x4 = 53

E.3.4 Number of Bytes per Character

The following table lists the number of bytes per character.

The given values relate to the common character sets EUC-JP and UTF8.

Character type	Character set	Number of bytes per character
ASCII	EUC_JP	1
Halfwidth katakana	EUC_JP	2
JIS X 0208 kanji characters	EUC_JP	2
JIS X 0212 kanji characters	EUC_JP	3
ASCII	UTF8	1
Halfwidth katakana	UTF8	3
JIS X 0208 kanji characters	UTF8	3
JIS X 0212 kanji characters	UTF8	3

E.4 Estimating Transaction Log Space Requirements

This section provides the formula for estimating transaction log space requirements.

```
Transaction log space requirements = max_wal_size
```

However, if the update volume is extremely high (for example, due to a large data load and batch processing), disk writing at a checkpoint may not be able to keep up with the load, and a higher number of transaction logs than indicated here may temporarily be accumulated.

E.5 Estimating Archive Log Space Requirements

This section explains how to estimate archive log space requirements.

The archive log is an archive of the transaction logs from the time of a previous backup to the present, so it fluctuates depending on the backup period and the content of update transactions.

The longer the backup period and the more update transactions, the greater the space required for the archive log.

Therefore, measure the actual archive log space by using a test environment to simulate backup scheduling and database update in a real operating environment.

E.6 Estimating Backup Disk Space Requirements

This section provides the formula for estimating backup disk space requirements.

```
Backup disk space requirements = size of the database cluster x 2 + transaction log space requirements
                               + archive log space requirements
```

Note

If the pgx_dmpall command performs a backup using a user exit, the backup disk size differs according to the database resources targeted for backup and the copy method.

E.7 Estimating VCI Disk Space Requirements

This section provides the formula for estimating VCI disk space requirements.

```
Disk space = (number of rows in tables) x (number of bytes per row) x (compression ratio) + (WOS size)
```

Number of bytes per row

```
Number of bytes per row = (19 + (number of columns specified in CREATE INDEX) / 8
                                  + (number of bytes per single column value)) x 1.1
```

Note: Round up the result to the nearest integer.

Compression ratio

Specify a value between 0 and 1. Since compression ratio depends on the data being compressed, use actual data or test data that simulates it, then compare the value with the estimation result. As a guide, the compression ratio measured with the Fujitsu sample data is shown below:

- Data with high degree of randomness (difficult to compress): Up to approximately 0.9 times.
- Data with high degree of similarity (easy to compress): Up to approximately 0.5 times.

WOS size

```
WOS size = (number of WOS rows) / 185 x 8096
```

One row is added to the number of WOS rows for each INSERT and DELETE, and two rows are added for UPDATE. On the other hand, the number decreases to 520,000 rows or less during conversion to ROS performed by the ROS control daemon.

Note

VCI does not support retrieval of disk space usage using the database object size function pg_indexes_size. To find out the actual total VCI disk space, check the disk space of the storage directory using an OS command or other method.

E.8 Estimating pgvector Disk Space Requirements

When using pgvector, refer to the pgvector documentation for the size of each data type and index. Refer to "OSS Supported by Fujitsu Enterprise Postgres" in the General Description for the documentation URL.

Information

For pgvector 0.7.4, refer to the documentation "Reference" for details on each data type, and the source code for index sizes.

E.9 Estimating Hybrid Search Trace Information Disk Space Requirements

The bulk of the size of the hybrid search trace information is the text chunks that are the search results.

Describes the formula for estimating the amount of text chunks recorded per hybrid search.

```
Total size of text chunks recorded per hybrid search = average size of text chunks x (n_0 + n_1 + n_2)
```

n_0: Number of hybrid search returned

n_1: Number of semantic text search returned

n_2: Number of full-text search returned

Appendix F Estimating Memory Requirements

This appendix explains how to estimate the memory.

F.1 Fujitsu Enterprise Postgres Memory Requirements

This section describes the formulas for estimating Fujitsu Enterprise Postgres memory requirements.

Use the following formula to obtain a rough estimate of memory required for Fujitsu Enterprise Postgres:

```
fujitsuEnterprisePostgresRequiredMemory = sharedMemoryAmount + localMemoryAmount
```

Shared memory amount

```
sharedMemoryAmount = 1523444
                        + 8518 x x
                        + 7154 x (a + b + c + d + 1)
                        + 405 x (a + b + c + d + e) x f
                        + (1208 + g) x (a + b + c + d + 9)
                        + 64 x b
                        + 568 x c
                        + 104 x d
                        + 5666 x e
                        + 112 x h
                        + 8200 x i
                        + 512 x j
                        + 4 x (k + 10)
                        + 1097984 x m
                        + 258 x (a + b + c + d + 1 + e) x o
                        + (1024 x 1024) x p
                        + n
                        + 128 x q
```

The above units are Byte.

Parameter Details:

```
x = shared_buffer/8
    Note : Units of shared_buffer (kB)
    Example : x = 16384 (128 x 1024/8) when shared_buffer = 128 MB
        Convert MB to KB to calculate x.
a = max_connections
b = autovacuum_max_workers
c = max_worker_processes
d = max_wal_senders
e = max_prepared_transactions
f = max_locks_per_transaction
g = track_activity_query_size (byte)
h = max_logical_replication_workers
i = wal_buffers/8
  Note: If wal_buffers is the default value (-1), calculate i = x/32.
        However, if it becomes 2048 or more, set the maximum value to 2048.
        If i = x/32, there is a limit on the maximum value of i.
        Max i = WAL segment size/8
        The WAL segment size can be set with the initdb option --wal-segsize.
        The WAL segment size is in kilobytes.
        (The default WAL segment size is 16 MB. Convert to KB when calculating i)
  Example: If shared_buffer = 128 MB and wal_buffers = -1, i = 512 (16384/32)
           If shared_buffer = 2 GB and wal_buffers = -1, i = 2048 (2 x 1024 x 1024/8/32 = 8192,
           but the maximum value of i is 2048)
           If wal_buffers = 512 kB, i = 64 (512/8)
           i = 4096 (32 x 1024/8) when wal_buffers = 32 MB
```

```
                  Converts MB to KB to calculate i.
j = max_replication_slots
k = old_snapshot_threshold
  Note: If old_snapshot_threshold is the default value (-1), there is no need to add "4 x (k + 10)"
to the quote formula.
           old_snapshot_threshold units (min)
  Example: k = 60 (1 x 60) if old_snapshot_threshold = 1 h
               Convert h to min to get k.
m = pgx_global_metacache (megabytes)
n = memory size requested by the plug-in (determined by the plug-in)
o = max_pred_locks_per_transaction
p = min_dynamic_shared_memory (MB)
q = number of database roles
```

However, note that if instances have been created using WebAdmin, the parameters below will be configured automatically when the instances are created. Take this into account when calculating the shared memory size.

Parameter name	Set value
shared_buffers	30 percent of the internal memory of the machine.
max_connections	100
max_prepared_transactions	100

Local memory amount

```
localMemoryAmount = processStackArea
                  + memoryUsedInDbSessionsThatUseTempTables
                  + memoryUsedInDbSessionsThatPerformSortAndHashTableOperations
                  + memoryUsedInMaintenanceOperations
                  + baseMemoryUsedInEachProcess
                  + memoryUsedPreparingForDataAccess
```

Process stack area

```
processStackArea
  = max_stack_depth x (max_connections + autovacuum_max_workers + 9)
```

This formula evaluates to the maximum value.
Actually it is used according to the growth of the stack.
In the formula above, 9 is the number of processes that perform roles specific to servers.

Memory used in database sessions that use temporary tables

```
memoryUsedInDbSessionsThatUseTempTables
  = temp_buffers x max_connections
```

This formula evaluates to the maximum value.
Memory is gradually used as temporary buffers are used, and is released when the session ends.

Memory used in database sessions that perform sort and hash table operations

```
memoryUsedInDbSessionsThatPerformSortAndHashTableOperations
  = work_mem (*1) x max_connections
```

*1) For hash table operations, multiply work_mem by hash_mem_multiplier.
This formula evaluates to the maximum value.
Memory is gradually used as operations such as sort are performed, and is released when the query ends.

Memory used in maintenance operations

```
memoryUsedInMaintenanceOperations
  = maintenance_work_mem x (numOfSessionsPerformingMaintenance + autovacuum_max_workers)
```

Note that 'maintenance operations' are operations such as VACUUM, CREATE INDEX, and ALTER TABLE ADD FOREIGN KEY.

Base memory used in each process

```
baseMemoryUsedInEachProcess
  = baseMemoryUsedInOneProcess x (max_connections + autovacuum_max_workers + 9)
```

Use the result of the following formula for memory consumed per process. This formula evaluates to the memory used when server processes are running.
In the formula above, 9 is the number of processes that perform roles specific to servers.

The amount of memory consumed per process is determined by the number of tables, indexes, and all columns of all tables that the process accesses. If your system has about 100 tables, you can estimate it to be 3 MB, but otherwise use the following estimate:

```
baseMemoryUsedInOneProcess
  = (1.9KB x All user tables + 2.9KB x All user indexes + 1.0KB x All user columns) x 1.5(*1)

If you enable the Global Meta Cache feature, use the following formula:
baseMemoryUsedInOneProcess
 = (All user tables + All user indexes + All user columns) x 1.0KB x 1.5 (*1)
    + (All user tables x 1.4KB + All user indexes x 2.4KB)
```

*1) Safety Factor (1.5)
There are variable length information. This value takes that into account.

Memory used preparing for data access

```
memoryUsedPreparingForDataAccess
 = variationAmount x (max_connections + autovacuum_max_workers + 4)

  where variationAmount = shared_buffers / 8KB x 4 bytes
      (note that 8KB is the page length, and 4 bytes is the size of page management data)
```

This formula evaluates to the memory required to access the database cache in the shared memory.
In the formula above, among the processes that perform roles specific to servers, 4 is the number of processes that access the database.

F.2 Database Multiplexing Memory Requirements

This section describes the formula for estimating database multiplexing memory requirements for the database server.

Use the following formula to obtain a rough estimate of memory required for database multiplexing:

```
Memory usage of the database multiplexing feature for the database server
           = Peak memory usage of the Mirroring Controller processes
           + Peak memory usage of the Mirroring Controller commands

Peak memory usage of the Mirroring Controller processes=150 MB

Peak memory usage of the Mirroring Controller commands=50 MB x Number of commands executed
simultaneously
```

F.3 VCI Memory Requirements

This section describes the formula for estimating VCI memory requirements.

Use the following formula to obtain a rough estimate of memory requirements:

```
memUsedByVci = memForData + memForEachProcess
```

Memory required to store data in memory

Secure the space estimated using the formula below on the stable buffer (part of shared_buffers).

```
memForData = (numOfRowsInTables) x (numOfBytesPerRow) + (wosSize)
```

Number of bytes per row

```
numOfBytesPerRow
 = (19 + (numOfColsInCreateIndexStatement) / 8 + (numOfBytesPerSingleColValue)) x 1.1
```

Note: Round up the result to the nearest integer.

WOS size

```
wosSize = (numOfWosRows) / 185 x 8096
```

One row is added to the number of WOS rows for each INSERT and DELETE, and two rows are added for UPDATE. On the other hand, the number decreases to 520,000 rows or less during conversion to ROS performed by the ROS control daemon.

Memory required for each process

```
memForEachProcess
 = memUsedPerScanning
 + memUsedForVciMaintenace
 + memUsedByCreateIndexStatement
```

Memory used per scanning

- Parallel scan

```
memUsedPerScanning
 = vci.shared_work_mem + (numOfParallelWorkers + 1) x vci.maintenance_work_mem
```

Note: The number of parallel workers used by VCI simultaneously in the entire instance is equal to or less than vci.max_parallel_degree.

- Non-parallel scan

```
memUsedPerScanning = vci.max_local_ros + vci.maintenance_work_mem
```

Note

- vci.shared_work_mem, and vci.max_local_ros are used to create local ROS. If local ROS exceeds these sizes, execute a query without using VCI according to the conventional plan.
- vci.maintenance_work_mem specifies the memory size to be secured dynamically. If it exceeds the specified value, a disk temporary file is used for operation.

Memory used for VCI maintenance

```
memUsedForVciMaintenace = vci.maintenance_work_mem x vci.control_max_workers
```

Memory used by CREATE INDEX

```
memUsedByCreateIndexStatement = vci.maintenance_work_mem
```

Note

vci.maintenance_work_mem specifies the memory to be secured dynamically. If it exceeds the specified value, a disk temporary file is used for operation.

F.4 High-Speed Data Load Memory Requirements

This section describes the formula for estimating memory requirements for the high-speed data load feature.

Use the following formula to obtain a rough estimate of memory requirements:

```
Memory usage of high speed data load
 = (Peak memory usage of pgx_loader processes + Peak memory usage of the pgx_loader commands)
 x Number of commands executed simultaneously

Peak memory usage of pgx_loader processes
 = Peak memory usage of the backend process   (6 MB)
 + Peak memory usage of parallel workers       (6 MB x number of parallel workers)
 + Peak memory usage of dynamic shared memory (80 MB x number of parallel workers)

Peak memory usage of the pgx_loader commands=9 MB
```

Point

In addition to the size calculated using the formula above, the database cache on the shared memory estimated using the shared_buffers parameter is consumed according to the size of the data (table and index keys) loaded using this feature. Refer to "E.1 Estimating Table Size Requirements" and "E.2 Estimating Index Size Requirements" for information on estimating an appropriate shared buffers value.

F.5 Global Meta Cache Memory Requirements

This section describes the formula for estimating Global Meta Cache memory requirements.

The memory calculated by "Size of the GMC area" is allocated to the shared memory. The memory calculated by the per-process meta cache management information is allocated to the local memory. Refer to the graphic in "Architecture of Global Meta Cache Feature" in the "Memory usage reduction by Global Meta Cache" in the General Description for more information.

Use the following formula to obtain a rough estimate of memory requirements:

```
Amount of memory used by the Global Meta Cache feature
  = Size of GMC area + Per-process meta cache management information

Size of GMC area = (All user tables x 0.4 KB
     + All user indexes x 0.3 KB
     + All user columns x 0.8 KB) x 1.5 (*1)

Per-process meta cache management information
  = (All user tables + All user indexes + All user columns) x 0.1KB x max_connections x 1.5 (*1)
```

*1) Safety Factor (1.5)
This value takes into account the case where both GMC before and after the change temporarily exist at the same time in shared memory when the table definition is changed or the row of the system catalog is changed.

Appendix G Quantitative Limits

This appendix lists the quantitative limits of Fujitsu Enterprise Postgres.

Refer to the pgvector documentation for quantitative limits on the capabilities provided by pgvector. Refer to "OSS Supported by Fujitsu Enterprise Postgres" in the General Description for the documentation URL.

Table G.1 Length of identifier

Item	Limit
Database name	Up to 63 bytes (*1) (*2)
Schema name	Up to 63 bytes (*1) (*2)
Table name	Up to 63 bytes (*1) (*2)
View name	Up to 63 bytes (*1) (*2)
Index name	Up to 63 bytes (*1) (*2)
Tablespace name	Up to 63 bytes (*1) (*2)
Cursor name	Up to 63 bytes (*1) (*2)
Function name	Up to 63 bytes (*1) (*2)
Aggregate function name	Up to 63 bytes (*1) (*2)
Trigger name	Up to 63 bytes (*1) (*2)
Constraint name	Up to 63 bytes (*1) (*2)
Conversion name	Up to 63 bytes (*1) (*2)
Role name	Up to 63 bytes (*1) (*2)
Cast name	Up to 63 bytes (*1) (*2)
Collation sequence name	Up to 63 bytes (*1) (*2)
Encoding method conversion name	Up to 63 bytes (*1) (*2)
Domain name	Up to 63 bytes (*1) (*2)
Extension name	Up to 63 bytes (*1) (*2)
Operator name	Up to 63 bytes (*1) (*2)
Operator class name	Up to 63 bytes (*1) (*2)
Operator family name	Up to 63 bytes (*1) (*2)
Rewrite rule name	Up to 63 bytes (*1) (*2)
Sequence name	Up to 63 bytes (*1) (*2)
Text search settings name	Up to 63 bytes (*1) (*2)
Text search dictionary name	Up to 63 bytes (*1) (*2)
Text search parser name	Up to 63 bytes (*1) (*2)
Text search template name	Up to 63 bytes (*1) (*2)
Data type name	Up to 63 bytes (*1) (*2)
Enumerator type label	Up to 63 bytes (*1) (*2)
Profile name	Up to 63 bytes (*1) (*2)

*1: This is the character string byte length when converted by the server character set character code.

*2: If an identifier that exceeds 63 bytes in length is specified, the excess characters are truncated and it is processed.

Table G.2 Database object

Item	Limit
Number of databases	Less than 4,294,967,296 (*1)
Number of schemas	Less than 4,294,967,296 (*1)
Number of tables	Less than 4,294,967,296 (*1)
Number of views	Less than 4,294,967,296 (*1)
Number of indexes	Less than 4,294,967,296 (*1)
Number of tablespaces	Less than 4,294,967,296 (*1)
Number of functions	Less than 4,294,967,296 (*1)
Number of aggregate functions	Less than 4,294,967,296 (*1)
Number of triggers	Less than 4,294,967,296 (*1)
Number of constraints	Less than 4,294,967,296 (*1)
Number of conversion	Less than 4,294,967,296 (*1)
Number of roles	Less than 4,294,967,296 (*1)
Number of casts	Less than 4,294,967,296 (*1)
Number of collation sequences	Less than 4,294,967,296 (*1)
Number of encoding method conversions	Less than 4,294,967,296 (*1)
Number of domains	Less than 4,294,967,296 (*1)
Number of extensions	Less than 4,294,967,296 (*1)
Number of operators	Less than 4,294,967,296 (*1)
Number of operator classes	Less than 4,294,967,296 (*1)
Number of operator families	Less than 4,294,967,296 (*1)
Number of rewrite rules	Less than 4,294,967,296 (*1)
Number of sequences	Less than 4,294,967,296 (*1)
Number of text search settings	Less than 4,294,967,296 (*1)
Number of text search dictionaries	Less than 4,294,967,296 (*1)
Number of text search parsers	Less than 4,294,967,296 (*1)
Number of text search templates	Less than 4,294,967,296 (*1)
Number of data types	Less than 4,294,967,296 (*1)
Number of enumerator type labels	Less than 4,294,967,296 (*1)
Number of default access privileges defined in the ALTER DEFAULT PRIVILEGES statement	Less than 4,294,967,296 (*1)
Number of large objects	Less than 4,294,967,296 (*1)
Number of index access methods	Less than 4,294,967,296 (*1)
Number of profile	Less than 4,294,967,296 (*1)

*1: The total number of all database objects must be less than 4,294,967,296.

Table G.3 Schema element

Item	Limit
Number of columns that can be defined in one table	From 250 to 1600 (according to the data type)
Table row length	Up to 400 gigabytes

Item	Limit
Number of columns comprising a unique constraint	Up to 32 columns
Data length comprising a unique constraint	Less than 2,000 bytes (*1) (*2)
Table size	Up to 32 terabyte
Search condition character string length in a trigger definition statement	Up to 800 megabytes (*1) (*2)
Item size	Up to 1 gigabyte

*1: Operation might proceed correctly even if operations are performed with a quantity outside the limits.

*2: This is the character string byte length when converted by the server character set character code.

Table G.4 Index

Item	Limit
Number of columns comprising a key (including VCI)	Up to 32 columns
Key length (other than VCI)	Less than 2,000 bytes (*1)

*1: This is the character string byte length when converted by the server character set character code.

Table G.5 Data types and attributes that can be handled

Item			Limit
Character	Data length		Data types and attributes that can be handled (*1)
	Specification length (n)		Up to 10,485,760 characters (*1)
Numeric	External decimal expression		Up to 131,072 digits before the decimal point, and up to 16,383 digits after the decimal point
	Internal binary expression	2 bytes	From -32,768 to 32,767
		4 bytes	From -2,147,483,648 to 2,147,483,647
		8 bytes	From -9,223,372,036,854,775,808 to 9,223,372,036,854,775,807
	Internal decimal expression		Up to 13,1072 digits before the decimal point, and up to 16,383 digits after the decimal point
	Floating point expression	4 bytes	From -3.4E+38 to -7.1E-46, 0, or from 7.1E-46 to 3.4E+38
		8 bytes	From -1.7E+308 to -2.5E-324, 0, or from 2.5E-324 to 1.7E+308
bytea			Up to one gigabyte minus 53 bytes
Large object			Up to 4 terabyte

*1: This is the character string byte length when converted by the server character set character code.

Table G.6 Function definition

Item	Limit
Number of arguments that can be specified	Up to 100
Number of variable names that can be specified in the declarations section	No limit

Item	Limit
Number of SQL statements or control statements that can be specified in a function processing implementation	No limit

Table G.7 Data operation statement

Item	Limit
Maximum number of connections for one process in an application (remote access)	4,000 connections
Number of expressions that can be specified in a selection list	Up to 1,664
Number of tables that can be specified in a FROM clause	No limit
Number of unique expressions that can be specified in a selection list/ DISTINCT clause/ORDER BY clause/GROUP BY clause within one SELECT statement	Up to 1,664
Number of expressions that can be specified in a GROUP BY clause	No limit
Number of expressions that can be specified in an ORDER BY clause	No limit
Number of SELECT statements that can be specified in a UNION clause/INTERSECT clause/EXCEPT clause	Up to 4,000 (*1)
Number of nestings in joined tables that can be specified in one view	Up to 4,000 (*1)
Number of functions or operator expressions that can be specified in one expression	Up to 4,000 (*1)
Number of expressions that can be specified in one row constructor	Up to 1,664
Number of expressions that can be specified in an UPDATE statement SET clause	Up to 1,664
Number of expressions that can be specified in one row of a VALUES list	Up to 1,664
Number of expressions that can be specified in a RETURNING clause	Up to 1,664
Total expression length that can be specified in the argument list of one function specification	Up to 800 megabytes (*2)
Number of cursors that can be processed simultaneously by one session	No limit
Character string length of one SQL statement	Up to 800 megabytes (*1) (*3)
Number of input parameter specifications that can be specified in one dynamic SQL statement	No limit
Number of tokens that can be specified in one SQL statement	Up to 10,000
Number of values that can be specified as a list in a WHERE clause IN syntax	No limit
Number of expressions that can be specified in a USING clause	No limit
Number of JOINs that can be specified in a joined table	Up to 4,000 (*1)
Number of expressions that can be specified in COALESCE	No limit
Number of WHEN clauses that can be specified for CASE in a simple format or a searched format	No limit
Data size per record that can be updated or inserted by one SQL statement	Up to one gigabyte minus 53 bytes
Number of objects that can share a lock simultaneously	Up to 256,000 (*1)

*1: Operation might proceed correctly even if operations are performed with a quantity outside the limits.

*2: The total number of all database objects must be less than 4,294,967,296.

*3: This is the character string byte length when converted by the server character set character code.

Table G.8 Data size

Item	Limit
Data size per record for input data files (COPY statement, psql command \copy meta command)	Up to 800 megabytes (*1)
Data size per record for output data files (COPY statement, psql command \copy meta command)	Up to 800 megabytes (*1)

*1: Operation might proceed correctly even if operations are performed with a quantity outside the limits.

Appendix H Configuring Kernel Parameters

Use the "System V IPC Parameters" table in "Managing Kernel Resources" in the PostgreSQL Documentation for the relationship between configuration parameters and kernel parameters, as well as calculation formulas.
Refer to the "Managing Kernel Resources" in the PostgreSQL Documentation to calculate shared memory usage.

For multiple instances, the kernel parameters should be evaluated for all instances. For example, in the case of the maximum number of shared memory segments for the entire system (SHMMNI), the total number of segments obtained by all instances should be added to the kernel parameters. In the case of the maximum number of semaphores for each process (SEMMSL), the largest of all sizes obtained by all instances should be compared to the current value prior to configuring the settings.

Note

If there is insufficient shared memory due to miscalculation of SHMMAX, a message will be output indicating that the shmget system call failed at "errno=22 (EINVAL)". Review the calculation, and reconfigure.

The relationship between System V IPC parameters and kernel parameters in various operating systems is shown below.

System	V IPC parameter	Kernel parameter action
SHMMAX	kernel.shmmax	If *currentValue* < *calculatedValue*, configure the calculated value
SHMMIN	No compatible parameter	
SHMALL	kernel.shmall	Specify *currentValue* + *calculatedValue*
SHMSEG	No compatible parameter	
SHMMNI	kernel.shmmni	Specify *currentValue* + *calculatedValue*
SEMMNI	Fourth parameter of kernel.sem	Specify *currentValue* + *calculatedValue*
SEMMNS	Second parameter of kernel.sem	Specify *currentValue* + *calculatedValue*
SEMMSL	First parameter of kernel.sem	If *currentValue* < *calculatedValue*, configure the calculated value
SEMMAP	No compatible parameter	
SEMVMX	No compatible parameter	

Remark 1: kernel.shmall specifies the number of pages.
Remark 2: Specify all four parameters for kernel.sem. At this time, the value specified in the third parameter should be the same value as before configuration.

Appendix I Determining the Preferred WebAdmin Configuration

This appendix describes the two different configurations in which WebAdmin can be used and how to select the most suitable configuration.

I.1 WebAdmin Configurations

WebAdmin can be installed in two configurations:

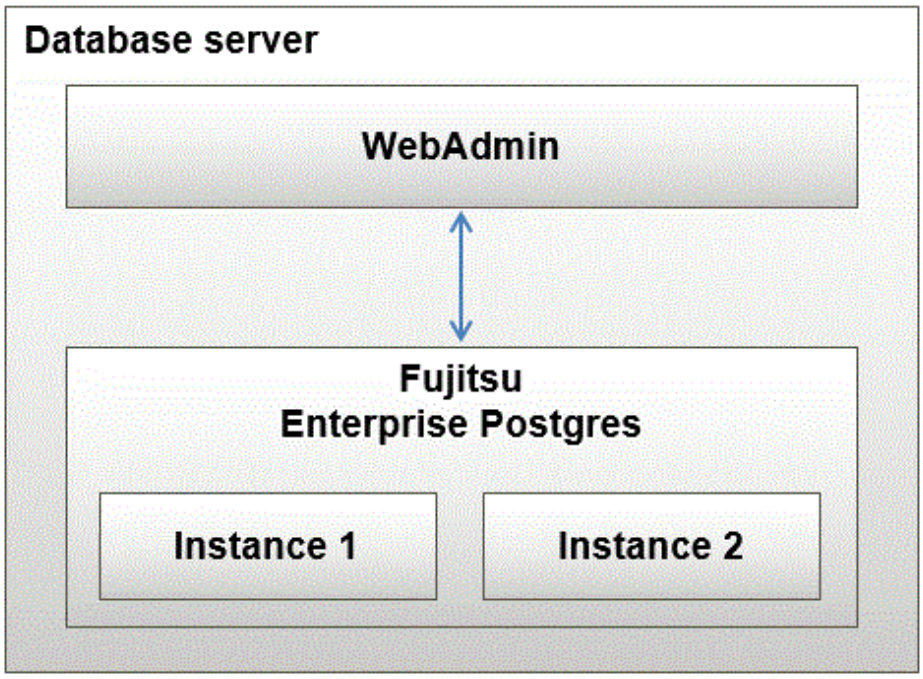
- Single-server
- Multiserver

WebAdmin supports the option to select http or secure https between browsers and servers and between servers. If you have a multi-server environment with a mix of older versions, select http (the default) during setup to continue using the HTTP protocol. This is because older versions do not support HTTPS and all HTTPS settings must be the same on the configuration server.

I.1.1 Single-Server Configuration

A single-server configuration enables you to create and operate instances on a single server. In this configuration, WebAdmin must be installed on the same database server as the Fujitsu Enterprise Postgres Server component.

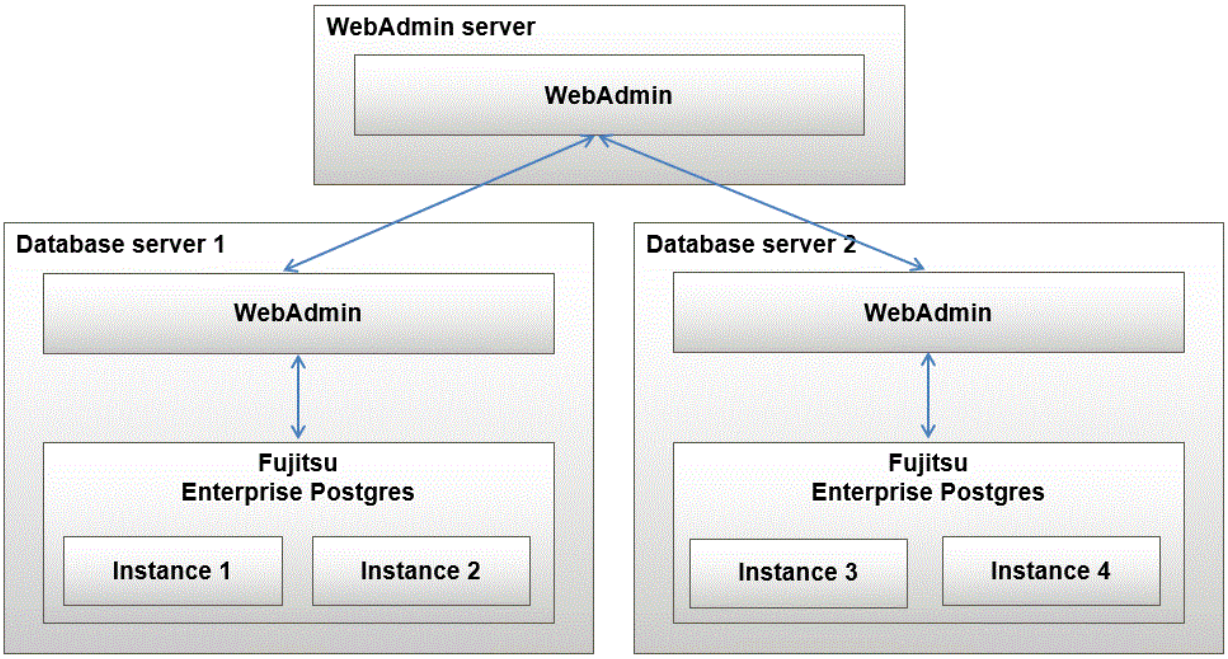
Single-server configuration



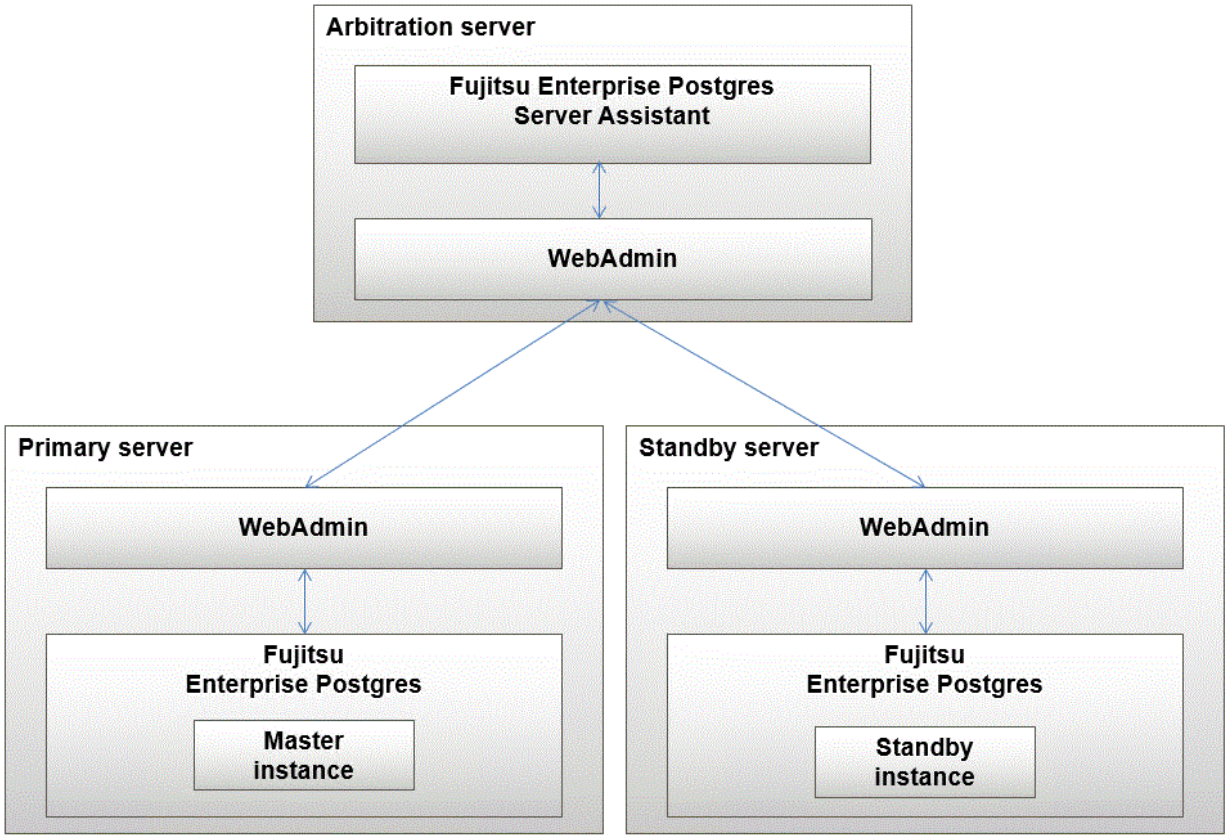
I.1.2 Multiserver Configuration

A multiserver configuration enables you to create and operate instances stored on multiple database servers. As shown in the figure below, WebAdmin can be installed on a dedicated WebAdmin server and used to collectively manage the instances stored on the database servers.

Multiserver configuration



Also, when setting up the arbitration server by WebAdmin during database multiplexing mode, install WebAdmin on the arbitration server.



I.2 Installing WebAdmin in a Single-Server Configuration

To install WebAdmin in a single-server configuration, the Fujitsu Enterprise Postgres Server component and WebAdmin must be installed on the same machine.

Select the following items when installing Fujitsu Enterprise Postgres in a single-server configuration:

- Fujitsu Enterprise Postgres Advanced Edition or Fujitsu Enterprise Postgres Standard Edition
- WebAdmin

I.3 Installing WebAdmin in a Multiserver Configuration

In a multiserver configuration, install WebAdmin on one server, and both WebAdmin and the Fujitsu Enterprise Postgres Server component on any number of database servers.

Select the following items when installing Fujitsu Enterprise Postgres in a multiserver configuration:

- WebAdmin server:
  - WebAdmin
- Database server:
  - Fujitsu Enterprise Postgres Advanced Edition or Fujitsu Enterprise Postgres Standard Edition
  - WebAdmin

Also, when setting up the arbitration server by WebAdmin during database multiplexing mode, select the following when installing Fujitsu Enterprise Postgres.

- Arbitration server
  - Fujitsu Enterprise Postgres Server Assistant
  - WebAdmin

See

Refer to the Installation and Setup Guide for Server Assistant for details on how to install the Server Assistant.

Appendix J System Configuration when using Pgpool-II

Describes the system configuration when using Pgpool-II.

The system configuration when using Pgpool-II is as follows:

Place on database server

System configuration to coexist the database server with Pgpool-II.

Place on application server

System configuration to coexist the application server with Pgpool-II.

Place on dedicated server

System configuration in which Pgpool-II resides on a dedicated server (Pgpool-II Server) that is separate from the database and application servers.

Select the system configuration that best meets your operational requirements.

J.1 Pgpool-II Configuration

In this example, Pgpool-II is deployed on a different Pgpool-II server than the database and application servers.

There are three configurations of Pgpool-II:

- Single-machine configuration
- Two-machine configuration
- Three-machine configuration

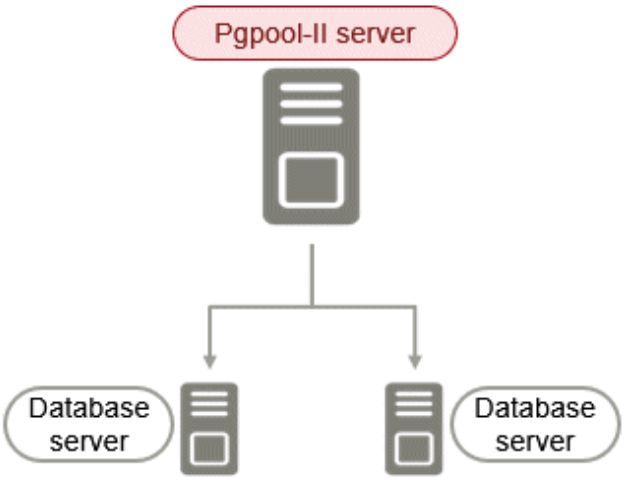
Although the Pgpool-II server can be operated on a single machine, to ensure business continuity, it is recommended to operate the Pgpool-II server using a three-machine configuration in Fujitsu Enterprise Postgres.

If employing a configuration of three or more machines, use an odd number of machines in the configuration.

J.1.1 Single-Machine Configuration

This is the basic configuration when running Pgpool-II.

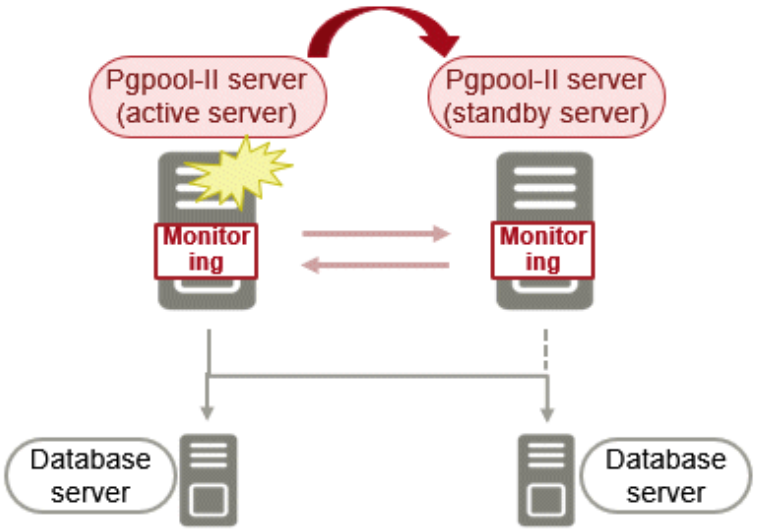
Although the database server has redundancy, if an error occurs on the Pgpool-II server that accesses the database server, the job will stop.



J.1.2 Two-Machine Configuration

When an error occurs on the active server, the Pgpool-II monitoring feature that mutually monitors the status of the Pgpool-II servers enables jobs to continue uninterrupted by switching to the standby server.

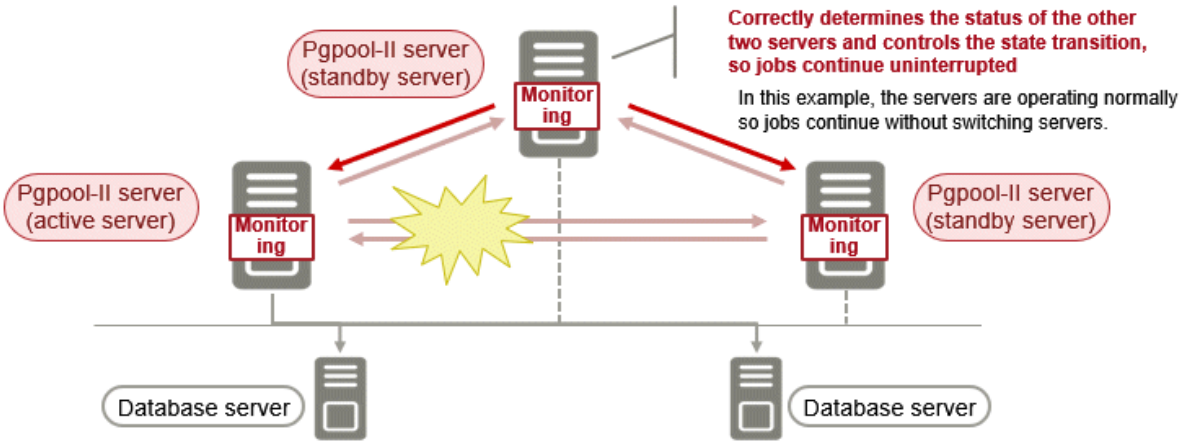
If the network between Pgpool-II servers is disconnected, even if the Pgpool-II servers are running correctly, which may lead to stoppage of jobs.



J.1.3 Three-Machine Configuration

The Pgpool-II monitoring feature enables a Pgpool-II server to monitor the other two Pgpool-II servers.

Even if any of the networks monitoring the Pgpool-II servers are disconnected, the status of servers on a network that is operating normally can be checked correctly, enabling accurate continuation of jobs.



J.2 Installing Pgpool-II

Pgpool-II is bundled with the server program and the client program. To use Pgpool-II, use the server program or the client program to install and set up Pgpool-II.

Depending on where Pgpool-II is installed, select the appropriate DVD for deployment:

Installing on Database Server (coexist)

Install the Pgpool-II program along with the server program from the server program DVD.

Installing on Application Server (coexist)

Install the Pgpool-II program along with the client program from the client program DVD.

Installing on Dedicated server different from the above (Pgpool-II server)

Install the Pgpool-II program along with the client program from the client program DVD.

J.3 Pgpool-II Setup

Describes how to set up Pgpool-II.

J.3.1 Setting Environment Variables

If you use the Pgpool-II command, set the following environment variables:

PATH environment variable

Add "Install Directory/bin".

The following is an example of setting environment variables:

Example

The following is an example of setting environment variables when the installation directory is "/ opt/fsepv < x > pgpool-II".

"< x >"” indicates the product version.

```
$ PATH=/opt/fsepv<x>pgpool-II/bin:$PATH ; export PATH
```

J.3.2 Configuration file

Describes Pgpool-II configuration files.

J.3.2.1 Configuring pgpool.conf

To configure pgpool.conf, see the Pgpool-II documentation.

A sample configuration file is located under the installation directory/etc.

J.3.2.2 Using Configuration Files

The pgpool command makes use of configuration files such as pgpool.conf, pcp.conf, and pool_hba.conf.

To take advantage of these configuration files, specify the path to the files in the pgpool command options.

The following example shows how to configure options for the pgpool command:

Example

```
$ pgpool -f /usr/local/etc/pgpool.conf -F /usr/local/etc/pcp.conf -a / usr/local/etc/pool_hba.conf
```

Appendix K Supported contrib Modules and Extensions Provided by External Projects

Fujitsu Enterprise Postgres supports PostgreSQL contrib modules, and extensions provided by external projects.

Refer to the following for details on the supported contrib modules:

- "Additional Supplied Modules" in the PostgreSQL Documentation
- "Additional Supplied Programs" in the PostgreSQL Documentation

Information

You can also check the list of available extensions using the pg_available_extensions view.

Refer to "OSS Supported by Fujitsu Enterprise Postgres" in the General Description for information on supported extensions provided by external projects.

Appendix L Procedure when Modifying the JRE Installation

This appendix describes the procedures to follow when modifying the JRE installation.

The JRE, of which the installation destination is specified in the JAVA_HOME environment variable when installing Fujitsu Enterprise Postgres, is used by features such as WebAdmin and database multiplexing.

Therefore, when updating or reinstalling JRE after installing Fujitsu Enterprise Postgres, the procedures below must be performed.

L.1 When Using WebAdmin

WebAdmin must be set up again.

Follow the procedure below to modify the JRE installation:

1. Stop the Web server feature of WebAdmin

   Refer to "B.1.4 Stopping the Web Server Feature of WebAdmin" for details.

2. Remove WebAdmin

   Refer to "B.2 Removing WebAdmin" for details.

3. Modify the JRE installation

4. Set the JAVA_HOME environment variable

   Set the JAVA_HOME environment variable to the installation destination of JRE 8.

   Example

   ```
   # export JAVA_HOME="Jre8InstallDir"
   ```

5. Set up WebAdmin

   Refer to "B.1.1 Setting Up WebAdmin" for details.

6. Start the Web server feature of WebAdmin

   Refer to "B.1.3 Starting the Web Server Feature of WebAdmin" for details.

L.2 When Performing Database Multiplexing

Mirroring Controller must be restarted.

Follow the procedure below to modify the JRE installation:

1. Stop Mirroring Controller

   Refer to the Cluster Operation Guide (Database Multiplexing) for details.

2. Modify the JRE installation

3. Change the installation environment to be used by Mirroring Controller

   Note

   If database multiplexing is performed using WebAdmin, perform the procedure described in this procedure after performing step 4 "Set the JAVA_HOME environment variable" in "L.1 When Using WebAdmin".

   Set the JAVA_HOME environment variable to the installation destination of JRE 8, and use the mc_update_jre_env command to change the installation environment to be used by Mirroring Controller.
   This procedure must be executed by the superuser.

Example

/opt/fsepv<*x*>server64/bin is the installation directory where the server product is installed.

```
$ su -
Password:******
# export JAVA_HOME="Jre8InstallDir"
# /opt/fsepv<x>server64/bin/mc_update_jre_env
```

4. Start Mirroring Controller

   Refer to the Cluster Operation Guide (Database Multiplexing) for details.

Appendix M Access to Key Management System Using Plug-in

M.1 What to do with Plug-ins

Plug-ins are called to verify, encrypt, and decrypt keys.

Key validation, encryption, and decryption requests are required.

M.2 Where the Plug-in is Stored

Plug-ins are stored as executables with the same name as the plug-in name in the directory specified in the tde_kms.plugin.path parameter. It is the responsibility of the database administrator to ensure that only secure plugins are stored in this directory.

M.3 Invoking the Plug-in

The plug-in runs with the same ownership as the user running the FEP server. The plug-in is passed information that should be kept secret. It is the database administrator's responsibility to ensure that the plug-in is trustworthy.

Plug-ins can be invoked at the same time (multiple).

The plug-in must complete the operation in a timely manner and return a response.

M.4 Passing Confidential Information to Plug-ins

Confidential credentials passed to the FEP instance using the FEP keystore open facility (pgx _ open _ keystore function, opening at server startup prompt, opening using obfuscated files) are passed to the plug-in as environment variables.

You can pass arbitrary values as arguments when calling the plug-in, but do not use this feature to pass sensitive information.

The authentication and authorization of access to the key management system depends on the implementation of the plug-in.

M.5 Calling Convention

M.5.1 Key Verification

Arguments

The following arguments are supplied:

	Argument value	Notes
First argument	validate-key	Fixed
second argument	--keyid	Fixed
third argument	*keyid*	Variable; the key ID specified in the pgx_declare_external_master_key function is passed
After the fourth argument	*extraarg*	Arguments specified in the connection information file, if any, are given in the specified order

Environment variable

The following environment variables are supplied:

Name of the environment variable	Value of the environment variable	Notes
TDE_KMS_SECRET	KMS Secret	String entered in the FEP to open the keystore

Return value

The command ends with the following return values:

Return value	Condition
0	If the processing is successful
Other than 0	When processing does not complete normally

delivery of data

Data is delivered to the plug-in in the following way.The plug-in also returns results in the following ways:

Classification	Data Content	Delivery method	Notes
Input	Key ID	Arguments	
Output	Process Status	Plug-in return code	
Output	Message	Plugin standard error output	Expected to be printable

Calling opportunity

Called before starting to use the encryption key.

Processing contents

Verifies the existence of the encryption key identified by the key ID and whether the user is authorized to use the encryption key.

M.5.2 Encryption

Arguments

The following arguments are supplied:

	Argument value	Notes
First argument	encrypt	Fixed
second argument	--keyid	Fixed
third argument	*keyid*	Variable; the key ID specified in the pgx_declare_external_master_key function is passed
After the fourth argument	*extraarg*	The values specified in extra-args in the key management system connection information file, if any, are passed in the specified order

Environment variable

The following environment variables are supplied:

Name of the environment variable	Value of the environment variable	Notes
TDE_KMS_SECRET	KMS Secret	String entered in the FEP to open the keystore

Return value

The command ends with the following return values:

Return value	Condition
0	If the processing is successful
Other than 0	When processing does not complete normally

delivery of data

Data is delivered to the plug-in in the following way.The plug-in also returns results in the following ways:

Classification	Data Content	Delivery method	Notes
Input	Data to be encrypted	Standard input for the plug-in	As Is (not Base 64 encoding, etc)
Input	Key ID	Arguments	
Input	Encryption parameter	-	Not passed by the FEP
Output	Encryption result	Standard output of the plug-in	As Is (not Base 64 encoding, etc)
Output	Status of the action	plug-in return code	
Output	Message	Standard error output of the plug-in	It is expected to be printable

Calling opportunity

Called when encryption with the master encryption key is required.

Processing Contents

Encrypts the given data to be encrypted with the encryption key identified by the specified key ID, and returns the result. The returned encryption result must be decryptable with the same key ID.

Caution

- Implement so that data to be encrypted is not leaked. For example, temporarily storing encrypted data that is plaintext in a file poses a risk of disclosure.
- Fujitsu Enterprise Postgres only guarantees the following during decryption:
  - The same key ID is handed over during decryption as during encryption.
  - The data received as a result of the "encryption" operation is passed as-is when decrypting.
- The maximum amount of data to be encrypted passed from the Fujitsu Enterprise Postgres is 2048 bytes.

M.5.3 Decryption

Arguments

The following arguments are supplied:

	Argument value	Notes
First argument	decrypt	Fixed
second argument	--keyid	Fixed
third argument	*keyid*	Variable; the key ID specified in the pgx_declare_external_master_key function is passed
After the fourth argument	*extraarg*	The values specified in extra-args in the key management system connection information file, if any, are passed in the specified order.

Environment variable

The following environment variables are supplied:

Name of the environment variable	Value of the environment variable	Notes
TDE_KMS_SECRET	KMS Secret	String entered in the FEP to open the keystore

Return value

The command ends with the following return values:

Return value	Condition
0	If the processing is successful
Other than 0	When processing does not complete normally

delivery of data

Data is delivered to the plug-in in the following way.The plug-in also returns results in the following ways:

Classification	Data Content	Delivery method	Notes
Input	Data to be decrypted	Standard input for the plug-in	As Is (not Base 64 encoding, etc.)
Input	Key ID	Arguments	
Input	Encryption parameter	-	Not passed by the FEP
Output	Decoding result	Standard output of the plug-in	As Is (not Base 64 encoding, etc.)
Output	Status of the action	plug-in return code	
Output	Message	Standard error output of the plug-in	It is expected to be printable

Calling opportunity

Called when decryption with the master encryption key is required.

Processing Contents

Decrypts the given encrypted data with the encryption key identified by the given key ID and returns the result.

Caution

- Implement so that the decrypted data is not leaked. For example, there is a risk of leakage if the decryption result data, which is clear text, is temporarily stored in a file.
- If decryption requires the same encryption parameters as encryption, it is the plug-in's responsibility to ensure this. During decryption, the FEP only ensures that the plug-in receives the same key ID and encrypted data as was encrypted.
- The data to be decrypted is passed as is the data returned by the plug-in in response to the encryption request.

Appendix N Deploying Virtual Machines by Cloning

Learn how to install Fujitsu Enterprise Postgres on a virtual machine, clone the virtual machine, and deploy a new virtual machine.

N.1 If you are installing only

There are no guidelines for installing Fujitsu Enterprise Postgres on a virtual machine only and cloning a virtual machine.

N.2 If you are creating an instance

When creating an instance on a virtual machine and cloning the virtual machine, the following precautions must be taken:

- Clone the virtual machine while the instance and WebAdmin are stopped.
- Modify the IP address and host name settings in files such as postgresql.conf and pg_hba.conf if they are different for each replicated machine.
- Use transparent data encryption on the replicated machine. Instances that use transparent data encryption cannot be cloned for use.
- If you cloned the virtual machine that contains the WebAdmin server, reinstall WebAdmin and import the instance that WebAdmin created.

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FUJITSU

Fujitsu
Enterprise Postgres 17 SP2

Installation and Setup Guide for Server

Windows

B1WS-1492-03ENZ0(00)
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Preface

Purpose of this document

The Fujitsu Enterprise Postgres database system extends the PostgreSQL features and runs on the Windows platform.

This document describes how to install and set up "Fujitsu Enterprise Postgres".

Intended readers

This document is intended for those who install and operate Fujitsu Enterprise Postgres.

Readers of this document are assumed to have general knowledge of:

- PostgreSQL
- SQL
- Windows

Structure of this document

This document is structured as follows:

Chapter 1 Overview of Installation

Describes the installation types and procedures

Chapter 2 Operating Environment

Describes the operating environment required to use Fujitsu Enterprise Postgres

Chapter 3 Installation

Describes how to perform a new installation of Fujitsu Enterprise Postgres

Chapter 4 Setup

Describes the setup to be performed after installation

Chapter 5 Uninstallation

Describes how to uninstall Fujitsu Enterprise Postgres

Appendix A Recommended WebAdmin Environments

Describes the recommended WebAdmin environment

Appendix B Setting Up and Removing WebAdmin

Describes how to set up and remove WebAdmin

Appendix C WebAdmin Disallow User Inputs Containing Hazardous Characters

Describes characters that are not allowed in WebAdmin.

Appendix D Configuring Parameters

Describes Fujitsu Enterprise Postgres parameters

Appendix E Estimating Database Disk Space Requirements

Describes how to estimate database disk space requirements

Appendix F Estimating Memory Requirements

Describes the formulas for estimating memory requirements

Appendix G Quantitative Limits

Describes the quantity range

Appendix H Determining the Preferred WebAdmin Configuration

Describes the two different configurations in which WebAdmin can be used and how to select the most suitable configuration

Appendix I Supported contrib Modules and Extensions Provided by External Projects

Lists the PostgreSQL contrib modules and the extensions provided by external projects supported by Fujitsu Enterprise Postgres.

Appendix J Deploying Virtual Machines by Cloning

Describes installing Fujitsu Enterprise Postgres on a virtual machine, cloning the virtual machine, and deploying a new virtual machine.

Export restrictions

Exportation/release of this document may require necessary procedures in accordance with the regulations of your resident country and/or US export control laws.

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Contents

Chapter 1 Overview of Installation

This chapter provides an overview of Fujitsu Enterprise Postgres installation.

1.1 Features that can be Installed

Each Fujitsu Enterprise Postgres feature is installed on the machine that was used to build the database environment.

The following table shows the relationship between the product to be installed and the features that can be installed.

Feature that can be installed	Product name	
	AE	SE
Basic feature (server feature, client feature)	Y	Y

Y: Can be installed

1.2 Installation Types

The following installation types are available for Fujitsu Enterprise Postgres:

- New installation
- Reinstallation
- Multi-version installation

1.2.1 New Installation

In initial installation, Fujitsu Enterprise Postgres is installed for the first time.

1.2.2 Reinstallation

Perform reinstallation to repair installed program files that have become unusable for any reason.

1.2.3 Multi-Version Installation

Fujitsu Enterprise Postgres products can be installed on the same server if the product version (indicated by "*x*" in "*x* SP*z*") is different from that of any version of the product that is already installed.

1.3 Installation Procedure

The following installation procedures are available for Fujitsu Enterprise Postgres:

- Installation in interactive mode
- Installation in silent mode

Select the installation procedure that corresponds to your environment.

1.3.1 Installation in Interactive Mode

Interactive mode enables installation to be performed while the required information is entered interactively.

In the interactive mode installation, the installation state of Fujitsu Enterprise Postgres is determined automatically. Install Fujitsu Enterprise Postgres using one of the following installation types in accordance with the installation state:

- New installation
- Reinstallation

- Multi-version installation

1.3.2 Installation in Silent Mode

Silent mode enables installation to be performed without the need to enter any information interactively.

New installations and multi-version installations can be performed in silent mode.

1.4 Uninstallation

Uninstallation removes the system files of the installed Fujitsu Enterprise Postgres.

Chapter 2 Operating Environment

This chapter describes the operating environment required to use Fujitsu Enterprise Postgres.

See

Refer to "Operating Environment" in the Installation and Setup Guide for Client when installing the Fujitsu Enterprise Postgres client feature at the same time.

2.1 Required Operating System

One of the operating systems shown below is required in order to use Fujitsu Enterprise Postgres.

Table 2.1 Operating systems

Operating system name
- Microsoft(R) Windows Server(R) 2016 Datacenter - Microsoft(R) Windows Server(R) 2016 Standard - Microsoft(R) Windows Server(R) 2016 Essentials
- Microsoft(R) Windows Server(R) 2019 Datacenter - Microsoft(R) Windows Server(R) 2019 Standard - Microsoft(R) Windows Server(R) 2019 Essentials
- Microsoft(R) Windows Server(R) 2022 Datacenter - Microsoft(R) Windows Server(R) 2022 Standard - Microsoft(R) Windows Server(R) 2022 Essentials
- Microsoft(R) Windows Server(R) 2025 Datacenter - Microsoft(R) Windows Server(R) 2025 Standard - Microsoft(R) Windows Server(R) 2025 Essentials

The following components of Windows Server(R) 2016, Windows Server(R) 2019, Windows Server(R) 2022 and Windows Server(R) 2025 are not supported:

- Server Core
- Nano Server
- Windows Server Container

2.2 Related Software

The following table lists the software required to use Fujitsu Enterprise Postgres.

Table 2.2 Related software

No.	Software name	Version	Product name of Fujitsu Enterprise Postgres		Remarks
			AE	SE	
1	Perl	5.40.0	Y	Y	Required when using PL/Perl.
2	Python	3.12.x	Y	Y	Required when using PL/Python based on Python 3.
3	Tcl	9.0	Y	Y	Required when using PL/Tcl.

No.	Software name	Version	Product name of Fujitsu Enterprise Postgres		Remarks
			AE	SE	
4	Oracle Call Interface (OCI) libraries	19c or later	Y	Y	Required when using oracle_fdw.
5	Amazon Web Services Command Line Interface (AWS CLI)	2.x or later	Y	Y	Required for monitoring database operations using Amazon CloudWatch.

Y: Can be used

Note

The following programs are installed during installation of Fujitsu Enterprise Postgres. Do not uninstall it because it is required for Fujitsu Enterprise Postgres to work.

- Microsoft Visual C++ 2015-2022 Redistributable version 14.44.35211.0

The following table lists client that can be connected to the Fujitsu Enterprise Postgres server feature.

Table 2.3 Connectable client

OS	Product name
Windows Linux	Fujitsu Enterprise Postgres Client 17 or later

The following table lists server assistant that can be connected to the Fujitsu Enterprise Postgres server feature.

Table 2.4 Connectable server assistant

OS	Product name
Windows Linux	Fujitsu Enterprise Postgres Server Assistant 17 or later

2.3 Excluded Software

This section describes excluded software.

Fujitsu Enterprise Postgres

Fujitsu Enterprise Postgres cannot be installed if all the following conditions are met:

- The product version (indicated by "*x*" in "*x* SP*z*") of the product to be installed is the same as that of the installed product
- The editions are different

Example

In the following cases, Fujitsu Enterprise Postgres cannot be installed as an exclusive product:

- The installed product is Fujitsu Enterprise Postgres Standard Edition (64bit) 17
- The product to be installed is Fujitsu Enterprise Postgres Advanced Edition (64bit) 17 SP2

Other products

There are no exclusive products.

2.4 Required Patches

There are no required patches.

2.5 Hardware Environment

The following hardware is required to use Fujitsu Enterprise Postgres.

Memory

256 MB or more is recommended (at least 128 MB is required).

2.6 Disk Space Required for Installation

The following table shows the disk space requirements for new installation of Fujitsu Enterprise Postgres. If necessary, increase the size of the file system.

Table 2.5 Disk space required for installation

Directory	Required disk space (Unit: MB)
Windows system drive	7 + 310 (*1) + 40 (*2)
Installation destination of the Server	970
Installation destination of the WebAdmin	810
Installation destination of the Client (32bit)	370
Installation destination of the Client (64 bit)	1940

*1: Required for the installation of the Uninstall (middleware) tool.

*2: Required for the installation of FJQSS.

2.7 Supported System Environment

This section describes the supported system environment.

2.7.1 TCP/IP Protocol

Fujitsu Enterprise Postgres supports version 4 and 6 (IPv4 and IPv6) of TCP/IP protocols.

Do not use link-local addresses if TCP/IP protocol version 6 addresses are used.

2.7.2 File System

You can install Fujitsu Enterprise Postgres only if the system folder is an NTFS volume.

2.8 PostgreSQL Version Used for Fujitsu Enterprise Postgres

Fujitsu Enterprise Postgres is based on PostgreSQL 17.

2.9 Notes on Using Streaming Replication

To use streaming replication, build the primary server and all standby servers using the same Fujitsu Enterprise Postgres version. The same version refers to *x* SP*z* x, which is represented as the product version.

Streaming replication cannot be used in combination with Open Source PostgreSQL.

Chapter 3 Installation

This chapter describes the procedures for the installation of Fujitsu Enterprise Postgres.

Note

If you have antivirus software installed, the server may crash, fail to start, or stop responding, during installation or when starting up after installation. Set scan exception settings for the installation directory and resource allocation directory so that the files in these directories are not scanned for viruses.

3.1 Pre-installation Tasks

Check the system environment below before installing Fujitsu Enterprise Postgres.

Check the disk space

Ensure that there is sufficient disk space to install Fujitsu Enterprise Postgres.

Refer to "2.6 Disk Space Required for Installation" for information on the required disk space.

Check the installed products and determine the installation method

In [Start] menu, click [All apps], then [Fujitsu], and then [Uninstall (middleware)]. In the displayed window, check the installed products.

If Fujitsu Enterprise Postgres is already installed, determine which installation method to use:

- Reinstallation
- Multi-version installation

The shortcuts displayed on the [Start] menu might be arranged differently depending on the operating system.

Remove applied updates(For Reinstallation)

Use the following procedure to remove applied fixes.

If you install the product without removing the fix, you will apply the same version of the fix with the same fix number, resulting in an error that has already been applied. Remove the fix and then reinstall.

1. Display the applied updates

   Execute the following command to display the applied updates:

```
C:\>uam showup
```

2. Remove the updates

   Execute the command below to remove the updates. If an update with the same update number was applied more than once, the updates are removed in order, starting from the highest version number.

```
C:\>uam remove -i update-number
```

Confirm service

The Windows Installer service must be running.

Determine the preferred WebAdmin configuration

Starting with Fujitsu Enterprise Postgres 9.5, WebAdmin can be installed in two configurations:

- Single-server
- Multiserver

See

Refer to "Appendix H Determining the Preferred WebAdmin Configuration" for details.

3.2 Pre-installation Considerations

The following describes the precautions before installation.

- The remote desktop service is installed in application server mode, it is necessary to switch to install mode by executing the command shown below before installation. Also, after the installation is completed, execute the command shown below to switch back to execute mode.

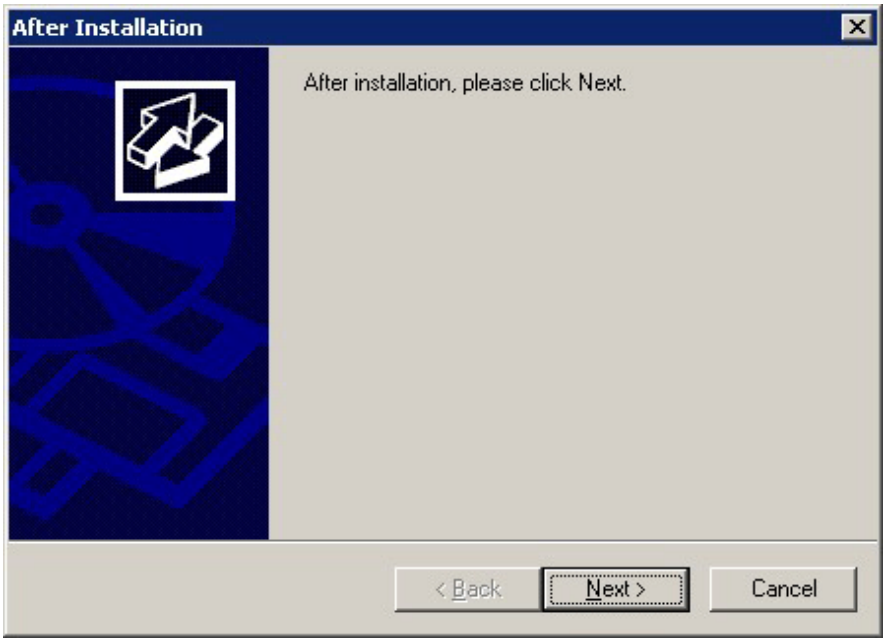
  [Before the installation]

```
CHANGE USER /INSTALL
```

  [After the installation]

```
CHANGE USER /EXECUTE
```

- The following window may be displayed when executing the installation program:



If this window is displayed, perform the following operations:

1. Perform the installation steps until the [Finish Install] window is displayed.
2. At the window shown above, click [Next].

3. The window shown below is displayed. Click [Finish].

Information

- If a [User Account Control] dialog box is displayed at the start of the installation, click [Yes] to continue processing:

  If [No] is clicked, permission to continue is denied and an [Error] dialog box will be displayed.
  To continue the installation, click [Retry] at the [Error] dialog box. To end the installation, click [Cancel].

- If installation is suspended or processing terminates abnormally, the [Program Compatibility Assistant] dialog box may be displayed. Click [This program installed correctly] and continue operation.

3.3 Installation in Interactive Mode

Describes an interactive installation.

For a new or multi-version installation

For installation in interactive mode, default values are set for the installation information. The following settings can be changed for a new installation or a multi-version installation:

- Installation destination
  - It is necessary to specify a local disk as the installation destination of Fujitsu Enterprise Postgres.
  - If using WebAdmin, do not use fullwidth characters or halfwidth katakana characters in [Installation destination folder].
- WebAdmin setup information, if WebAdmin is selected
  To change the port number, confirm that it is an unused port number between 1024 and 49151. Additionally, take note of the Web server port number for the Windows Firewall settings.

For Reinstallation

Back up the following folders that contain WebAdmin instance management information:

webAdminInstallFolder\data\fepwa

Follow the procedure below to perform the backup.

1. Stop the WebAdmin server. Refer to "B.1.4 Stopping the Web Server Feature of WebAdmin" for details.

2. Back up the following folder:

   webAdminInstallFolder\data\fepwa

Replace the above folder with the backed up folder when the reinstallation is complete.

Installation Instructions

The installation procedure is described below.

The installation must be performed by a user with administrator privileges (a user ID that belongs to the Administrators group).

You can set up WebAdmin during installation, but if you want WebAdmin to use the HTTPS protocol and perform client authentication, you must set it up again after installation is complete. Refer to "B.1 Setting Up WebAdmin" and perform WenAdmin setup again.

1. Stop applications and programs

When reinstalling the product, all applications and programs that use the product must be stopped.

Before starting the installation, stop the following:

- Applications that use the product
- Connection Manager
- Instance
- Web server feature of WebAdmin

  If you are using WebAdmin, stop WebAdmin.

  Refer to "B.1.4 Stopping the Web Server Feature of WebAdmin" for details.
- Mirroring Controller

  Execute the mc_ctl command with the stop mode option specified and stop the Mirroring Controller.

  Example

  ```
  > mc_ctl stop -M D:\mcdir\inst1
  ```
- pgAdmin

2. Inserting the DVD

Insert the Fujitsu Enterprise Postgres DVD into the drive.

3. Run the installation

The installation menu will be displayed. Click [Installation].

If the Autorun feature of Windows is disabled, or a remote desktop service (terminal service) is used, the installation program is not automatically started. Execute the following file using [Run] or Windows Explorer.

```
Z:\autorun.exe
```

Z: The drive into which the DVD is inserted.

4. Select the products to install

The [Installation product] window will be displayed.

Select the products to install, and then click [Next].

If a selected product can only be reinstalled, refer to "6. Check the settings".

Information

- To develop or execute a 32-bit application in a 64-bit environment, Fujitsu Enterprise Postgres Client (32bit) is required. When installing the Fujitsu Enterprise Postgres Client (32 bit), do not specify a destination folder under the environment ProgramFiles variable.
- The Fujitsu Enterprise Postgres server component and WebAdmin can be installed on the same machine by selecting the "Fujitsu Enterprise Postgres server component" and the "WebAdmin component".
- If the selected product has been installed, the [Select installation method] window is displayed for each product. To perform a multi-version installation, click [Next].

5. Checking the installation content

The [Confirm installation] window will be displayed.

Click [Next] to start the installation.

To modify the settings, select [Modify], and then click [Next]. Follow the on-screen instructions.

If using WebAdmin for operation, make a note of the Web server port number displayed in the settings, for use in the Windows firewall settings.

If you have not set up WebAdmin during installation, refer to "Appendix B Setting Up and Removing WebAdmin for details.

6. Check the settings

The [Confirm installation] window is displayed for reinstallation, or if the installation information is modified.

Click [Install] to start the installation.

To change any settings, click [Back].

7. Completing installation

The [Installation complete] window is displayed.

Click [Finish].

In [Start] menu, click [All apps], then [Fujitsu], and then [Uninstall (middleware)]. If the installed product names have been added under [Software Name], installation is complete.

The shortcuts displayed on the [Start] menu might be arranged differently depending on the operating system.

3.4 Installation in Silent Mode

Installation in silent mode can be performed only when the installation method is one of the following:

- New installation
- Multi-version installation

See

Refer to the Fujitsu Enterprise Postgres product website for information on installation in silent mode, such as the installation parameters and error messages.

Installation Instructions

The installation procedure is described below.

The installation must be performed by a user with administrator privileges (a user ID that belongs to the Administrators group).

You can set up WebAdmin during installation, but if you want WebAdmin to use the HTTPS protocol and perform client authentication, you must set it up again after installation is complete. Refer to "B.1 Setting Up WebAdmin" and perform WenAdmin setup again.

1. Insert the DVD

Insert the "server program" DVD in the DVD drive.

The [Install Menu] window will be displayed automatically. Click [Finish].

2. Create an installation parameters CSV file

Consider the features that will be required for system operations, and then create an installation parameters CSV file that uses the following specification format.

When installing the Fujitsu Enterprise Postgres Client (32 bit), do not specify a destination folder under the environment ProgramFiles variable.

If using WebAdmin for operation, make a note of the Web server port number displayed in the settings (the port number defined in WebPortNumber1), for use in the Windows firewall settings.

```
sectionName, parameterName, value
sectionName, parameterName, value
    :
```

Information

The template for the installation parameters CSV file is "*Z*:\sample\sample.csv" (*Z* is the drive into which the DVD is insered).

3. Start the command prompt

In Windows, right-click [Command Prompt] and then select [Run as administrator].

4. Run the installation

Execute the command below.

```
Z:\>silent.bat c:\temp\inspara.csv
```

Z: The drive into which the DVD is inserted.

Also in the example above, c:\temp\inspara.csv is the installation parameter CSV file name.

If the installer ends in an error, a message is output to the log file and return values are returned.

Chapter 4 Setup

This chapter describes the setup procedures to be performed after installation completes.

4.1 Operating Method Types and Selection

This section describes how to operate Fujitsu Enterprise Postgres.

There are two methods of managing Fujitsu Enterprise Postgres operations.

- Simple operation management using a WebAdmin (web-based GUI tool)

  Suitable when using frequently used basic settings and operations for operation management.

  This method allows you to perform simple daily tasks such as starting the system before beginning business, and stopping the system when business is over, using an intuitive operation.

- Advanced operation management using server commands

  Operations that use Fujitsu Enterprise Postgres or PostgreSQL server commands or server applications.

  When operating in a system that is automated by operation management middleware (Systemwalker Centric Manager, for example), this method allows you to use more detailed settings and operations and perform higher level operation management.

  Refer to Reference and the PostgreSQL Documentation for information on server commands and server applications.

Select one that suits your purposes.

How WebAdmin and Server Commands Work

Here are the differences between using WebAdmin and server commands:

Operation		Operation with the WebAdmin	Operation with commands
Setup	Creating an instance	The server machine capacity, and the optimum parameter for operations using WebAdmin, are set automatically. Instances that you create and manage in WebAdmin are registered in the WebAdmin administrative information, so you must delete the instance from WebAdmin.	The configuration file is edited directly using the initdb command.
	Creating a standby instance	WebAdmin performs a base backup of the source instance and creates a standby instance.	A standby instance is created using the pg_basebackup command.
	Changing the configuration files	You can change the values in the configuration file on the WebAdmin screen.	The configuration file is edited directly.
Starting and stopping an instance		You can start and stop with one click from the WebAdmin screen.	The net command or sc command of the operating system is used.
Creating a database		This is defined using pgAdmin of the GUI tool, or using the psql command or the application after specifying the DDL statement.	
Backing up the database		WebAdmin, or the pgx_dmpall command, is used. It cannot be used interchangeably with operation using server commands or server applications. If	It is recommended that the pgx_dmpall command be used. Recovery to the latest database can be performed.

Operation		Operation with the WebAdmin	Operation with commands
		used, WebAdmin will not be able to properly manage the instance. If you are backing up by using the copy command with the pgx_dmpall command, select the command operation method.	
Database recovery		You can recover using a backup taken with WebAdmin or the pgx_dmpall command.	To use the backup that was performed using the pgx_dmpall command, the pgx_rcvall command is used.
Monitoring	Database errors	The status in the WebAdmin window can be checked. (*1)	The messages that are output to the database server log are monitored (*1)
	Disk space	The status in the WebAdmin window can be checked. A warning will be displayed if the free space falls below 20%. (*1)	This is monitored using the fsutil command (check free space), and the dir command (check used space), of the operating system, for example. (*1)
	Connection status	This can be checked using pgAdmin of the GUI tool, or referencing pg_stat_activity of the standard statistics view from psql or the application.	

*1: This can be used together with system log monitoring using operations management middleware (Systemwalker Centric Manager, for example).

See

Refer to "Periodic Operations" and "Actions when an Error Occurs" in the Operation Guide for information on monitoring and database recovery.

4.2 Preparations for Setup

This section describes the preparation required before setting up Fujitsu Enterprise Postgres.

4.2.1 Creating an Instance Administrator

Decide the OS user account that will become the instance administrator. Use either a new user, or a user that already exists.To create a user in Windows, select [Administrative Tools], [Computer Management], and then create the user in [Local Users and Groups]. Refer to "Help and Support" for details.

The following characters can be used for user names:

- - (hyphen)
- _ (underscore)
- Space
- A-Z, a-z, 0-9 (alphanumeric)

When using WebAdmin

- The instance administrator must have a local OS user account.
- After creating the user account of the instance administrator, log in to the operating system. A profile directory is created for the user when logging in to the operating system for the first time. This directory will be used by WebAdmin.

- If changing the password for the user account of the instance administrator, always ensure to stop the instance and log out of WebAdmin before making the change. If you mistakenly change the password while logged in to WebAdmin or while the instance is running, log out from WebAdmin, and then log in again, and stop and start the instance.
- If you change the password for the OS user account, use ALTER ROLE WITH PASSWORD to change the instance administrator password as well.

4.2.1.1 Security policy settings

If using commands for operation, security settings that allow logon as a service are required for the operating system user account of the instance administrator in order to start and stop an instance using a Windows service.

If using WebAdmin for operation, these settings are not required as WebAdmin performs the settings automatically for the user ID (operating system user account) that logged in to the database server.

The following explains how to perform the security settings to allow logon as a service:

1. Displaying the Local Security Policy window

   In Windows, select [Administrative Tools], and then click [Local Security Policy].

2. Setting up security

   1. In the [Local Security Policy] window, select [Security Settings], select [Local Policies], and then click [User Rights Assignment].
   2. Under [Policy] in the [User Rights Assignment] window, double-click [Log on as a service].
   3. In the [Log on as a service Properties] window, set the following:
      a. Select the [Local Security Setting] tab.
      b. On the [Local Security Setting] tab, click [Add User or Group].
      c. In the [Select Users or Groups] window, enter the operating system user account of the instance administrator in [Enter the object names to select].
      d. Click [OK].
   4. In the [Log on as a service Properties] window, click [OK].

4.2.2 Preparing Directories for Resource Deployment

Prepare the directories required when creating instances.

If anti-virus software is used, set scan exception settings for folders so that none of the server resources that comprise Fujitsu Enterprise Postgres are scanned for viruses. Alternatively, if the server resources that comprise Fujitsu Enterprise Postgres are to be scanned for viruses, stop the instance and perform the scan when tasks that use Fujitsu Enterprise Postgres are not operating.

Considerations when deploying resources

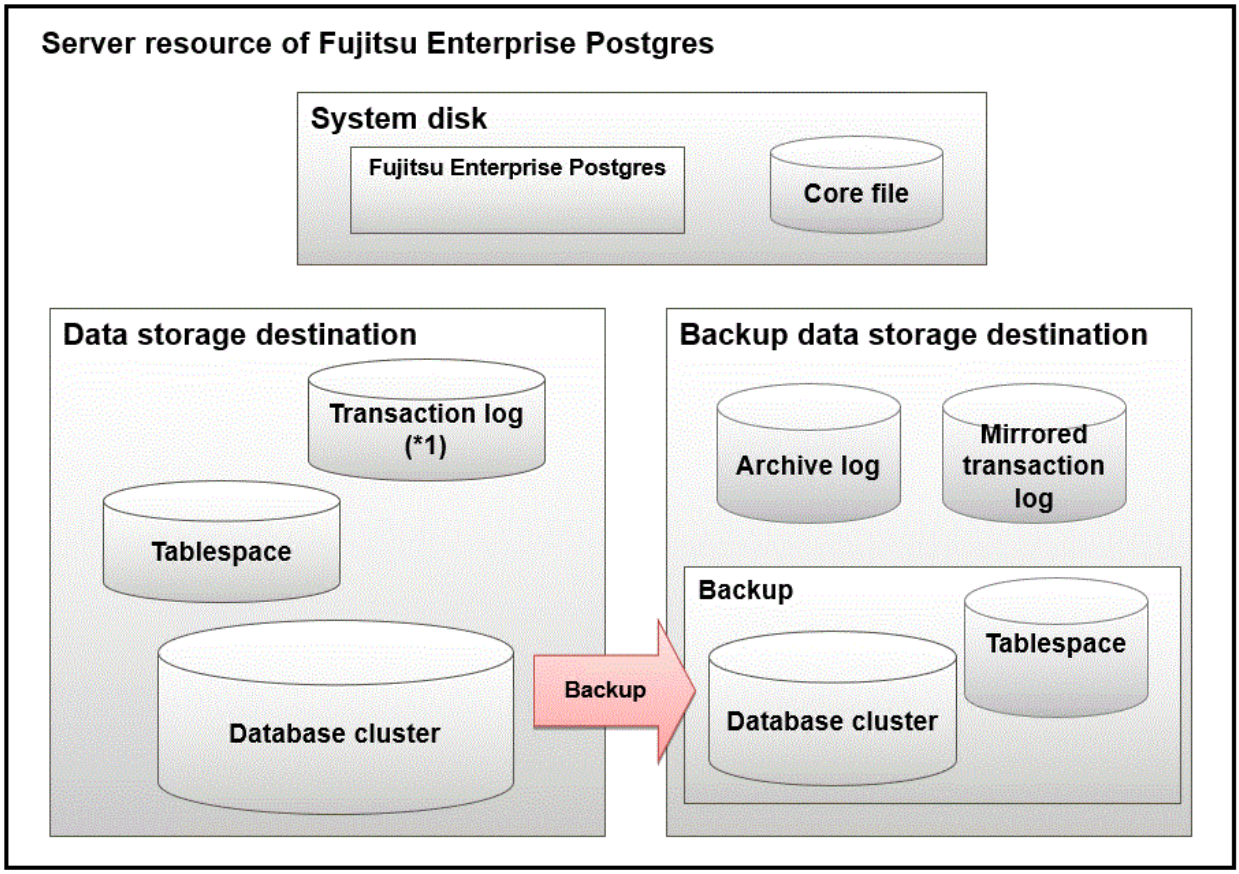
The disk configuration on the resource deployment destination is important, because it affects not only recovery following disk corruption, but normal operation as well. The points for determining the disk configuration are as follows:

1. If the backup data storage destination and the data storage destination are both lost, it will not be possible to recover the data, so deploy them to separate disks.
2. To shorten the recovery time following a single disk fault, deploy the system disk and data storage destination to separate disks.
3. The backup data storage destination requires at least double the capacity of the data storage destination, so deploy it to the disk with the most space available.
4. When large amounts of data are updated, the write-to load for the data storage destination, transaction log storage destination, and backup data storage destination (mirrored transaction log) will also be great. For this reason, deploy them to separate disks, out of consideration for performance.

Information

If you choose to place the archive log and mirrored transaction log (mirrored WAL) on a disk that is separate from the backup data storage destination, keep the following points in mind:

- Recovery requires not only the backup data, but also the archive log and mirrored transaction log (mirrored WAL). Therefore, make sure that these items can be stored together.
- Note that the permissions and mount state are the same at the time of the recovery as they were at the time of the backup. Make the archive log and mirrored transaction log (mirrored WAL) available before starting the recovery.



*1: To distribute the I/O load, place the transaction log on a different disk from the data storage destination.

Resource	Role
Database cluster	The area where the database is stored. It is a collection of databases managed by an instance.
Tablespace	Stores table files and index files in a separate area from the database cluster. Specify a space other than that under the database cluster.
Transaction log	Stores log information in preparation for a crash recovery or rollback. This is the same as the WAL (Write Ahead Log).
Archive log	Stores log information for recovery
Mirrored transaction log (mirrored WAL)	Enables a database cluster to be restored to the state immediately before an error even if both the database cluster and transaction log fail when

Resource	Role
	performing backup/recovery operations using the pgx_dmpall command or WebAdmin.
Corefile	Fujitsu Enterprise Postgres process corefile output when an error occurs with a Fujitsu Enterprise Postgres process.

Examples of disk deployment

The following are examples of disk deployment:

Number of disks	Disk	Deployment
3	System disk	Fujitsu Enterprise Postgres program
		Corefile
	Connected physical disk	Data storage destination, transaction log storage destination
	Connected physical disk	Backup data storage destination
2	System disk	Fujitsu Enterprise Postgres program
		Corefile
		Data storage destination, transaction log storage destination
	Connected physical disk	Backup data storage destination

Preparing directories

You cannot use directories mounted over the network.
Examples include NFS (Network File System) and CIFS (Common Internet File System).
Do not use these directories unless you are creating tablespaces on a storage device on your network.

The directories to be prepared depend on the way that you create the instances.

Using WebAdmin

For WebAdmin, WebAdmin automatically creates the directory during instance creation.

Directory	Description
Data storage destination	Specify in the GUI.
Backup data storage destination	Specify in the GUI. Place them on a disk different from the data storage destination.
Transaction log storage destination	Specify in the GUI. The default is to create in a directory in the data storage destination. When it is necessary to distribute the I/O load for the database data and the transaction log, consider putting the transaction log storage destination on a different disk from the data storage destination
Corefile output destination	WebAdmin generates it automatically, so no specification is required. For more information about directories, refer to "Directory for Core File Output when Using WebAdmin".

Directory for Core File Output when Using WebAdmin

The corefile path is as follows:

```
userProfileFolder\localSettingsFolder\Fujitsu\fsep_productVersion_WA_architecture
\instanceNamePortNumber\core
```

product version

Contains the version of the Server Product Type that WebAdmin specifies when creating an instance.

If you manage multiple versions, the fsep_version directory is created for as many versions as you manage.

PortNumber

Contains the port number of the database server specified when the instance was created.

Example:

```
C:\Users\naomi\AppData\Local\Fujitsu\fsep_170_WA_64\myinst27599\core
```

To change the output destination, specify in the core_directory parameter and core_contents parameter in postgresql.conf. Refer to "Parameters" in the Operation Guide for information on the settings for these parameters.

Using the initdb Command

For the inidb command, prepare the directory in advance.

The directories to prepare in advance are:

Directory to be prepared	Required / Optional
Data storage destination	Required
Backup data storage destination	Optional
Transaction log storage destination	Optional
Corefile output destination	Optional

Confirm and configure directory access permissions

If the instance administrator user has "Administrator" permissions (user ID belonging to the Administrators group), it is necessary to configure the settings so that each directory inherits the file and directory access permissions for the instance administrator user.

Therefore, ensure that the setting to inherit permissions has been configured.

The following is an explanation on how to confirm and configure the settings.

How to confirm access permissions

Perform the following operations in Windows Explorer on the directories to be prepared in advance:

1. Right-click on the applicable directory, and then click [Properties] from the menu that is displayed.
2. In the [*applicableDir* Properties] window, select [Security] >> [Advanced].
3. In the [Advanced Security Settings for *applicableDir*] window, and in the [Permission entries] list under the [Permissions] tab, confirm that [Applies to] for the instance administrator user is "This folder, subfolders and files".
4. Click [OK].

How to configure the access permissions

Perform the following operations in Windows Explorer if there are any directories that have not been configured for the access permissions to be inherited.

1. Right-click on the applicable directory, and then click [Properties] from the menu that is displayed.
2. In the [*applicableDir* Properties] window, select [Security] >> [Advanced].
3. In the [Advanced Security Settings for *applicableDir*] window, click [Add].
4. In the [Permission Entry for *applicableDir*] window, click [Select a principal].
5. In the [Select User or Group] window, enter the instance administrator user name as the object name to select, and then click [OK].
6. In the [Permission Entry for *applicableDir*] window, set [This folder, subfolders and files] for [Applies to:], and under [Basic permissions], allow read and write permissions, and then click [OK].

7. In the [Advanced Security Settings for *applicableDir*] window, confirm that the instance administrator user has been added, with [This folder, subfolders and files] set for [Applies to] in the [Permission entries] list.

8. Click [OK].

Information

The access permissions can also be configured using the icacls command provided by the operating system.

The following is an execution example in which the application destination is set to "(OI)(CI)" and the access permissions are set to "(F) (Full access permissions)" when the data storage destination is "D:\database\inst1" and the instance administrator user is "fsepuser":

```
>icacls D:\database\inst1 /grant fsepuser:(OI)(CI)(F)
processed file: D:\database\inst1
Successfully processed 1 files; Failed processing 0 files
```

4.2.3 Estimating Resources

Estimate the resources to be used on the Fujitsu Enterprise Postgres.

Refer to "Appendix E Estimating Database Disk Space Requirements" for information on estimating database disk space requirements.

Refer to "Parameters automatically set by WebAdmin according to the amount of memory" when creating multiple instances with WebAdmin.

Refer to "Appendix F Estimating Memory Requirements" when creating instances with the initdb command, to estimate memory usage.

4.2.4 Windows Firewall Settings

This section explains the Windows firewall settings required if using WebAdmin for operation.

These settings are not required if using server commands for operation.

If the Windows firewall feature is to be enabled, you should enable a port number on the Web server. The following explains how to enable a port number:

Windows Server(R) 2016:

1. Select [Systems and Security] from [Control Panel] and click [Windows Firewall].
2. In the [Windows Firewall] window, click [Advanced settings].
3. In the [Windows Firewall with Advanced Security] window, click [Inbound Rules] on the left side of the window.
4. Click [New Rule] on the right side of the window.
5. In the [New Inbound Rule Wizard] window, select [Port], and then click [Next].
6. Select [TCP] and [Specific local ports], then specify the Web server port number specified during the WebAdmin setup, and then click [Next].
7. Select [Allow the connection], and then click [Next].
8. Select the profiles for which this rule applies, and then click [Next].
9. In [Name], specify the desired name, and then click [Finish].
10. In the [Windows Firewall with Advanced Security] window, check if the added rule is enabled under [Inbound Rules] in the center of the window.

In cases other than the above:

1. Select [Systems and Security] from [Control Panel] and click [Windows Defender Firewall].
2. In the [Windows Defender Firewall] window, click [Advanced settings].

3. In the [Windows Defender Firewall with Advanced Security] window, click [Inbound Rules] on the left side of the window.
4. Click [New Rule] on the right side of the window.
5. In the [New Inbound Rule Wizard] window, select [Port], and then click [Next].
6. Select [TCP] and [Specific local ports], then specify the Web server port number specified during the WebAdmin setup, and then click [Next].
7. Select [Allow the connection], and then click [Next].
8. Select the profiles for which this rule applies, and then click [Next].
9. In [Name], specify the desired name, and then click [Finish].
10. In the [Windows Defender Firewall with Advanced Security] window, check if the added rule is enabled under [Inbound Rules] in the center of the window.

4.2.5 Preparing for Output to the Event Log

This subsection describes the preparation operations for using commands and outputting error logs to the event log.If outputting error logs to the event log, you should register an event source name beforehand.

If you do not register an event source name, the message content output to the event log may be incomplete.

Due to the default event source name "FUJITSU Enterprise Postgres Server" being output to the event log when using the following commands, you should register this default event source name beforehand:

- pg_ctl command
- pgx_dmpall command
- pgx_rcvall command

The following is an example in which the DLL of a 64-bit product is registered under the default event source name:

```
> regsvr32  "C:\Program Files\Fujitsu\fsepv<x>server64\lib\pgevent.dll"
```

If using multiple instances

You can output messages corresponding to the event source name assigned by the user, so that messages output to the event log can be identified by instance.

The following is an example in which the DLL of a 64-bit product is registered under the event source name "Fujitsu Enterprise Postgres inst1":

```
> regsvr32 /n /i:"Fujitsu Enterprise Postgres inst1" "C:\Program Files\Fujitsu\fsepv<x>server64\lib
\pgevent.dll"
```

You will need to edit the parameters for each instance, therefore, after creating an instance, refer to "4.5.1 Error Log Settings" when performing this setting.

If installing multiple versions

If Fujitsu Enterprise Postgres is already installed on the same machine, search for the key below in Registry Editor, and make a note of the path of the registered DLL. Afterwards, register a new DLL under the default event source name.

Use the DLL path that you made a note of in the above step when re-registering the default event source name during an uninstall.

`FUJITSU Enterprise Postgres Server`

See

Refer to "Registering Event Log on Windows" in "Server Setup and Operation" in the PostgreSQL Documentation for information on how to register event source names.

4.3 Creating Instances

There are two methods that can be used to create an instance:

- 4.3.1 Using WebAdmin
- 4.3.2 Using the initdb Command

Refer to "4.5.2 Configuring Automatic Start and Stop of an Instance" for information on how to start and stop the operating system of the database server, and how to start and stop linked instances.

4.3.1 Using WebAdmin

This section describes how to create an instance using WebAdmin.

WebAdmin must be set up correctly before it can be used. Refer to "B.1 Setting Up WebAdmin" for details. Additionally, if WebAdmin needs to be configured to use an external repository database, refer to "B.3 Using an External Repository for WebAdmin" for details.

4.3.1.1 Before Using WebAdmin

Learn what you need to know before using WebAdmin.

Recommended Browser

- Microsoft Edge

WebAdmin will work with other browsers, such as Firefox and Chrome, however, the look and feel may be different.

Configure your browser to allow cookies and pop-up requests from the server on which Fujitsu Enterprise Postgres is installed. Refer to "Appendix A Recommended WebAdmin Environments" for information on how to change the pop-up request settings and other recommended settings.

Notes on operations

- It will not work correctly if you operate the same instance from multiple WebAdmin screens at the same time.
- If you want to manage multiple versions of an instance, operate with the latest version of WebAdmin.
- It is recommended not to use the browser [Back] and [Forward] navigation buttons, the [Refresh] button, and context-sensitive menus, including equivalent keyboard shortcuts.
- Do not copy and paste or bookmark the URL of the WebAdmin login screen and skip directly.

Considerations for Using Transparent Data Encryption

After you create an instance in WebAdmin, follow the documentation for each feature in the Operation Guide for additional setup tasks.

About the PostgreSQL Configuration File Relationship

When creating or importing an instance in WebAdmin, set the log_directory parameter in postgresql.conf in the following format:

log_directory='userProfileFolder\\localSettingsFolder\\Fujitsu\\fsep_version\\instanceNamePortNumber\\log'

Example: userProfileFolder\\localSettingsFolder will be C:\\Users\\userName\\AppData\\Local.

4.3.1.2 Logging in to WebAdmin

This section describes how to log in to WebAdmin.

Startup URL for WebAdmin

In the browser address bar, type the startup URL of the WebAdmin window in the following format:

```
http://hostNameOrIpAddress:portNumber/
```

- *hostNameOrIpAddress*: Host name or IP address of the server where WebAdmin is installed
- *portNumber*: Port number of WebAdmin. The default port number is 27515.

The startup screen is displayed. From this window you can log in to WebAdmin or access the product documentation.

Logging in to WebAdmin

Click [Launch WebAdmin] in the startup URL window to start WebAdmin and display the login window. Enter the instance administrator user name (operating system user account name) and password, and log in to WebAdmin. User credential (instance administrator user ID and password) should not contain hazardous characters. Refer to "Appendix C WebAdmin Disallow User Inputs Containing Hazardous Characters".

If you set the account lock for login failure, login failure from WebAdmin might lock the account and prevent you from logging in to the OS. Check the account lock settings in advance.

4.3.1.3 Creating an Instance

This section describes how to create an instance.

Information

WebAdmin automatically sets the memory usage assuming you create one instance per machine. If you are creating multiple instances on a single machine, refer to "Parameters automatically set by WebAdmin according to the amount of memory" to adjust the memory usage after the instance is created.

1. Start WebAdmin, and log in to the database server.
2. In the [Instances] tab, click  .
3. Enter the information for the instance to be created.

   Enter the following items:

   [Host name] and [Operating system credential] should not contain hazardous characters. Refer to "Appendix C WebAdmin Disallow User Inputs Containing Hazardous Characters".

   - [Configuration type]: Whether to create a standalone instance or an instance that is part of a cluster.
   - [Server product type]: Sets which of the following instances to create:
     - Fujitsu Enterprise Postgres 9.5 Instances
     - Fujitsu Enterprise Postgres 9.6 Instances
     - Fujitsu Enterprise Postgres 10 Instances
     - Fujitsu Enterprise Postgres 11 Instances
     - Fujitsu Enterprise Postgres 12 Instances
     - Fujitsu Enterprise Postgres 13 Instances
     - Fujitsu Enterprise Postgres 14 Instances
     - Fujitsu Enterprise Postgres 15 Instances
     - Fujitsu Enterprise Postgres 16 Instances
     - Fujitsu Enterprise Postgres 17 Instances

   The default is "Fujitsu Enterprise Postgres 17".

- [Location]: Whether to create the instance in the server that the current user is logged into, or in a remote server. The default is "Local", which will create the instance in the server machine where WebAdmin is currently running.
- [Instance name]: Name of the database instance to manage

  The name must meet the conditions below:

  - Maximum of 16 characters
  - The first character must be an ASCII alphabetic character
  - The other characters must be ASCII alphanumeric characters
- [Instance port]: Port number of the database server
- [Data storage path]: Directory where the database data will be stored
- [Backup]: Whether to enable or disable the WebAdmin backup feature. The default is "Enabled". Select "Disabled" to disable all backup and restore functionality for the instance. If "Enabled" is selected, enter the following item:
  - [Backup storage path]: Directory where the database backup will be stored
- [Transaction log path]: Directory where the transaction log will be stored
- [Encoding]: Database encoding system
- [WAL file size]: Allow the WAL file size to be set when creating an instance. The default is 16 MB if the field is blank. The size specified must be a power of 2 between 1 and 1024. This option is not available for standby instances.

If "Remote" is selected for [Location], enter the following additional items:

- [Host name]: Name of the host where the instance is to be created
- [Operating system credential]: Operating system user name and password for the remote machine where the instance is to be created
- [Remote WebAdmin port for standalone]: Port in which WebAdmin is accessible in the remote machine

4. Click  to create the instance.

   If the instance is created successfully, a message indicating the same will be displayed.

5. The instance will be started when it is created successfully.

   The following message is output during startup of an instance when the startup process is operating normally, therefore, the user does not need to be aware of this message.

   ```
   FATAL:  the database system is starting up
   ```

6. Back up the basic information that was set

   Back up the WebAdmin management information periodically to ensure operational continuity when a fault occurs on the system disk. Follow the procedure below to perform the backup.

   a. Stop the WebAdmin server. Refer to "B.1.4 Stopping the Web Server Feature of WebAdmin" for details.

   b. Back up the following directory:

      webAdminInstallDir\data\fepwa

   Note that if you are using an external database as your WebAdmin repository, you must also back up the following:

   - *webAdminInstallDir*\data\remotemetadb.conf
   - Use the database features to back up external databases (if they are created on the system disk).

If the instance create was successful

When an instance that uses WebAdmin is created successfully, the following Windows service is registered:

`fsep_version_WA_architecture_userName_instanceNamePortNumber`

The account and password of the instance administrator are registered in the Windows service.
If the password for this account is changed, you must also change the password registered in the service.
Change this at the Properties window registered in the Windows service.

4.3.1.4 Changing Instance Settings

You can change the information that is set when an instance is created.

Change the following settings to suit the operating and management environment for Fujitsu Enterprise Postgres. Note that this cannot be changed for instances of FUJITSU Enterprise Postgres 9.5.

- Instance configuration
  - Character encoding
  - Communication
  - SQL options
  - Memory
  - Streaming replication
- Changing client authentication information
- Editing instance information

Information

- These settings are the same as the parameters that can be set in the files shown below. Refer to "Appendix D Configuring Parameters" for information on the equivalence relationship between the item name and the parameter.
  - postgresql.conf
  - pg_hba.conf
- When [Instance name] or [Instance port] is modified, the log_directory and core_directory parameters in postgresql.conf are updated. Also, the specified directories are created if they do not exist. Refer to "4.3.1.5 Importing Instances" for information on the format of these directories.

4.3.1.4.1 Instance configuration

1. Start WebAdmin and log in to the database server.
2. In the [Instances] tab, click  .
3. Click  to change the configuration.
4. Click  to save your changes.

See

Select a client-side encoding system that can be converted to/from the database encoding system. Refer to "Automatic Character Set Conversion Between Server and Client" in "Server Administration" in the "PostgreSQL Documentation" for information on the encoding system combinations that can be converted.

4.3.1.4.2 Changing client authentication information

1. Start WebAdmin and log in to the database server.
2. In the [Instances] tab, click  .

   Click  to register new authentication information.

To change authentication information, select the information, and then click  .

To delete authentication information, select the information, and then click  .

Notes on changing client authentication information

When creating the instance, do not delete the entry below, because it is a connection required for WebAdmin to monitor the operational status of the database:
Type= host, Database=all, User=all, and Method=md5

4.3.1.4.3 Editing instance information

Use the [Edit instance] page to modify the following items for an instance:

- Instance name
- Port number
- Backup storage path

1. In the [Instances] tab, click  . The [Edit instance] page is displayed.
2. Modify the relevant items.

   If [Backup storage path] is changed, [Backup management] is enabled. Select the required option:

   - Retain existing backup: Create a backup in [Backup storage path] and retain the existing backup in its original location.
   - Copy existing backup to new path: Copy the existing backup to [Backup storage path]. A new backup will not be created. The existing backup will be retained in its original location.
   - Move existing backup to new path: Move the existing backup to [Backup storage path]. A new backup will not be created.
   - Remove existing backup: Create a backup in [Backup storage path]. The existing backup will be removed.
3. Click  to save your changes.

4.3.1.5 Importing Instances

Instances can be created using WebAdmin, or via the command line using the initdb command. Instances created using the initdb command (command line instances) can be managed using WebAdmin, however, they must first be imported into WebAdmin.

You cannot import instances that use the Mirroring Controller.

Advance Preparation

- If the following file contains records that span multiple lines, change the record to a single line before importing.
  - pg_hba.conf
  - pg_ident.conf
- You must make the following changes to the parameters in postgresql.conf prior to importing the instance in WebAdmin.

Parameter	Requirements
port	The port parameter should be uncommented.

- Delete the values specified for the following parameters. Also, if you have changed the value of the parameter (where the file is stored) from the default, move the file to the data storage directory before importing it.
  - hba_file parameter (pg_hba.conf)
  - ident_file parameter (pg_ident.conf)

Import

This section explains how to import command line instances into WebAdmin.

1. In the [Instances] tab, click  . The [Import instance] page is displayed.
2. Enter the information for the instance being imported. Refer to "4.3.1.3 Creating an Instance" for information on the items that need to be entered.
3. Click  to import the instance.

If the instance import was successful

A Windows service is automatically registered when an instance is imported into WebAdmin. If a Windows service was registered by the user prior to importing the instance, that service will not be deleted. After importing the instance into WebAdmin, it is recommended to discontinue the use of the user-created service.

 Information

The log_directory and core_directory parameters in postgresql.conf are updated during import. Also, the specified directories are created if they do not exist.
The format of these directories is as follows:

```
log_directory: 'userProfileFolder\\localSettingsFolder\\Fujitsu\\fsep_version\\instanceNamePortNumber
\\log'

core_directory:
userProfileFolder\\localSettingsFolder\\Fujitsu\\fsep_version\\instanceNamePortNumber\\core'


    version: product version_WA_architecture
    PortNumber: port number specified when creating the instance
```

Examples:
log_directory: 'C:\\Users\\naomi\\AppData\\Local\\Fujitsu\\fsep_170_WA_64\\myinst27599\\log'
core_directory: 'C:\\Users\\naomi\\AppData\\Local\\Fujitsu\\fsep_170_WA_64\\myinst27599\\core'

4.3.2 Using the initdb Command

This section describes the procedure to create an instance using the initdb command.

Instances created using the initdb command (command line instances) can be managed using WebAdmin, however, they must first be imported into WebAdmin. Refer to "4.3.1.5 Importing Instances" for details.

4.3.2.1 Creating an Instance

Create an instance, with the database cluster storage destination specified in the PGDATA environment variable or in the -D option. Furthermore, the user that executed the initdb command becomes the instance administrator.

 See

Refer to "initdb" in "Reference" in the PostgreSQL Documentation for information on the initdb command.

The procedure to create an instance is described below.

1. Use the OS user account that you want as the instance administrator.

   Connect with the server using the OS user account that you want as the instance administrator.

2. Configure the environment variables

   Configure the environment variables in the server with the newly created instance.

Set the following environment variables:

- PATH environment variables

  Add installDir\bin and installDir\lib.

Example

The following is a setting example for environment variables in which "C:\Program Files\Fujitsu\fsepv<*x*>server64" is used as the installation folder:

Note that "<*x*>" indicates the product version.

```
> SET PATH=C:\Program Files\Fujitsu\fsepv<x>server64\bin;C:\Program Files\Fujitsu
\fsepv<x>server64\lib;%PATH%
```

3. Create a database cluster

Create the database cluster with the initdb command, specifying the storage destination directory.

Specify the transaction log storage destination and the locale setting option as required.

If creating multiple instances, ensure that there is no duplication of directories that store database clusters.

Example

```
> initdb -D D:\database\inst1 --waldir=E:\transaction\inst1 --lc-collate="C" --lc-ctype="C" --
encoding=UTF8
```

- In some features, instance names are requested, and those names are required to uniquely identify the instance within the system. These features allow names that conform to WebAdmin naming conventions, so refer to the following points when determining the names:
  - Maximum of 16 characters
  - The first character must be ASCII alphabetic character
  - The other characters must be ASCII alphanumeric characters
- Messages may not display correctly if a value other than "C" is specified as the display language for messages.
- Specify "C" for collation and character category. Performance deteriorates if you specify a value other than "C" , although the behavior will follow the rules for particular languages, countries and regions. Furthermore, this may need to be revised when running applications on systems with different locales.
  For example, specify as follows:

  ```
  initdb --locale="C" --lc-messages="C"
  initdb --lc-collate="C" --lc-ctype="C"
  ```

- Specify an encoding system other than SQL_ASCII for the database. If SQL_ASCII is used, there is no guarantee that the encryption system for data in the database will be consistent, depending on the application used to insert the data.

See

Refer to "Locale Support" in "Localization" in "Server Administration" in the PostgreSQL Documentation for information on locales.

4. Set port number.

Specify a port number in the port parameter of postgresql.conf. Ensure that the specified port number is not already used for other software. If creating multiple instances, ensure that there is no duplication of port numbers.

If a port number is not specified, "27500" is selected.

Register the specified port numbers in the C:\Windows\System32\drivers\etc\services file if WebAdmin is used to create other instances. WebAdmin uses the services file to check if port numbers specified as available candidates have been duplicated.

Register any name as the service name.

Make a note of the port number for use in the Windows firewall settings.

5. Set the corefile output destination.

   Specify the output destination of the corefile, which can later be used to collect information for investigation, by setting the core_directory and core_contents parameters of postgresql.conf.

   See

   Refer to "Parameters" in the Operation Guide for information on the settings for these parameters.

6. Set the backup storage destination.

   Specify the backup data storage destination and other backup settings when backup is to be performed as a provision against database errors.

   See

   Refer to "Backup Methods" in the Operation Guide for information on specifying backup settings.

7. Register an instance in the Windows service

   Use the register mode of the pg_ctl command to register an instance in the Windows service.

   Specify the service name, user name, password and path to the instance in the pg_ctl command, and register the instance in the Windows service.

   This command must be executed by an instance administrator user with administrator privileges. Execute the command from the [Administrator: Command Prompt] window. Right-click [Command Prompt], and then select [Run as administrator] from the menu to display the [Administrator: Command Prompt] window.

   Example

   The following is a setting example, in which the service name to register is "inst1", the user name is "fepuser", and the storage destination directory of the database cluster is "D:\database\inst1":

   ```
   > pg_ctl register -N "inst1" -U fepuser -P ******** -D D:\database\inst1
   ```

   For the following reasons, a user name and password must always be specified:

   - Because the Windows service is started up by the Network Service account, all user resources are created as resources of that account. This can result in error events such as failing to access database resources and not being able to perform backups/recovery.
     Note that if not specifying a user name and password for security reasons, you should specify the account from the Windows services list immediately after registering the instance in Windows services.

   Commands such as sc query can be used to check the registration status.

8. Start an instance

   Use the following procedure to start the service:

   a. Display the [Services] window.

      In Windows, select [Administrative Tools], and then click [Services].

   b. Start the service

      From the services list, select the instance name that you wish to start, and click [Start Service].

If using commands to start the service, specify the service name using either the net start command or sc start command from the command prompt.

4.4 Configuring Remote Connections

This section describes the settings required when connecting remotely to Fujitsu Enterprise Postgres from a database application or a client command.

4.4.1 When an Instance was Created with WebAdmin

Settings related to connection

The default is to accept connections from remote computers to the database.

Change "listen_addresses" in postgresql.conf to modify the default behavior.

Refer to "Appendix D Configuring Parameters" for information on postgresql.conf.

Client Authentication Information settings

The following content is set by default when WebAdmin is used to create an instance.

- Authentication of remote connections from local machines is performed.

When changing Client Authentication Information, select [Client Authentication] from [Setting], and then change the settings.

4.4.2 When an Instance was Created with the initdb Command

Connection settings

The default setting only permits local connections from the client to the database. Remote connections are not accepted.

Change "listen_addresses" in postgresql.conf to perform remote connection.

All remote connections will be allowed when changed as shown below.

Example

```
listen_addresses = '*'
```

Also, configure the parameters shown below in accordance with the applications and number of client command connections.

Parameter name	Parameter description
superuser_reserved_connections	Number of connections reserved for database maintenance, for example backup or index rebuilding. If you need to simultaneously perform a large number of processes that exceed the default value, change this value accordingly.
max_connections	Set the value as: *numberOfSimultaneousConnectionsToInstance* + superuser_reserved_connections

Client authentication information settings

When trying to connect from a client to a database, settings are required to determine whether the instance permits connections from the client - if it does, then it is possible to make settings to determine if authentication is required.

See

Refer to "The pg_hba.conf File" in "Server Administration" in the PostgreSQL Documentation for details.

4.4.3 Windows Firewall Settings

If the Windows firewall feature is to be enabled, you should enable a port number on the database server. The following explains how to enable a port number:

Windows Server(R) 2016:

1. Select [Systems and Security] from [Control Panel] and click [Windows Firewall].
2. In the [Windows Firewall] window, click [Advanced settings].
3. In the [Windows Firewall with Advanced Security] window, click [Inbound Rules] on the left side of the window.
4. Click [New Rule] on the right side of the window.
5. In the [New Inbound Rule Wizard] window, select [Port], and then click [Next].
6. Select [TCP] and [Specific local ports], then specify the Web server port number specified during the WebAdmin setup, and then click [Next].
7. Select [Allow the connection], and then click [Next].
8. Select the profiles for which this rule applies, and then click [Next].
9. In [Name], specify the desired name, and then click [Finish].
10. In the [Windows Firewall with Advanced Security] window, check if the added rule is enabled under [Inbound Rules] in the center of the window.

In cases other than the above:

1. Select [Systems and Security] from [Control Panel] and click [Windows Defender Firewall].
2. In the [Windows Defender Firewall] window, click [Advanced settings].
3. In the [Windows Defender Firewall with Advanced Security] window, click [Inbound Rules] on the left side of the window.
4. Click [New Rule] on the right side of the window.
5. In the [New Inbound Rule Wizard] window, select [Port], and then click [Next].
6. Select [TCP] and [Specific local ports], then specify the Web server port number specified during the WebAdmin setup, and then click [Next].
7. Select [Allow the connection], and then click [Next].
8. Select the profiles for which this rule applies, and then click [Next].
9. In [Name], specify the desired name, and then click [Finish].
10. In the [Windows Defender Firewall with Advanced Security] window, check if the added rule is enabled under [Inbound Rules] in the center of the window.

4.5 Other Settings

This section describes settings that are useful for operations.

4.5.1 Error Log Settings

This section explains the settings necessary to monitor errors in applications and operations, and to make discovering the causes easier.

Make error log settings only when instances are created with the initdb command.

When creating instances with WebAdmin, these settings are already made and hence do not need to be set. Furthermore, some parameters are used by WebAdmin, and if changed, may cause WebAdmin to no longer work properly. Refer to "Appendix D Configuring Parameters" for details.

Edit the following parameters in postgresql.conf:

Parameter name	Parameter description	How to enable the settings
event_source	Specify the event source name to be attached to messages, for identifying messages output to the event log when using multiple instances.	- Restart services from the Windows services window. - Use the net command or sc command to stop and start services.
logging_collector	Specify "on" to ensure that messages are output by Fujitsu Enterprise Postgres to the server log file. The server log file is created in the log directory in the database cluster.	- Restart services from the Windows services window. - Use the net command or sc command to stop and start services.
log_destination	Specify " stderr, eventlog" to output messages from Fujitsu Enterprise Postgres to the screen and either the system log or the event log.	reload option of the pg_ctl mode
log_line_prefix	Specify information to be added at the start of messages output by an instance. This information is useful for automatic monitoring of messages. You can output the SQLSTATE value, output time, executing host, application name, and user ID. Refer to "What To Log" in the PostgreSQL Documentation for details. Example: log_line_prefix = '%e: %t [%p]: [%l-1] user = %u,db = %d,remote = %r app = %a '	reload option of the pg_ctl mode

Point

- If you want fewer application errors being output to the eventlog, refer to "When To Log" and "What To Log" in the PostgreSQL Documentation for information on how to reduce the output messages.
- If you want to separate errors output from other software, refer to "Where To Log" in the PostgreSQL Documentation to change the output destination to the server log file rather than the system log.

4.5.2 Configuring Automatic Start and Stop of an Instance

You can automatically start or stop an instance when the operating system on the database server is started or stopped.

Use the following procedure to configure automatic start and stop of an instance.

Note that, if an instance is started in a failover operation, the cluster system will control the start or stop, therefore this feature should not be used. Also, when performing database multiplexing, refer to "Enabling Automatic Start and Stop of Mirroring Controller and Multiplexed Instances" in the Cluster Operation Guide (Database Multiplexing).

When an instance was created with WebAdmin

When an instance is created with WebAdmin, the instance is registered in the Windows service and automatic start and stop is set for the instance.

To change the automatic start and stop setting for an instance, select the service for the applicable instance in the Windows services window, and in [Startup Type], select [Automatic] or [Manual].

When an instance was created with the initdb command

When the startup type of the service is set to [Manual], change it to [Automatic]. By setting the startup type to [Automatic], the service will start up automatically when the Windows(R) system is started up, and will stop automatically when the Windows(R) system is shut down.

The settings should be performed by a user with administrator privileges.

Use the following procedure to switch the service:

1. Display the [Services] window.

   In Windows, select [Administrative Tools], and then click [Services].

2. Switch the startup type

   Select the Fujitsu Enterprise Postgres service name, display the [Properties] dialog box, and then switch the startup type from [Manual] to [Automatic].

The above setting can also be changed using the sc config command.

4.5.3 Settings when Using the Features Compatible with Oracle Databases

To use the features compatible with Oracle databases, create a new instance and execute the following command for the "postgres" and "template1" databases:

```
CREATE EXTENSION oracle_compatible;
```

Features compatible with Oracle databases are defined as user-defined functions in the "public" schema created by default when database clusters are created, so they can be available for all users without the need for special settings.

For this reason, ensure that "public" (without the double quotation marks) is included in the list of schema search paths specified in the search_path parameter.

There are also considerations for use the features compatible with Oracle databases. Refer to "Precautions when Using the Features Compatible with Oracle Databases" in the Application Development Guide for details.

4.5.4 LDAP Authentication File Settings

You can use Active Directory as the LDAP server.

Refer to the Active Directory documentation for detailed settings.

4.5.5 Setting the server keytab file for GSSAPI authentication

When setting the server keytab file for GSSAPI authentication, be sure to set the "krb_server_keyfile" parameter, as the default value in postgresql.conf (FILE:/usr/local/pgsql/etc/krb5.keytab) will not take effect.

4.6 Integration with Message-Monitoring Software

To monitor messages output by Fujitsu Enterprise Postgres using software, configure the product to monitor SQLSTATE, instead of the message text - this is because the latter may change when Fujitsu Enterprise Postgres is upgraded.

Configure Fujitsu Enterprise Postgres to output messages in a format that can be read by the message-monitoring software by specifying "%e" in the log_line_prefix parameter of postgresql.conf to output the SQLSTATE value.

A setting example is shown below - it outputs the output time, executing host, application name, and user ID, in addition to the SQLSTATE value.

Example

```
log_line_prefix = '%e: %t [%p]: [%l-1] user = %u,db = %d,remote = %r app = %a '
```

See

Refer to "What To Log" in the PostgreSQL Documentation for information on how to configure the settings.

4.7 Setting Up and Removing OSS

This section explains how to set up OSS supported by Fujitsu Enterprise Postgres.

If you want to use OSS supported by Fujitsu Enterprise Postgres, follow the setup procedure.

If you decide not to use the OSS supported by Fujitsu Enterprise Postgres, follow the removing procedure.

Information

- In this section, the applicable database that enables the features of each OSS is described as "postgres".
- Execute CREATE EXTENSION for the "template1" database also, so that each OSS can be used by default when creating a new database.

Refer to "OSS Supported by Fujitsu Enterprise Postgres" in the General Description for information on OSS other than those described below.

4.7.1 oracle_fdw

This feature is available only when the server command is used. It is not available for instances created with WebAdmin.

4.7.1.1 Setting Up oracle_fdw

1. Add the path of the OCI library to the environment variable.
   Add the installation path of the OCI library to the PATH environment variable.
2. Open a command prompt with administrator privileges and run the following command:

```
> xcopy /E "c:\Program Files\Fujitsu\fsepv<x>server64\OSS\oracle_fdw\*"
        "c:\Program Files\Fujitsu\fsepv<x>server64"
```

3. Restart Fujitsu Enterprise Postgres.
4. Execute CREATE EXTENSION for the database that will use this feature.
   Use the psql command to connect to the "postgres" database.

```
postgres=# CREATE EXTENSION oracle_fdw;
CREATE EXTENSION
```

Information

- If the OCI library is not installed on the server, install it using the Oracle client or Oracle Instant Client.
  Refer to the relevant Oracle manual for information on the installation procedure.
- If the version of the OCI library is updated, change the path of the OCI library in the PATH environment variable to the updated path.

4.7.1.2 Removing oracle_fdw

1. Execute DROP EXTENSION for the database that will use this feature.
   Use the psql command to connect to the "postgres" database.

```
postgres=# DROP EXTENSION oracle_fdw CASCADE;
DROP EXTENSION
```

2. Open a command prompt with administrator privileges and run the following command:

```
> del "c:\Program Files\Fujitsu\fsepv<x>server64\filesCopiedDuringSetup"
```

Information

The files copied during setup can be checked below.

```
> dir /b /s "c:\Program Files\Fujitsu\fsepv<x>server64\OSS\oracle_fdw"
```

4.7.2 pg_hint_plan

4.7.2.1 Setting Up pg_hint_plan

1. Set the postgresql.conf file parameters.
   Add "pg_hint_plan" to the "shared_preload_libraries" parameter.
2. Open a command prompt with administrator privileges and run the following command:

```
> xcopy /E "c:\Program Files\Fujitsu\fsepv<x>server64\OSS\pg_hint_plan\*"
        "c:\Program Files\Fujitsu\fsepv<x>server64"
```

3. Restart Fujitsu Enterprise Postgres.
4. Run CREATE EXTENSION for the database that uses this feature.
   The target database is described as "postgres" here.
   Use the psql command to connect to the "postgres" database.

```
postgres=# CREATE EXTENSION pg_hint_plan;
CREATE EXTENSION
```

See

Refer to "Enhanced Query Plan Stability" in the Operation Guide for details.

4.7.2.2 Removing pg_hint_plan

Unsetting pg_hint_plan will cause hints registered in the hint_plan.hints table to be lost. Therefore, if you might later use pg_hint_plan again, back up each database's hint_plan.hints table with pg_dump before unsetting it up.

1. Execute DROP EXTENSION for the database that will use this feature.
   Use the psql command to connect to the "postgres" database.

```
postgres=# DROP EXTENSION pg_hint_plan CASCADE;
DROP EXTENSION
```

2. Set the postgresql.conf file parameters.
   Delete "pg_hint_plan" to the shared_preload_libraries parameter.
3. Restart Fujitsu Enterprise Postgres.
4. Open a command prompt with administrator privileges and run the following command:

```
> del "c:\Program Files\Fujitsu\fsepv<x>server64\filesCopiedDuringSetup"
```

Information

The files copied during setup can be checked below.

```
> dir /b /s "c:\Program Files\Fujitsu\fsepv<x>server64\OSS\pg_hint_plan"
```

4.7.3 pg_dbms_stats

4.7.3.1 Setting Up pg_dbms_stats

1. Set the postgresql.conf file parameter.
   Add "pg_dbms_stats" to the "shared_preload_libraries" parameter.

2. Open a command prompt with administrator privileges and run the following command:

```
> xcopy /E "c:\Program Files\Fujitsu\fsepv<x>server64\OSS\pg_dbms_stats\*"
       "c:\Program Files\Fujitsu\fsepv<x>server64"
```

3. Restart Fujitsu Enterprise Postgres.

4. Run CREATE EXTENSION for the database that will use this feature.
   The target database is described as "postgres" here.
   Use the psql command to connect to the "postgres" database.

```
postgres=# CREATE EXTENSION pg_dbms_stats;
CREATE EXTENSION
```

See

Refer to "Enhanced Query Plan Stability" in the Operation Guide for details.

4.7.3.2 Removing pg_dbms_stats

Unsetting pg_dbms_stats causes statistics managed by pg_dbms_stats to be lost. Therefore, if you plan to use pg_dbms_stats again later, back up each table in each database's dbms_stats schema in binary format, as shown below, and then perform unsetup.

```
postgres > # COPY <dbms_stats Schema's table name> TO '<Filename>' FORMAT binary;
```

1. Execute DROP EXTENSION for the database that will use this feature.
   Use the psql command to connect to the "postgres" database.

```
postgres=# DROP EXTENSION pg_dbms_stats CASCADE;
DROP EXTENSION
```

2. Set the postgresql.conf file parameters.
   Delete "pg_dbms_stats" to the shared_preload_libraries parameter.

3. Restart Fujitsu Enterprise Postgres.

4. Open a command prompt with administrator privileges and run the following command:

```
> del "c:\Program Files\Fujitsu\fsepv<x>server64\filesCopiedDuringSetup"
```

Information

The files copied during setup can be checked below.

```
> dir /b /s "c:\Program Files\Fujitsu\fsepv<x>server64\OSS\pg_dbms_stats"
```

4.7.4 pgvector

Note that while OSS is named "pgvector", the binaries and the extensions themselves are named "vector".

It is not possible to data masking data added by pgvector using data masking features.

When using in-memory features, data types and functions added in pgvector cannot be accelerated.

4.7.4.1 Setting Up pgvector

1. Open a command prompt with administrator privileges and run the following command:

```
> xcopy /E "c:\Program Files\Fujitsu\fsepv<x>server64\OSS\pgvector\*"
        "c:\Program Files\Fujitsu\fsepv<x>server64"
```

2. Execute CREATE EXTENSION for the database that will use this feature.
   Use the psql command to connect to the "postgres" database.

```
postgres=# CREATE EXTENSION vector;
CREATE EXTENSION
```

4.7.4.2 Removing pgvector

1. Execute DROP EXTENSION for the database that will use this feature.
   Use the psql command to connect to the "postgres" database.

```
postgres=# DROP EXTENSION vector CASCADE;
DROP EXTENSION
```

2. Open a command prompt with administrator privileges and run the following command:

```
> del "c:\Program Files\Fujitsu\fsepv<x>server64\filesCopiedDuringSetup"
```

Information

The files copied during setup can be checked below.

```
> dir /b /s "c:\Program Files\Fujitsu\fsepv<x>server64\OSS\pgvector"
```

4.8 Deleting Instances

This section explains how to delete an instance.

- 4.8.1 Using WebAdmin
- 4.8.2 Using Server Commands

4.8.1 Using WebAdmin

This section explains how to delete an instance using WebAdmin. Always use WebAdmin to delete instances that were created or imported using WebAdmin. Because WebAdmin managementinformation cannot be deleted, WebAdmin will determine that the instance is abnormal.

Use the following procedure to delete an instance.

1. Stop the instance

   In the [Instances] tab, select the instance to stop and click  .

2. Back up files.

   Before deleting the instance, back up any required files under the data storage destination, the backup data storage destination, and the transaction log storage destination.

3. Delete the instance

   In the [Instances] tab, select the instance to delete and click  .

Deleting Unnecessary Directories

Deleting an instance deletes only the following lowest-level directories. If they are not required, delete them manually.

- Data storage destination
- Backup data storage destination
- Transaction log storage destination (if different from the data storage destination)

4.8.2 Using Server Commands

This section explains how to delete an instance using server commands.

Use the following procedure to delete an instance.

1. Stop the instance

   Stop the instance in Windows services, or use the pg_ctl command stop mode.

   Use the following procedure to stop a service in Windows services:

   a. Display the [Services] window.

      In Windows, select [Administrative Tools], and then click [Services].

   b. Stop the service

      Select the instance name that you wish to stop from the services list, and click [Stop Service]. If you stop a service while applications and commands are running, Fujitsu Enterprise Postgres will force those applications and commands to close and will stop normally.

   You can also stop a service by specifying the service name in the net stop command or sc stop command.

2. Back up files

   Before deleting the instance, you should back up all necessary files contained in the data storage destination, backup data storage destination, and transaction log storage destination.

3. Delete the instance

   Use a command such as rmdir to delete the following directories:

   - Data storage destination directory
   - Backup data storage destination directory
   - Transaction log storage destination directory (if a different directory to the data storage destination directory was specified)

Chapter 5 Uninstallation

This chapter explains the uninstallation of Fujitsu Enterprise Postgres.

Note that "*x* SP*z*" indicates the version and level of the installed product and "<*x*>" in paths indicates the product version.

Information

- If a [User Account Control] dialog box is displayed at the start of the uninstallation, click [Yes] to continue processing.

  If [No] is clicked, permission to continue is denied and an [Error] dialog box will be displayed.
  To continue the uninstallation, click [Retry] in the [Error] dialog box. To end the operation, click [Cancel].

- If uninstallation is suspended or processing terminates abnormally, the [Program Compatibility Assistant] dialog box may be displayed. Click [This program uninstalled correctly] and continue operation.

5.1 Pre-uninstallation Tasks

Before uninstalling Fujitsu Enterprise Postgres, do the following:

When user files are placed in the installation directory

When you perform uninstallation, all files and directories under the installation directory are deleted. If necessary, back up the files before uninstalling them.

When WebAdmin is used for operation

If performing operation with WebAdmin, back up the following folder before uninstallation.
Instances will not be recognized by WebAdmin even if Fujitsu Enterprise Postgres is reinstalled after uninstallation.
If performing operation with WebAdmin after reinstalling Fujitsu Enterprise Postgres, replace the following backed up file after installation.

Follow the procedure below to perform the backup.

1. Stop the WebAdmin server. Refer to "B.1.4 Stopping the Web Server Feature of WebAdmin" for details.
2. Back up the following folder:

   webAdminInstallFolder\data\fepwa

By replacing the above folder in the installation folder after installation, the instance will be recognized by WebAdmin, and the recognized instance will be set to automatically start and stop.
To disable the automatic start and stop setting for an instance, select the service for the applicable instance in the Windows services window, and in [Startup Type], select [Manual].

When using HTTPS or HTTPS client authentication with WebAdmin

In case of secure connection, all the certificates placed in "keystore" directory will be removed when uninstalling WebAdmin. Back up these certificates and its configuration file in advance if required.

webAdminInstallDir\tomcat\keystore
webAdminInstallDir\tomcat\conf\server.xml

They are backed up because the keystore contains certificates, and server.xml contains information for the keystorePass, keyAlias, and trustorePass attributes.

When database multiplexing is performed

If using database multiplexing, refer to "Uninstalling in Database Multiplexing Mode" in the Fujitsu Enterprise Postgres Cluster Operation Guide (Database Multiplexing) before performing the uninstallation.

5.2 Uninstallation in Interactive Mode

The uninstallation procedure is described below.

If an error occurs while the product is being uninstalled, refer to "Uninstall (middleware) Messages" in the Fujitsu Enterprise Postgres product website, and take the required action.

1. Stop applications and programs

Before starting the uninstallation, stop the following:

- Applications that use the product
- Connection Manager
- pgAdmin

2. Stop instances

Stop all instances that are using the product to be uninstalled.

Stopping of instances should be performed by the appropriate instance administrator.

When an instance was created with WebAdmin

In the [Instances] tab, select the instance to stop and click  .

When an instance was created with the initdb command

Use the following procedure to stop a service:

a. Display the [Services] window

   In Windows, select [Administrative Tools], and then click [Services].

b. Stop the service

   Select the instance name that you wish to stop from the services list, and click [Stop Service]. If you stop a service while applications and commands are running, Fujitsu Enterprise Postgres will force those applications and commands to close and will stop normally.

You can also stop a service by specifying the service name in the net stop command or sc stop command.

3. Stop WebAdmin

If you are using WebAdmin, stop WebAdmin.

Refer to "B.1.4 Stopping the Web Server Feature of WebAdmin" for details.

4. Unregister Windows services(When an instance is created with the initdb command)

Unregister the instance registered in Windows services.

Use the unregister mode of the pg_ctl command to specify the registered service name and unregister the instance from Windows services.

This command must be executed by an instance administrator user with administrator privileges. Execute the command from the [Administrator: Command Prompt] window. Right-click [Command Prompt], and then select [Run as administrator] from the menu to display the [Administrator: Command Prompt] window.

Example

The following is an example showing execution of this command on the registered service name "inst1".

```
> pg_ctl unregister -N "inst1"
```

Information

You should unregister services before uninstalling Fujitsu Enterprise Postgres. If you uninstall Fujitsu Enterprise Postgres while services are running, several files will remain after the uninstallation.

If you have carried out the uninstallation without unregistering services beforehand, use the server command sc delete to unregister the services.

5. Delete registrations related to the event log

If you are outputting to the event log, a DLL registration mentioned in "4.2.5 Preparing for Output to the Event Log" has been performed.

To prevent unnecessary issues from occurring, you should delete this registration. Refer to "Server Setup and Operation", "Registering Event Log on Windows" in the PostgreSQL Documentation for details.

Ensure to delete DLLs before the uninstallation. If you perform the uninstallation without doing so, you may not be able to delete the DLLs at a later time.

The following is an example showing deletion of the DLL registration for a 64-bit product under the default event source name.

```
> regsvr32 /u "c:\Program Files\Fujitsu\fsepv<x>server64\lib\pgevent.dll"
```

If using multiple instances

DLL registration is performed so that you can output messages corresponding to the event source name assigned by the user, allowing you to identify messages output to the event log by instance.

Since it is necessary to delete the DLL registration for each instance, delete the DLL registration by event source name.

The following is an example showing deletion of the DLL of a 64-bit product registered under the event source name "Enterprise Postgres inst1".

```
> regsvr32 /u /i:"Enterprise Postgres inst1" "C:\Program Files\Fujitsu\fsepv<x>server64\lib
\pgevent.dll"
```

Note that this step is not required if the instance was created with WebAdmin.

If installing multiple versions

If the instances you created using this package have been set to output error logs to the event log, use the DLL path name that you took note of previously as explained in "4.2.5 Preparing for Output to the Event Log" to reregister the default event source name.

6. Start Uninstall (middleware)

In [Start] menu, click [All apps], then [Fujitsu], and then [Uninstall (middleware)].

The shortcuts displayed on the [Start] menu might be arranged differently depending on the operating system.

7. Select the software

Select the product to be uninstalled from [Software Name], and then click [Remove].

8. Start the uninstallation

Click [Uninstall].

9. Finish the uninstallation

The uninstallation completion window will be displayed. Click [Finish].

The installation folder may remain after uninstallation. If it is not required, delete it.

10. Stop Uninstall (middleware)

In Uninstall (middleware), click [Close].

5.3 Uninstallation in Silent Mode

The uninstallation procedure is described below.

Refer to the Fujitsu Enterprise Postgres product website for information on uninstallation in silent mode, such as the error messages.

1. Stop applications and programs

Before starting the uninstallation, stop the following:

- Applications that use the product
- Connection Manager
- pgAdmin

2. Stop all instances

Stop all instances that are using the product to be uninstalled.

When an instance was created with WebAdmin

In the [Instances] tab, select the instance to stop and click  .

When an instance was created with the initdb command

Use the following procedure to stop a service:

a. Display the [Services] window.

   In Windows, select [Administrative Tools], and then click [Services].

b. Stop the service

   Select the instance name that you wish to stop from the services list, and click [Stop Service]. If you stop a service while applications and commands are running, Fujitsu Enterprise Postgres will force those applications and commands to close and will stop normally.

You can also stop a service by specifying the service name in the net stop command or sc stop command.

3. Stop WebAdmin

If you are using WebAdmin, stop WebAdmin.

Refer to "B.1.4 Stopping the Web Server Feature of WebAdmin" for details.

4. Unregister Windows services(When an instance is created with the initdb command)

Unregister the instance registered in Windows services.

Use the unregister mode of the pg_ctl command to specify the registered service name and unregister the instance from Windows services.

This command must be executed by an instance administrator user with administrator privileges. Execute the command from the [Administrator: Command Prompt] window. Right-click [Command Prompt], and then select [Run as administrator] from the menu to display the [Administrator: Command Prompt] window.

Example

The following is an example showing execution of this command for the registered service name "inst1".

```
> pg_ctl unregister -N "inst1"
```

Information

You should unregister services before uninstalling Fujitsu Enterprise Postgres. If you uninstall Fujitsu Enterprise Postgres while services are running, several files will remain after the uninstallation.

If you have carried out the uninstallation without unregistering services beforehand, use the server command sc delete to unregister the services.

5. Delete registrations related to the event log

If you are outputting to the event log, a DLL registration mentioned in "4.2.5 Preparing for Output to the Event Log" has been performed.

To prevent unnecessary issues from occurring, you should delete this registration. Refer to "Server Setup and Operation", "Registering Event Log on Windows" in the PostgreSQL Documentation for details.

Ensure to delete DLLs before the uninstallation. If you perform the uninstallation without doing so, you may not be able to delete the DLLs at a later time.

The following is an example showing deletion of the DLL registration for a 64-bit product under the default event source name.

```
> regsvr32 /u "c:\Program Files\Fujitsu\fsepv<x>server64\lib\pgevent.dll"
```

If using multiple instances

DLL registration is performed so that you can output messages corresponding to the event source name assigned by the user, allowing you to identify messages output to the event log by instance.

Since it is necessary to delete the DLL registration for each instance, delete the DLL registration by event source name.

The following is an example showing deletion of the DLL of a 64-bit product registered under the event source name "Enterprise Postgres inst1".

```
> regsvr32 /u /i:"Enterprise Postgres inst1" "c:\Program Files\Fujitsu\fsepv<x>server64\lib
\pgevent.dll"
```

Note that this step is not required if the instance was created with WebAdmin.

If installing multiple versions

If the instances you created using this package have been set to output error logs to the event log, use the DLL path name that you took note of previously as explained in "4.2.5 Preparing for Output to the Event Log" to reregister the default event source name.

6. Start the command prompt

In Windows, right-click [Command Prompt] and then select [Run as administrator].

7. Run the uninstaller

Execute the command below.

The installation folder may remain after uninstallation. If it is not required, delete it.

Example

```
X:> installFolder\suninst.bat
```

X: Drive on which the product is installed

Appendix A Recommended WebAdmin Environments

This appendix describes the recommended WebAdmin environment. The following explanation is based on the assumption that Microsoft Edge is used unless otherwise stated.

Note

The displayed screen varies depending on your environment, so check and set according to the screen.

A.1 Recommended Browser Settings

- Use a display resolution of 1280 x 768 or higher, and 256 colors or more.
- Select [Setting] >>[Appearance] >> [Font size] >> [Medium (Recommended)].
- Select [Setting] >>[Appearance] >> [Zoom] >> [100%].

A.2 How to Set Up the Pop-up Blocker

If the Pop-up Blocker is enabled, use the procedure below to configure settings to allow pop-ups from the server where Fujitsu Enterprise Postgres is installed.

1. Click [Setting] >> [Cookie and site permissions] >> [All Permissions] >> [Pop-ups and redirects].
   If the [Block (Recommended)] switch is not on (blue), the pop-up blocker is not working, and no further action is required.
2. Under [Pop-ups and Redirects], click the [Allow] >> [Add] button.
3. In [Add Site], in [Site], enter the address of the server where you installed Fujitsu Enterprise Postgres and click the [Add] button.
4. Close Microsoft Edge.

Appendix B Setting Up and Removing WebAdmin

This appendix describes how to set up and remove WebAdmin.

Note that "<*x*>" in paths indicates the product version.

B.1 Setting Up WebAdmin

This section explains how to set up WebAdmin.

B.1.1 Setting Up WebAdmin

In the case of a re-setup, the existing server.xml is overwritten with the default values. Therefore, back up the information in server.xml beforehand and update it manually after setting up WebAdmin.

No action is required because the certificate is not overwritten during re-setup.

Follow the procedure below to set up WebAdmin.

1. Log in

   Log in as a user that belongs to the Administrators group.

2. Display the setup window

   From the [Start] menu, select All Apps, select Fujitsu Enterprise Postgres WebAdmin (64bit) <x>, and then start WebAdmin Setup.

   "<x>" indicates the product version.

   The shortcuts displayed on the [Start] menu might be arranged differently depending on the operating system.

   Note

   If the same [User Account Control] dialog box as that shown below is displayed, click [Yes] to continue processing.

3. Specifying Setup Items

   Specify the following:

   Refer to the services file. Only change to a different port number if the same port number is being used by another service.

   Make a note of the Web server port number, because it will be required for starting the WebAdmin window.

Item	Default value
WebAdmin secure connection support	HTTP
Web server port number	27515
WebAdmin internal port number	27516
WebAdmin automatic start	Selected

   WebAdmin secure connection support

   - **HTTP**

     Specifies that HTTP is used.

   - **HTTPS**

     Specifies to use HTTPS for secure communication with WebAdmin.

     To facilitate HTTPS deployment, WebAdmin automatically creates a self-signed server certificate. This certificate should only be used for testing purposes, such as connection verification, and should be replaced with an appropriate CA-signed certificate in production.

Refer to "B.1.2 Certificate Settings For Secure Connection Support" for detail certificate settings.

Point

If you continue to use the self-signed server certificate that WebAdmin created, your browser displays a warning screen when you access the WebAdmin page because you can access WebAdmin but the certificate is not signed by a known and trusted CA.

- **HTTPS with client authentication**

  Specifies to use HTTPS for secure communication with WebAdmin and to use HTTPS client authentication so that only authenticated clients can use WebAdmin.

  See “HTTPS” for instructions to facilitate HTTPS deployment.

  To facilitate the deployment of HTTPS client authentication, WebAdmin automatically creates two self-signed client certificates.

  One is for browser-to-server authentication. and one for server-to-server authentication.

  Server to server authentication is required because WebAdmins can have multiple server configurations and communicate between them. Refer to "Appendix H Determining the Preferred WebAdmin Configuration".

  These certificate should only be used for testing purposes, such as connection verification, and should be replaced with an appropriate CA-signed certificate in production.

  Refer to "B.1.2 Certificate Settings For Secure Connection Support" for detail certificate settings.

Point

If client authentication is selected, client certificate for browser must be registered in user’s browser before accessing to WebAdmin. Otherwise, WebAdmin will not be accessible.

Web server port number

Specify an unused port number in the following range for the port number used for communication between the Web browser and Web server:

- 1024 to 49151

The Web server port number is registered as a port number of the following service name in the services file.

fep_170_WA_64_WebAdmin_Port1

WebAdmin internal port number

Specify an unused port number in the following range for the port number used for communication between the Web server and WebAdmin runtime environment:

- 1024 to 49151

The WebAdmin internal port number is registered as a port number of the following service name in the services file.

fep_170_WA_64_WebAdmin_Port2

WebAdmin automatic start

Select whether or not to start WebAdmin when the machine is started.

Note

- Make a note of the Web server port number for use in the Windows firewall settings.
- Unused port numbers
  In the operating system and other products, regardless of the information in the service file, unused port numbers may be automatically numbered and then used, or port numbers specified in environment files within products may also be used. Check the port numbers used by the OS and other products, and ensure that these are not duplicated.

- Access restrictions
  Prevent unauthorized access and maintain security by using a firewall product, or the packet filtering feature of a router device, to restrict access to the server IP address and the various specified port numbers.
- Port access permissions
  If a port is blocked (access permissions have not been granted) by a firewall, enable use of the port by granting access. Refer to the vendor document for information on how to grant port access permissions.
  Consider the security risks carefully when opening ports.
- Changing port numbers
  When using WebAdmin in multiserver mode, it is recommended not to change WebAdmin ports after creating instances. Otherwise, the created instances may not be accessible through WebAdmin after the port is changed.

4. Prepare for setup

Click [OK] in the setup window, and after completing the WebAdmin setup, refer to "4.2 Preparations for Setup" and perform the required preparations for setting up Fujitsu Enterprise Postgres if using WebAdmin for operation.

B.1.2 Certificate Settings For Secure Connection Support

Describes how to support secure connections.

You must replace the certificate used for HTTPS and client authentication with a CA-signed certificate. To determine if it has been replaced, check the certificate in the "keystore" to ensure that it has been replaced with a CA-signed certificate.

Certificate Storage Directory

If you specify Use HTTPS or Use HTTPS Client Authentication during setup, a new subdirectory "keystore" for storing certificates is added to the WebAdmin Tomcat installation directory.

Example: If WebAdmin is installed in C:\Program Files\Fujitsu\fsepv<x>webadmin:

```
Tomcat installation directory (C:\Program Files\Fujitsu\fsepv<x>webadmin\tomcat\)
├─── bin
├─── Building.txt
├─── conf
├─── CONTRIBUTING.md
├─── keystore
│    ├─── keystore.p12            → For HTTPS
│    ├─── clientbrowser.p12       → For client authentication
│    ├─── clientkeystore.p12      → For client authentication
│    ├─── truststore.p12          → For client authentication
│    ├─── clientkeystore.conf     → For client authentication
├─── ...
```

Certificate Configuration

To configure a certificate:

1. Prepare CA-signed certificates

Certificate	Summary
keystore.p12 (private and public keys included)	One server certificate for HTTPS. Used for data encryption.
clientbrowser.p12 (private key included)	One client certificate to authenticate the browser between the browser and the server. It is registered in the user's browser. The number of certificates generated corresponds to the number of clients (browsers) accessing WebAdmin.
clientkeystore.p12 (private key included)	One client certificate for server-to-server authentication. Used internally by WebAdmin.

Certificate	Summary
truststore.p12 (clientbrowser.p12 and clientkeystore.p12)	Imported public keys for all client certificates.

2. Place certificates in keystore directory

Single-server configuration

1. Place keystore.p12, truststore.p12 and clientkeystore.p12 files in "keystore" directory
2. Import clientbrowser.p12 into your browser.
   If you use multiple clients (browsers), import the certificate into each browser.

Multi-server configuration

1. Place keystore.p12, truststore.p12 and clientkeystore.p12 files in "keystore" directory
2. Import clientbrowser.p12 into your browser.
   If you use multiple clients (browsers), import the certificate into each browser.
3. Import the public key corresponding to the private key in clientkeystore.p12 into truststore.p12 on the other server you want to connect to.

3. Update certificate information in server.xml and clientkeystore.conf files

- **keystore.p12 and truststore.p12**

  Populate server.xml with the information from keystore.p12 and truststore.p12.

  The server.xml file is located under C:\Program Files\Fujitsu\fsepv<x>webadmin\tomcat\conf.

  HTTPS

  Set the keystorePass and keyAlias attributes to the password and alias for keystore.p12.

  server.xml (C:\Program Files\Fujitsu\fsepv<x>webadmin\tomcat\conf)

```
<Connector port="27515" sslProtocol="TLS"
    protocol="org.apache.coyote.http11.Http11NioProtocol"
    maxThreads="150" SSLEnabled="true" scheme="https" secure="true"
    clientAuth="false" keystoreType="PKCS12"
    keystoreFile="C:\Program Files\Fujitsu\fsepv<x>webadmin\tomcat\keystore\keystore.p12"
    keystorePass="password" keyAlias="alias" />
```

  HTTPS and client authentication

  Set the keystorePass and keyAlias attributes to the password and alias for keystore.p12.

  Set the truststorePass attribute to the password for truststore.p12.

  server.xml (C:\Program Files\Fujitsu\fsepv<x>webadmin\tomcat\conf)

```
<Connector port="27515" sslProtocol="TLS"
    protocol="org.apache.coyote.http11.Http11NioProtocol"
    maxThreads="150" SSLEnabled="true" scheme="https" secure="true"
    clientAuth="true" keystoreType="PKCS12"
    keystoreFile="C:\Program Files\Fujitsu\fsepv<x>webadmin\tomcat\keystore\keystore.p12"
    keystorePass="password" keyAlias="alias"
    truststoreType="PKCS12"
    truststoreFile="C:\Program Files\Fujitsu\fsepv<x>webadmin\tomcat\keystore\truststore.p12"
    truststorePass="password" />
```

- **clientkeystore.p12**

  Populate clientkeystore.conf with the information from clientkeystore.p12.

  clientkeystore.conf file is generated by WebAdmin and its filename cannot be modified.

HTTPS and client authentication

Sets the client certificate information for server authentication.

Set the password for the private key imported into clientkeystore.p12 and the password and alias for clientkeystore.p12.

clientkeystore.conf (C:\Program Files\Fujitsu\fsepv<x>webadmin\tomcat\keystore\)

```
clientkeystore.key.pass=password
clientkeystore.store.pass=password
clientkeystore.alias=alias
```

4. Back up

Back up the certificates and server.xml file.

Point

When you uninstall WebAdmin, all certificates in the keystore directory are deleted. Also, when you reinstall WebAdmin, the server.xml file is overwritten with the default settings. Back up your data in case of incorrect operation.

5. Restart WebAdmin

Stop WebAdmin and start it again.

Refer to "B.1.4 Stopping the Web Server Feature of WebAdmin" and "B.1.3 Starting the Web Server Feature of WebAdmin" for detailed instructions.

Point

If certificates or connection failures occur, refer to the Tomcat log directory (C:\Program Files\Fujitsu\fsepv<x>webadmin\tomcat\logs\) for detailed error messages.

B.1.3 Starting the Web Server Feature of WebAdmin

Follow the procedure below to start the Web server feature of WebAdmin.

1. Display the Services window

In Windows, select [Administrative Tools], and then click [Services].

2. Start the service

Select the displayed name "Fujitsu Enterprise Postgres WebAdmin *version*", and then click [Start Service].

You can also start the service by specifying the service name of the Web server feature of WebAdmin in the net start command or sc start command.

B.1.4 Stopping the Web Server Feature of WebAdmin

Follow the procedure below to stop the Web server feature of WebAdmin.

1. Display the Services window

In Windows, select [Administrative Tools], and then click [Services].

2. Stop the service

Select the displayed name "Fujitsu Enterprise Postgres WebAdmin *version*", and then click [Stop Service].

You can also stop the service by specifying the service name of the Web server feature of WebAdmin in the net stop command or sc stop command.

Note

- For efficient operation of WebAdmin, it is recommended to stop the Web server feature only during a scheduled maintenance period.
- When WebAdmin is used to create and manage instances in a multiserver configuration, the Web server feature must be started and running on all servers at the same time.

B.2 Removing WebAdmin

This section explains how to remove WebAdmin.

This removal procedure stops WebAdmin and ensures that it no longer starts automatically when the machine is restarted.

To remove the setup, execute the command shown below.

Example

When WebAdmin is installed in "C:\Program Files\Fujitsu\fsepv<*x*>webadmin":

```
> C:
> cd C:\Program Files\Fujitsu\fsepv<x>webadmin\sbin
> WebAdminSetup --delete
```

Note

- The removal of the WebAdmin setup must be performed by a user with administrator privileges (a user ID that belongs to the Administrators group).
- Commands that require administrator privileges must be executed from the [Administrator: Command Prompt] window. Right-click [Command Prompt], and then select [Run as administrator] from the menu to display the [Administrator: Command Prompt] window.

B.3 Using an External Repository for WebAdmin

WebAdmin can be configured to use an external database, where it can store the various metadata information it uses. WebAdmin will use this database as a repository to store the information it uses to manage all the created instances. This can be a Fujitsu Enterprise Postgres database.

Using an external database as a WebAdmin repository provides you with more flexibility in managing WebAdmin. This repository can be managed, backed up and restored as needed using pgAdmin or command line tools, allowing users to have greater flexibility and control.

Follow the procedure below to set up the repository.

1. Start WebAdmin, and log in to the database server.
2. Click the [Settings] tab, and then click  in the [WebAdmin repository configuration] section.

   Enter the following items:

   - [Host name]: Host name of the database server
   - [Port]: Port number of the database server
   - [Database name]: Name of the database
   - [User name]: User name to access the database
   - [Password]: Password of the database user

Note

- Database type
  It is recommended to use a Fujitsu Enterprise Postgres database as a repository. A compatible PostgreSQL database can also be used as an alternative.
- It is recommended to click [Test connection] to ensure that the details entered are valid and WebAdmin is able to connect to the target database.
- Host name, Database name, User name, Password should not contain hazardous characters. Refer to "Appendix C WebAdmin Disallow User Inputs Containing Hazardous Characters".

3. Click to register the repository details.

Note

- Once the repository is set up, it can be changed any number of times by the user logged into WebAdmin. When a repository is changed:
  - It is recommended to preload the backup into this database.
  - If the data is not preloaded, WebAdmin will create a new repository.
- The database repository can be set up even after WebAdmin was already used to create instances. In that scenario, the instances already created are retained and can continue to be operated on.
- If the instance used as a repository is stopped, WebAdmin will be unusable. For this reason, it is recommended to be familiar with starting an instance from the command line. If the instance is stopped for any reason, start it from the command line and WebAdmin will be usable again.

B.4 Using the WebAdmin Auto-Refresh Feature

The WebAdmin auto-refresh feature automatically refreshes the operating status of all instances in the Instance list at the specified interval. It also refreshes the details of the selected instance. You can use the auto-refresh feature to prevent timeouts.

Follow the procedure below to configure the auto-refresh options.

1. Click the [Settings] tab, and then click in the [User preferences] section.
2. Enter the following items:
   - [Auto-refresh instance]: To use the auto-refresh feature, select "Enabled". The default is "Disabled".
   - [Refresh interval (seconds)]: Number of seconds between each refresh. This is a countdown timer, which is reset every time the instance status is refreshed by any operation. Specify a value from 30 to 3600 (seconds). The default is 30.
3. Click to save the auto-refresh settings.

Point

- Auto-refresh will run only if the [Instances] page is displayed and no user-initiated operation is in progress.
- A text indicator, which is independent of auto-refresh, is displayed at the top of the Instance list. It is dynamically updated to display when the page was last refreshed.

Appendix C WebAdmin Disallow User Inputs Containing Hazardous Characters

WebAdmin considers the following as hazardous characters, which are not allowed in user inputs.

```
| (pipe sign)

& (ampersand sign)

; (semicolon sign)

$ (dollar sign)

% (percent sign)

@ (at sign)

' (single apostrophe)

" (quotation mark)

\' (backslash-escaped apostrophe)

\" (backslash-escaped quotation mark)

<> (triangular parenthesis)

() (parenthesis)

+ (plus sign)

CR (Carriage return, ASCII 0x0d)

LF (Line feed, ASCII 0x0a)

, (comma sign)

\ (backslash)
```

Appendix D Configuring Parameters

WebAdmin operates and manages databases according to the contents of the following configuration files:

- postgresql.conf

  Contains various items of information that define the operating environment of Fujitsu Enterprise Postgres.

- pg_hba.conf

  Contains various items of information related to client authentication.

These configuration files are deployed to a data storage destination. Data is written to them when the instance is created by WebAdmin and when settings are changed, and data is read from them when the instance is started and when information from the [Setting] menu is displayed.

See

Refer to "Server Configuration" and "Client Authentication" in "Server Administration" in the PostgreSQL Documentation for information on the parameters.

Note

WebAdmin checks for port number and backup storage path anomalies when various operations are performed. An anomaly occurs when the value of [Port number] and/or [Backup storage path] in WebAdmin is different from the value of the corresponding parameter in postgresql.conf. Refer to "Anomaly Detection and Resolution" in the Operation Guide for details.

postgresql.conf

Parameters that can be changed in WebAdmin

The postgresql.conf parameters that can be changed in WebAdmin are shown below:

Section	WebAdmin item	postgresql.conf file parameter
Instance Configuration		
Character encoding	Character set	client_encoding
	Message locale	lc_messages
Communication	Max connections	max_connections
SQL options	Transform NULL format	transform_null_equals
	Date output format	DateStyle (*1)
	Interval output format	IntervalStyle
	Number of digits for floating values	extra_float_digits
	Transaction isolation levels	default_transaction_isolation
	Currency format	lc_monetary
	Date and time format	lc_time
	Numerical value format	lc_numeric
Memory	Sort memory (KB)	work_mem
	Shared buffers (KB)	shared_buffers
Streaming replication	WAL level	wal_level
	Maximum WAL senders	max_wal_senders

Section	WebAdmin item	postgresql.conf file parameter
	WAL save size (MB)	wal_keep_size
	Hot standby	hot_standby
	Synchronous standby names	synchronous_standby_names
	WAL receiver timeout (ms)	wal_receiver_timeout
Edit instance		
	Instance name	n/a
	Instance port	port
	Backup storage path	backup_destination

*1: If you specify "Postgres" as the output format, dates will be output in the "12-17-1997" format, not the "Wed Dec 17 1997" format used in the PostgreSQL Documentation.

Information

- Calculate the maximum number of connections using the formula below:

```
maximumNumberOfConnections = maximumNumberOfConnectionsFromApplications + 3 (*1)
```

*1: 3 is the default number of connections required by the system.
Calculate the maximum number of connections using the following formula when changing superuser_reserved_connections (connections reserved for use by the superuser) in postgresql.conf.

```
maximumNumberOfConnections = maximumNumberOfConnectionsFromApplications +
superuser_reserved_connections
```

- Also check if the memory used exceeds the memory installed (refer to "Parameters automatically set by WebAdmin according to the amount of memory").

Parameters set by WebAdmin

The following postgresql.conf parameters are set by WebAdmin during instance startup (they will be ignored even if specified in postgresql.conf):

Parameter	Value
event_source (*1)	'fsep_*version_userName_instanceNamePortNumber*'
listen_addresses	*
log_destination	'stderr,eventlog'
logging_collector	on
log_line_prefix	'%e: %t [%p]: [%l-1] user = %u,db = %d,remote = %r app = %a '
log_filename (*2) (*3)	'logfile-%a.log'
log_truncate_on_rotation	on
log_rotation_age	1d

*1: *PortNumber* is the port number of the database server specified when creating the instance.

*2: The server logs are split into files based on the day of the week, and are rotated after each week.

*3: If the date changes while the instance is stopped, old logs are not deleted and continue to exist.
Manually delete old logs that are no longer required to release disk space.

Parameters automatically set by WebAdmin according to the amount of memory

The postgresql.conf parameters automatically set according to the amount of installed memory, during the creation of instances by WebAdmin, are shown below:

Parameter	Value
shared_buffers	30% of the machine's installed memory
work_mem	30% of the machine's installed memory / max_connections / 2
effective_cache_size	75% of the machine's installed memory
maintenance_work_mem	10% of the machine's installed memory / (1 + autovacuum_max_workers) (*1)

*1: The value will be capped at 2097151 KB.

When determining the values to be configured in the above parameters, you must take into account any anticipated increases in access volume or effects on performance during business operations, such as the number of applications and commands that will access the instance, and the content of processes. Also, note that in addition to Fujitsu Enterprise Postgres, other software may be running on the actual database server. You will need to determine the degree of priority for the database and other software, as well as the memory allocation size.

WebAdmin automatically configures complex parameter settings such as those mentioned above, based on the size of the internal memory of the machine. This enables maximum leverage of the machine memory to facilitate resistance against fluctuations during business operations.

Accordingly, the effects of the above-mentioned factors must be estimated and taken into account when determining and configuring parameter values, so that memory resources can be effectively allocated among other software or instances, and so that adverse effects can be mutually avoided. Refer to "Memory" in "Resource Consumption", and "Planner Cost Constants" in "Query Planning", under "Server Administration" in the PostgreSQL Documentation for information on parameter values and required considerations.

Parameter values can be modified using the WebAdmin [Setting] menu, or edited directly using a text editor.

If adding an instance, determine the parameter values, including for existing instances, and make changes accordingly.

- You can edit postgresql.conf directly with a text editor. However, do not edit the following parameters. If you edit incorrectly, WebAdmin will not work correctly.
  - archive_mode
  - archive_command
  - wal_level
  - wal_sync_method
  - log_line_prefix
  - log_destination
  - logging_collector
  - log_directory
  - log_file_mode
  - log_filename
  - log_truncate_on_rotation
  - log_rotation_age
  - event_source
- If you edit postgresql.conf directly, the records should be single line. WebAdmin will not work correctly if the record spans multiple lines.

- If you change superuser_reserved_connections, set the value you want to change plus the number of connections required by WebAdmin of 3.

pg_hba.conf

Refer to "Client Authentication" in "Server Administration" in the PostgreSQL Documentation for information on content that can be configured in pg_hba.conf.

Note

- Use the following client authentication settings to allow the instance administrator to connect to the database using WebAdmin:
  - The connection type: "host"
  - The IP address is a loopback address ("127.0.0.1/32")
- You can also edit pg_hba.conf directly. However, do not modify items that cannot be configured in WebAdmin. WebAdmin does not work correctly.
- If you edit pg_hba.conf directly, the records should be single line. WebAdmin will not work correctly if the record spans multiple lines.

Appendix E Estimating Database Disk Space Requirements

This appendix describes how to estimate database disk space requirements.

E.1 Estimating Table Size Requirements

The following tables provide the formulas for estimating table size requirements.

Table E.1 Estimation formula when the record length is 2032 bytes or less

Item	Estimation formula (bytes)
(1) Record length	27(*1) + NULL map + OID + column data NULL map: Number of columns / 8 (*2) OID: 4 Column data: Sum of column lengths *1: Record header section *2: Round the result up to the next integer. - Because the column data is placed in boundaries of 8 bytes, you need to make an adjustment so that the sum of the record header section, NULL map and OID is a multiple of 8. For example, if the calculated length is 27 + 1 / 8 (rounded up) + 0 = 28 bytes, add 4 to make the length 32 bytes. - Because the data of each column is placed in boundaries of the defined data type, take the boundary of each data type into account for the length of the column data. For example, the length of the column data in the table below will not be the sum of the data types, which is 37 bytes, but will instead be 64 bytes following boundary adjustment. Definition: create table tb1(c1 char(1), c2 bigint, c3 int, c4 box) Estimation: CHAR type 1 byte + boundary adjustment of 7 bytes for BIGINT type 8 bytes + BIGINT type 8 bytes + INT type 4 bytes + boundary adjustment of 12 bytes for BOX type 32 bytes + BOX type 32 bytes = 64 bytes - Because each record is placed in boundaries of 8 bytes, you need to make an adjustment so that the length of the column data is a multiple of 8. - If the calculated record length exceeds 2,032 bytes, the variable length data in the record might be compressed automatically. If so, use the estimation formulas in "Table E.2 Estimation formula when the record length exceeds 2032 bytes" to estimate the table size.
(2) Page size requirement	8192 (*1) × fillfactor (*2) - 24 (*3) *1: Page length (8192) *2: Value of the fillfactor specified in the table definitions (if omitted, 100%) *3: Page header (24) - The calculated (2) page size requirement will be rounded down to the nearest integer.
(3) Number of records per page	(2) Page size requirement / ((1) record length + 4 (*1)) *1: Pointer length (4) - The result will be rounded down to the nearest integer.

Item	Estimation formula (bytes)
(4) Number of pages required for storing records	Total number of records / (3) number of records per page - The result will be rounded up to the next integer.
(5) Amount of space	(4) Number of pages required for storing records x page length x safety factor (*1) *1: Specify 2.0 or higher. - This is the safety factor assumed if vacuuming is performed for garbage collection in tables and indexes.

Table E.2 Estimation formula when the record length exceeds 2032 bytes

Item	Estimation formula (bytes)
(5) Amount of space	Total number of records x (1) record length x safety factor (*1) *1: Specify 2.0 or higher. - This is the safety factor assumed if vacuuming is performed for garbage collection in tables and indexes.

E.2 Estimating Index Size Requirements

This section provides the formulas for estimating index size requirements.

Fujitsu Enterprise Postgres provides six index types: B-tree, Hash, GiST, GIN, SP-GiST, and VCI. If you do not specify the index type in the CREATE INDEX statement, a B-tree index is generated.

The following describes how to estimate a B-tree index. Refer to "E.7 Estimating VCI Disk Space Requirements" for information on how to estimate VCI.

A B-tree index is saved as a fixed-size page of 8 KB. The page types are meta, root, leaf, internal, deleted, and empty. Since leaf pages usually account for the highest proportion of space required, you need to calculate the requirements for these only.

Table E.3 Estimation formula when the key data length is 512 bytes or less

Item	Estimation formula (bytes)
(1) Entry length	8 (*1) + key data length (*2) *1: Entry header *2: The key data length depends on its data type (refer to "E.3 Sizes of Data Types" for details). Because each entry is placed in boundaries of 8 bytes, you need to make an adjustment so that the length of the key data is a multiple of 8. For example, if the calculated length is 28 bytes, add 4 to make the length 32 bytes. - If the key data length exceeds 512 bytes, key data may be automatically compressed. In this case, use the estimation formula given in "Table E.4 Estimation formula when the key data length exceeds 512 bytes" to estimate the key data length.
(2) Page size requirement	8192 (*1) × fillfactor (*2) - 24 (*3) - 16 (*4) *1: Page length (8192) *2: Value of the fillfactor specified in the index definitions (if omitted, 90%) In the case of indexes of primary key constraints and unique constraints, the value of the fillfactor specified for each constraint in the table definitions (if omitted, 90%) *3: Page header (24) *4: Special data (16)

Item	Estimation formula (bytes)
	- The calculated (2) page size requirement will be rounded down to the nearest integer.
(3) Number of entries per page	(2) Page size requirement / ((1) entry length + 4 (*1)) *1: Pointer length - Result of (3) number of entries per page will be rounded down to the nearest integer.
(4) Number of pages required for storing indexes	Total number of records / (3) number of entries per page - Result of (4) number of pages required for storing indexes will be rounded up to the nearest integer.
(5) Space requirement	(4) Number of pages required for storing indexes x 8192 (*1) / usage rate (*2) *1: Page length *2: Specify 0.7 or lower.

Table E.4 Estimation formula when the key data length exceeds 512 bytes

Item	Estimation formula (bytes)
(5) Space requirement	Total number of records x key data length x compression ratio (*1) / usage rate (*2) *1: The compression ratio depends on the data value, so specify 1. *2: Specify 0.7 or lower as the usage rate.

E.3 Sizes of Data Types

This section lists the sizes of the data types.

E.3.1 Sizes of Fixed-Length Data Types

The following table lists the sizes of fixed-length data types.

Data type	Size (bytes)
SMALLINT (INT2)	2
INTEGER (INT4)	4
BIGINT (INT8)	8
REAL	4
DOUBLE PRECISION	8
SERIAL (SERIAL4)	4
BIGSERIAL (SERIAL8)	8
MONEY	8
FLOAT	8
FLOAT (1-24)	4
FLOAT (25-53)	8
TIMESTAMP WITHOUT TIME ZONE	8
TIMESTAMP WITH TIME ZONE	8
DATE	4
TIME WITHOUT TIME ZONE	8
TIME WITH TIME ZONE	12

Data type	Size (bytes)
INTERVAL	12
BOOLEAN	1
CIDR	IPv4: 7 IPv6: 19
INET	IPv4: 7 IPv6: 19
MACADDR	6
MACADDR8	8
POINT	16
LINE	32
LSEG	32
BOX	32
CIRCLE	24

E.3.2 Sizes of Variable-Length Data Types

The following table lists the sizes of variable-length data types.

Data type	Size (bytes)	Remarks
path	Length of size portion + 12 + 16 x number of vertices	1) When carrying out division, round to the next integer. 2) If the real data length is less than 127, then the length of the size portion is 1 byte, otherwise it is 4 bytes. 3) The number of bytes per character depends on the character set (refer to "E.3.4 Number of Bytes per Character" for details).
polygon	Length of size portion + 36 + 16 x number of vertices	
decimal	Length of size portion + 2 + (integer precision / 4 + decimal precision / 4) x 2	
numeric		
bytea	Length of size portion + real data length	
character varying(*n*), varchar(*n*)	Length of size portion + number of characters x number of bytes per character	
character(*n*), char(*n*)	Length of size portion + *n* x number of bytes per character	
text	Length of size portion + number of characters x number of bytes per character	

E.3.3 Sizes of Array Data Types

The following table lists the sizes of array data types.

Data type	Size (bytes)	Remarks
Array	Length of size portion + 12 + 8 x number of dimensions + data size of each item	If the real data length is less than 127, then the length of the size portion is 1 byte, otherwise it is 4 bytes. - Example of estimation when array data is "ARRAY[[1,2,3],[1,2,3]]" Number of dimensions: 2 INTEGER data size: 4 Total size = 1+12+8x2+6x4 = 53

E.3.4 Number of Bytes per Character

The following table lists the number of bytes per character.

The given values relate to the common character sets EUC-JP and UTF8.

Character type	Character set	Number of bytes per character
ASCII	EUC_JP	1
Halfwidth katakana	EUC_JP	2
JIS X 0208 kanji characters	EUC_JP	2
JIS X 0212 kanji characters	EUC_JP	3
ASCII	UTF8	1
Halfwidth katakana	UTF8	3
JIS X 0208 kanji characters	UTF8	3
JIS X 0212 kanji characters	UTF8	3

E.4 Estimating Transaction Log Space Requirements

This section provides the formula for estimating transaction log space requirements.

```
Transaction log space requirements = max_wal_size
```

However, if the update volume is extremely high (for example, due to a large data load and batch processing), disk writing at a checkpoint may not be able to keep up with the load, and a higher number of transaction logs than indicated here may temporarily be accumulated.

E.5 Estimating Archive Log Space Requirements

This section explains how to estimate archive log space requirements.

The archive log is an archive of the transaction logs from the time of a previous backup to the present, so it fluctuates depending on the backup period and the content of update transactions.

The longer the backup period and the more update transactions, the greater the space required for the archive log.

Therefore, measure the actual archive log space by using a test environment to simulate backup scheduling and database update in a real operating environment.

E.6 Estimating Backup Disk Space Requirements

This section provides the formula for estimating backup disk space requirements.

```
Backup disk space requirements = size of the database cluster x 2 + transaction log space requirements
                               + archive log space requirements
```

If the pgx_dmpall command performs a backup using a user exit, the backup disk size differs according to the database resources targeted for backup and the copy method.

E.7 Estimating VCI Disk Space Requirements

This section provides the formula for estimating VCI disk space requirements.

```
Disk space = (number of rows in tables) x (number of bytes per row) x (compression ratio) + (WOS size)
```

Number of bytes per row

```
Number of bytes per row = (19 + (number of columns specified in CREATE INDEX) / 8
                                  + (number of bytes per single column value)) x 1.1
```

Note: Round up the result to the nearest integer.

Compression ratio

Specify a value between 0 and 1. Since compression ratio depends on the data being compressed, use actual data or test data that simulates it, then compare the value with the estimation result. As a guide, the compression ratio measured with the Fujitsu sample data is shown below:

- Data with high degree of randomness (difficult to compress): Up to approximately 0.9 times.
- Data with high degree of similarity (easy to compress): Up to approximately 0.5 times.

WOS size

```
WOS size = (number of WOS rows) / 185 x 8096
```

One row is added to the number of WOS rows for each INSERT and DELETE, and two rows are added for UPDATE. On the other hand, the number decreases to 520,000 rows or less during conversion to ROS performed by the ROS control daemon.

Note

VCI does not support retrieval of disk space usage using the database object size function pg_indexes_size. To find out the actual total VCI disk space, check the disk space of the storage directory using an OS command or other method.

E.8 Estimating pgvector Disk Space Requirements

When using pgvector, refer to the pgvector documentation for the size of each data type and index. Refer to "OSS Supported by Fujitsu Enterprise Postgres" in the General Description for the documentation URL.

Information

For pgvector 0.7.4, refer to the documentation "Reference" for details on each data type, and the source code for index sizes.

Appendix F Estimating Memory Requirements

This appendix explains how to estimate the memory.

F.1 Fujitsu Enterprise Postgres Memory Requirements

This section describes the formulas for estimating Fujitsu Enterprise Postgres memory requirements.

Use the following formula to obtain a rough estimate of memory required for Fujitsu Enterprise Postgres:

```
fujitsuEnterprisePostgresRequiredMemory = sharedMemoryAmount + localMemoryAmount
```

Shared memory amount

```
sharedMemoryAmount = 1523444
                        + 8518 x x
                        + 7154 x (a + b + c + d + 1)
                        + 405 x (a + b + c + d + e) x f
                        + (1208 + g) x (a + b + c + d + 9)
                        + 64 x b
                        + 568 x c
                        + 104 x d
                        + 5666 x e
                        + 112 x h
                        + 8200 x i
                        + 512 x j
                        + 4 x (k + 10)
                        + 1097984 x m
                        + 258 x (a + b + c + d + 1 + e) x o
                        + (1024 x 1024) x p
                        + n
                        + 128 x q
```

The above units are Byte.

Parameter Details:

```
x = shared_buffer/8
    Note : Units of shared_buffer (kB)
    Example : x = 16384 (128 x 1024/8) when shared_buffer = 128 MB
        Convert MB to KB to calculate x.
a = max_connections
b = autovacuum_max_workers
c = max_worker_processes
d = max_wal_senders
e = max_prepared_transactions
f = max_locks_per_transaction
g = track_activity_query_size (byte)
h = max_logical_replication_workers
i = wal_buffers/8
  Note: If wal_buffers is the default value (-1), calculate i = x/32.
        However, if it becomes 2048 or more, set the maximum value to 2048.
        If i = x/32, there is a limit on the maximum value of i.
        Max i = WAL segment size/8
        The WAL segment size can be set with the initdb option --wal-segsize.
        The WAL segment size is in kilobytes.
        (The default WAL segment size is 16 MB. Convert to KB when calculating i)
  Example: If shared_buffer = 128 MB and wal_buffers = -1, i = 512 (16384/32)
           If shared_buffer = 2 GB and wal_buffers = -1, i = 2048 (2 x 1024 x 1024/8/32 = 8192,
           but the maximum value of i is 2048)
           If wal_buffers = 512 kB, i = 64 (512/8)
           i = 4096 (32 x 1024/8) when wal_buffers = 32 MB
```

```
                  Converts MB to KB to calculate i.
j = max_replication_slots
k = old_snapshot_threshold
  Note: If old_snapshot_threshold is the default value (-1), there is no need to add "4 x (k + 10)"
to the quote formula.
           old_snapshot_threshold units (min)
  Example: k = 60 (1 x 60) if old_snapshot_threshold = 1 h
               Convert h to min to get k.
m = pgx_global_metacache (megabytes)
n = memory size requested by the plug-in (determined by the plug-in)
o = max_pred_locks_per_transaction
p = min_dynamic_shared_memory (MB)
q = number of database roles
```

However, note that if instances have been created using WebAdmin, the parameters below will be configured automatically when the instances are created. Take this into account when calculating the shared memory size.

Parameter name	Set value
shared_buffers	30 percent of the internal memory of the machine.
max_connections	100
max_prepared_transactions	100

Local memory amount

```
localMemoryAmount = processStackArea
                  + memoryUsedInDbSessionsThatUseTempTables
                  + memoryUsedInDbSessionsThatPerformSortAndHashTableOperations
                  + memoryUsedInMaintenanceOperations
                  + baseMemoryUsedInEachProcess
                  + memoryUsedPreparingForDataAccess
```

Process stack area

```
processStackArea
  = max_stack_depth x (max_connections + autovacuum_max_workers + 9)
```

This formula evaluates to the maximum value.
Actually it is used according to the growth of the stack.
In the formula above, 9 is the number of processes that perform roles specific to servers.

Memory used in database sessions that use temporary tables

```
memoryUsedInDbSessionsThatUseTempTables
  = temp_buffers x max_connections
```

This formula evaluates to the maximum value.
Memory is gradually used as temporary buffers are used, and is released when the session ends.

Memory used in database sessions that perform sort and hash table operations

```
memoryUsedInDbSessionsThatPerformSortAndHashTableOperations
  = work_mem (*1) x max_connections
```

*1) For hash table operations, multiply work_mem by hash_mem_multiplier.
This formula evaluates to the maximum value.
Memory is gradually used as operations such as sort are performed, and is released when the query ends.

Memory used in maintenance operations

```
memoryUsedInMaintenanceOperations
  = maintenance_work_mem x (numOfSessionsPerformingMaintenance + autovacuum_max_workers)
```

Note that 'maintenance operations' are operations such as VACUUM, CREATE INDEX, and ALTER TABLE ADD FOREIGN KEY.

Base memory used in each process

```
baseMemoryUsedInEachProcess
  = baseMemoryUsedInOneProcess x (max_connections + autovacuum_max_workers + 9)
```

Use the result of the following formula for memory consumed per process. This formula evaluates to the memory used when server processes are running.
In the formula above, 9 is the number of processes that perform roles specific to servers.

The amount of memory consumed per process is determined by the number of tables, indexes, and all columns of all tables that the process accesses. If your system has about 100 tables, you can estimate it to be 3 MB, but otherwise use the following estimate:

```
baseMemoryUsedInOneProcess
  = (1.9KB x All user tables + 2.9KB x All user indexes + 1.0KB x All user columns) x 1.5(*1)

If you enable the Global Meta Cache feature, use the following formula:
baseMemoryUsedInOneProcess
 = (All user tables + All user indexes + All user columns) x 1.0KB x 1.5 (*1)
    + (All user tables x 1.4KB + All user indexes x 2.4KB)
```

*1) Safety Factor (1.5)
There are variable length information. This value takes that into account.

Memory used preparing for data access

```
memoryUsedPreparingForDataAccess
 = variationAmount x (max_connections + autovacuum_max_workers + 4)

  where variationAmount = shared_buffers / 8KB x 4 bytes
      (note that 8KB is the page length, and 4 bytes is the size of page management data)
```

This formula evaluates to the memory required to access the database cache in the shared memory.
In the formula above, among the processes that perform roles specific to servers, 4 is the number of processes that access the database.

F.2 Database Multiplexing Memory Requirements

This section describes the formula for estimating database multiplexing memory requirements for the database server.

Use the following formula to obtain a rough estimate of memory required for database multiplexing:

```
Memory usage of the database multiplexing feature for the database server
          = Peak memory usage of the Mirroring Controller processes
          + Peak memory usage of the Mirroring Controller commands

Peak memory usage of the Mirroring Controller processes=150 MB

Peak memory usage of the Mirroring Controller commands=50 MB x Number of commands executed
simultaneously
```

F.3 VCI Memory Requirements

This section describes the formula for estimating VCI memory requirements.

Use the following formula to obtain a rough estimate of memory requirements:

```
memUsedByVci = memForData + memForEachProcess
```

Memory required to store data in memory

Secure the space estimated using the formula below on the stable buffer (part of shared_buffers).

```
memForData = (numOfRowsInTables) x (numOfBytesPerRow) + (wosSize)
```

Number of bytes per row

```
numOfBytesPerRow
 = (19 + (numOfColsInCreateIndexStatement) / 8 + (numOfBytesPerSingleColValue)) x 1.1
```

Note: Round up the result to the nearest integer.

WOS size

```
wosSize = (numOfWosRows) / 185 x 8096
```

One row is added to the number of WOS rows for each INSERT and DELETE, and two rows are added for UPDATE. On the other hand, the number decreases to 520,000 rows or less during conversion to ROS performed by the ROS control daemon.

Memory required for each process

```
memForEachProcess
 = memUsedPerScanning
 + memUsedForVciMaintenace
 + memUsedByCreateIndexStatement
```

Memory used per scanning

- Parallel scan

```
memUsedPerScanning
 = vci.shared_work_mem + (numOfParallelWorkers + 1) x vci.maintenance_work_mem
```

Note: The number of parallel workers used by VCI simultaneously in the entire instance is equal to or less than vci.max_parallel_degree.

- Non-parallel scan

```
memUsedPerScanning = vci.max_local_ros + vci.maintenance_work_mem
```

Note

- vci.shared_work_mem, and vci.max_local_ros are used to create local ROS. If local ROS exceeds these sizes, execute a query without using VCI according to the conventional plan.
- vci.maintenance_work_mem specifies the memory size to be secured dynamically. If it exceeds the specified value, a disk temporary file is used for operation.

Memory used for VCI maintenance

```
memUsedForVciMaintenace = vci.maintenance_work_mem x vci.control_max_workers
```

Memory used by CREATE INDEX

```
memUsedByCreateIndexStatement = vci.maintenance_work_mem
```

Note

vci.maintenance_work_mem specifies the memory to be secured dynamically. If it exceeds the specified value, a disk temporary file is used for operation.

F.4 High-Speed Data Load Memory Requirements

This section describes the formula for estimating memory requirements for the high-speed data load feature.

Use the following formula to obtain a rough estimate of memory requirements:

```
Memory usage of high speed data load
 = (Peak memory usage of pgx_loader processes + Peak memory usage of the pgx_loader commands)
 x Number of commands executed simultaneously

Peak memory usage of pgx_loader processes
 = Peak memory usage of the backend process   (6 MB)
 + Peak memory usage of parallel workers       (6 MB x number of parallel workers)
 + Peak memory usage of dynamic shared memory (80 MB x number of parallel workers)

Peak memory usage of the pgx_loader commands=9 MB
```

Point

In addition to the size calculated using the formula above, the database cache on the shared memory estimated using the shared_buffers parameter is consumed according to the size of the data (table and index keys) loaded using this feature. Refer to "E.1 Estimating Table Size Requirements" and "E.2 Estimating Index Size Requirements" for information on estimating an appropriate shared buffers value.

F.5 Global Meta Cache Memory Requirements

This section describes the formula for estimating Global Meta Cache memory requirements.

The memory calculated by "Size of the GMC area" is allocated to the shared memory. The memory calculated by the per-process meta cache management information is allocated to the local memory. Refer to the graphic in "Architecture of Global Meta Cache Feature" in the "Memory usage reduction by Global Meta Cache" in the General Description for more information.

Use the following formula to obtain a rough estimate of memory requirements:

```
Amount of memory used by the Global Meta Cache feature
  = Size of GMC area + Per-process meta cache management information

Size of GMC area = (All user tables x 0.4 KB
     + All user indexes x 0.3 KB
     + All user columns x 0.8 KB) x 1.5 (*1)

Per-process meta cache management information
  = (All user tables + All user indexes + All user columns) x 0.1KB x max_connections x 1.5 (*1)
```

*1) Safety Factor (1.5)
This value takes into account the case where both GMC before and after the change temporarily exist at the same time in shared memory when the table definition is changed or the row of the system catalog is changed.

Appendix G Quantitative Limits

This appendix lists the quantitative limits of Fujitsu Enterprise Postgres.

Refer to the pgvector documentation for quantitative limits on the capabilities provided by pgvector. Refer to "OSS Supported by Fujitsu Enterprise Postgres" in the General Description for the documentation URL.

Table G.1 Length of identifier

Item	Limit
Database name	Up to 63 bytes (*1) (*2)
Schema name	Up to 63 bytes (*1) (*2)
Table name	Up to 63 bytes (*1) (*2)
View name	Up to 63 bytes (*1) (*2)
Index name	Up to 63 bytes (*1) (*2)
Tablespace name	Up to 63 bytes (*1) (*2)
Cursor name	Up to 63 bytes (*1) (*2)
Function name	Up to 63 bytes (*1) (*2)
Aggregate function name	Up to 63 bytes (*1) (*2)
Trigger name	Up to 63 bytes (*1) (*2)
Constraint name	Up to 63 bytes (*1) (*2)
Conversion name	Up to 63 bytes (*1) (*2)
Role name	Up to 63 bytes (*1) (*2)
Cast name	Up to 63 bytes (*1) (*2)
Collation sequence name	Up to 63 bytes (*1) (*2)
Encoding method conversion name	Up to 63 bytes (*1) (*2)
Domain name	Up to 63 bytes (*1) (*2)
Extension name	Up to 63 bytes (*1) (*2)
Operator name	Up to 63 bytes (*1) (*2)
Operator class name	Up to 63 bytes (*1) (*2)
Operator family name	Up to 63 bytes (*1) (*2)
Rewrite rule name	Up to 63 bytes (*1) (*2)
Sequence name	Up to 63 bytes (*1) (*2)
Text search settings name	Up to 63 bytes (*1) (*2)
Text search dictionary name	Up to 63 bytes (*1) (*2)
Text search parser name	Up to 63 bytes (*1) (*2)
Text search template name	Up to 63 bytes (*1) (*2)
Data type name	Up to 63 bytes (*1) (*2)
Enumerator type label	Up to 63 bytes (*1) (*2)
Profile name	Up to 63 bytes (*1) (*2)

*1: This is the character string byte length when converted by the server character set character code.

*2: If an identifier that exceeds 63 bytes in length is specified, the excess characters are truncated and it is processed.

Table G.2 Database object

Item	Limit
Number of databases	Less than 4,294,967,296 (*1)
Number of schemas	Less than 4,294,967,296 (*1)
Number of tables	Less than 4,294,967,296 (*1)
Number of views	Less than 4,294,967,296 (*1)
Number of indexes	Less than 4,294,967,296 (*1)
Number of tablespaces	Less than 4,294,967,296 (*1)
Number of functions	Less than 4,294,967,296 (*1)
Number of aggregate functions	Less than 4,294,967,296 (*1)
Number of triggers	Less than 4,294,967,296 (*1)
Number of constraints	Less than 4,294,967,296 (*1)
Number of conversion	Less than 4,294,967,296 (*1)
Number of roles	Less than 4,294,967,296 (*1)
Number of casts	Less than 4,294,967,296 (*1)
Number of collation sequences	Less than 4,294,967,296 (*1)
Number of encoding method conversions	Less than 4,294,967,296 (*1)
Number of domains	Less than 4,294,967,296 (*1)
Number of extensions	Less than 4,294,967,296 (*1)
Number of operators	Less than 4,294,967,296 (*1)
Number of operator classes	Less than 4,294,967,296 (*1)
Number of operator families	Less than 4,294,967,296 (*1)
Number of rewrite rules	Less than 4,294,967,296 (*1)
Number of sequences	Less than 4,294,967,296 (*1)
Number of text search settings	Less than 4,294,967,296 (*1)
Number of text search dictionaries	Less than 4,294,967,296 (*1)
Number of text search parsers	Less than 4,294,967,296 (*1)
Number of text search templates	Less than 4,294,967,296 (*1)
Number of data types	Less than 4,294,967,296 (*1)
Number of enumerator type labels	Less than 4,294,967,296 (*1)
Number of default access privileges defined in the ALTER DEFAULT PRIVILEGES statement	Less than 4,294,967,296 (*1)
Number of large objects	Less than 4,294,967,296 (*1)
Number of index access methods	Less than 4,294,967,296 (*1)
Number of profile	Less than 4,294,967,296 (*1)

*1: The total number of all database objects must be less than 4,294,967,296.

Table G.3 Schema element

Item	Limit
Number of columns that can be defined in one table	From 250 to 1600 (according to the data type)
Table row length	Up to 400 gigabytes

Item	Limit
Number of columns comprising a unique constraint	Up to 32 columns
Data length comprising a unique constraint	Less than 2,000 bytes (*1) (*2)
Table size	Up to 32 terabyte
Search condition character string length in a trigger definition statement	Up to 800 megabytes (*1) (*2)
Item size	Up to 1 gigabyte

*1: Operation might proceed correctly even if operations are performed with a quantity outside the limits.

*2: This is the character string byte length when converted by the server character set character code.

Table G.4 Index

Item	Limit
Number of columns comprising a key (including VCI)	Up to 32 columns
Key length (other than VCI)	Less than 2,000 bytes (*1)

*1: This is the character string byte length when converted by the server character set character code.

Table G.5 Data types and attributes that can be handled

Item			Limit
Character	Data length		Data types and attributes that can be handled (*1)
	Specification length (n)		Up to 10,485,760 characters (*1)
Numeric	External decimal expression		Up to 131,072 digits before the decimal point, and up to 16,383 digits after the decimal point
	Internal binary expression	2 bytes	From -32,768 to 32,767
		4 bytes	From -2,147,483,648 to 2,147,483,647
		8 bytes	From -9,223,372,036,854,775,808 to 9,223,372,036,854,775,807
	Internal decimal expression		Up to 13,1072 digits before the decimal point, and up to 16,383 digits after the decimal point
	Floating point expression	4 bytes	From -3.4E+38 to -7.1E-46, 0, or from 7.1E-46 to 3.4E+38
		8 bytes	From -1.7E+308 to -2.5E-324, 0, or from 2.5E-324 to 1.7E+308
bytea			Up to one gigabyte minus 53 bytes
Large object			Up to 4 terabyte

*1: This is the character string byte length when converted by the server character set character code.

Table G.6 Function definition

Item	Limit
Number of arguments that can be specified	Up to 100
Number of variable names that can be specified in the declarations section	No limit

Item	Limit
Number of SQL statements or control statements that can be specified in a function processing implementation	No limit

Table G.7 Data operation statement

Item	Limit
Maximum number of connections for one process in an application (remote access)	4,000 connections
Number of expressions that can be specified in a selection list	Up to 1,664
Number of tables that can be specified in a FROM clause	No limit
Number of unique expressions that can be specified in a selection list/ DISTINCT clause/ORDER BY clause/GROUP BY clause within one SELECT statement	Up to 1,664
Number of expressions that can be specified in a GROUP BY clause	No limit
Number of expressions that can be specified in an ORDER BY clause	No limit
Number of SELECT statements that can be specified in a UNION clause/INTERSECT clause/EXCEPT clause	Up to 4,000 (*1)
Number of nestings in joined tables that can be specified in one view	Up to 4,000 (*1)
Number of functions or operator expressions that can be specified in one expression	Up to 4,000 (*1)
Number of expressions that can be specified in one row constructor	Up to 1,664
Number of expressions that can be specified in an UPDATE statement SET clause	Up to 1,664
Number of expressions that can be specified in one row of a VALUES list	Up to 1,664
Number of expressions that can be specified in a RETURNING clause	Up to 1,664
Total expression length that can be specified in the argument list of one function specification	Up to 800 megabytes (*2)
Number of cursors that can be processed simultaneously by one session	No limit
Character string length of one SQL statement	Up to 800 megabytes (*1) (*3)
Number of input parameter specifications that can be specified in one dynamic SQL statement	No limit
Number of tokens that can be specified in one SQL statement	Up to 10,000
Number of values that can be specified as a list in a WHERE clause IN syntax	No limit
Number of expressions that can be specified in a USING clause	No limit
Number of JOINs that can be specified in a joined table	Up to 4,000 (*1)
Number of expressions that can be specified in COALESCE	No limit
Number of WHEN clauses that can be specified for CASE in a simple format or a searched format	No limit
Data size per record that can be updated or inserted by one SQL statement	Up to one gigabyte minus 53 bytes
Number of objects that can share a lock simultaneously	Up to 256,000 (*1)

*1: Operation might proceed correctly even if operations are performed with a quantity outside the limits.

*2: The total number of all database objects must be less than 4,294,967,296.

*3: This is the character string byte length when converted by the server character set character code.

Table G.8 Data size

Item	Limit
Data size per record for input data files (COPY statement, psql command \copy meta command)	Up to 800 megabytes (*1)
Data size per record for output data files (COPY statement, psql command \copy meta command)	Up to 800 megabytes (*1)

*1: Operation might proceed correctly even if operations are performed with a quantity outside the limits.

Appendix H Determining the Preferred WebAdmin Configuration

This appendix describes the two different configurations in which WebAdmin can be used and how to select the most suitable configuration.

H.1 WebAdmin Configurations

WebAdmin can be installed in two configurations:

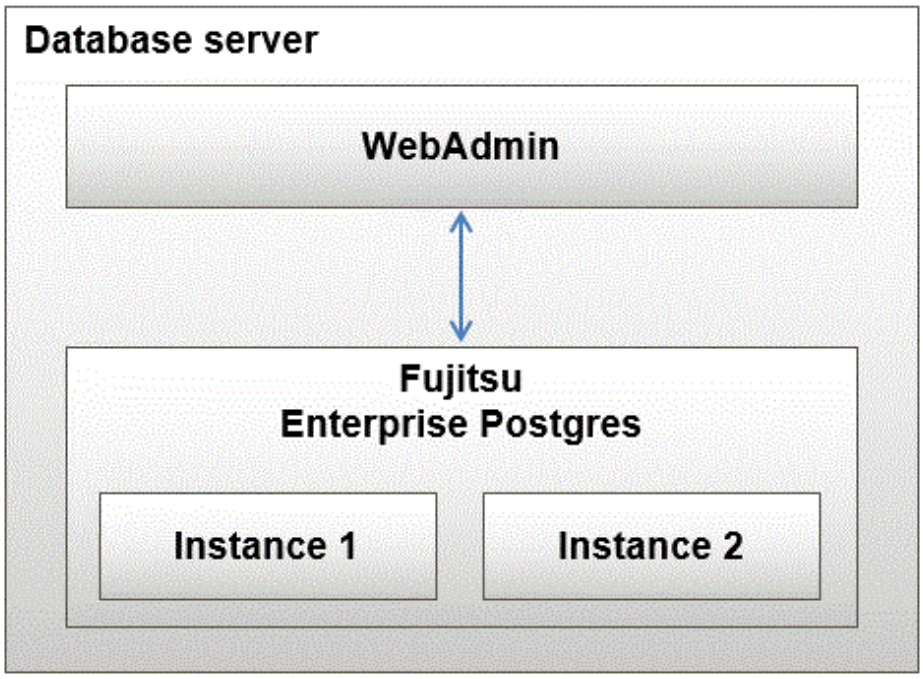
- Single-server
- Multiserver

WebAdmin supports the option to select http or secure https between browsers and servers and between servers. If you have a multi-server environment with a mix of older versions, select http (the default) during setup to continue using the HTTP protocol. This is because older versions do not support HTTPS and all HTTPS settings must be the same on the configuration server.

H.1.1 Single-Server Configuration

A single-server configuration enables you to create and operate instances on a single server. In this configuration, WebAdmin must be installed on the same database server as the Fujitsu Enterprise Postgres Server component.

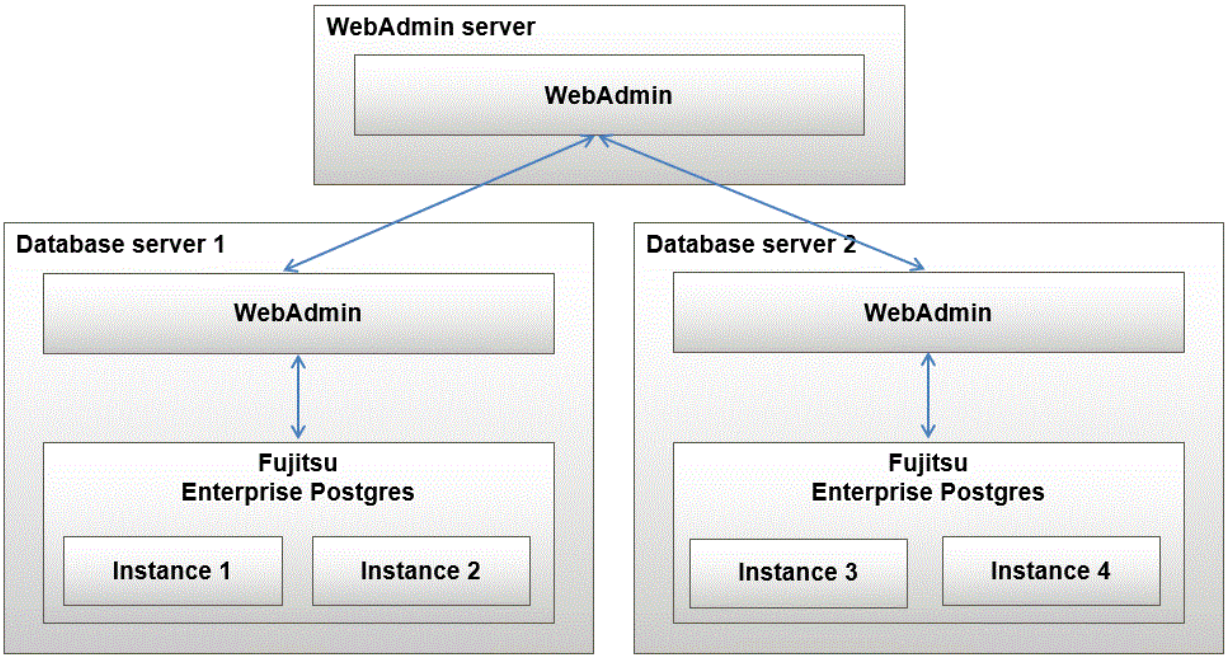
Single-server configuration



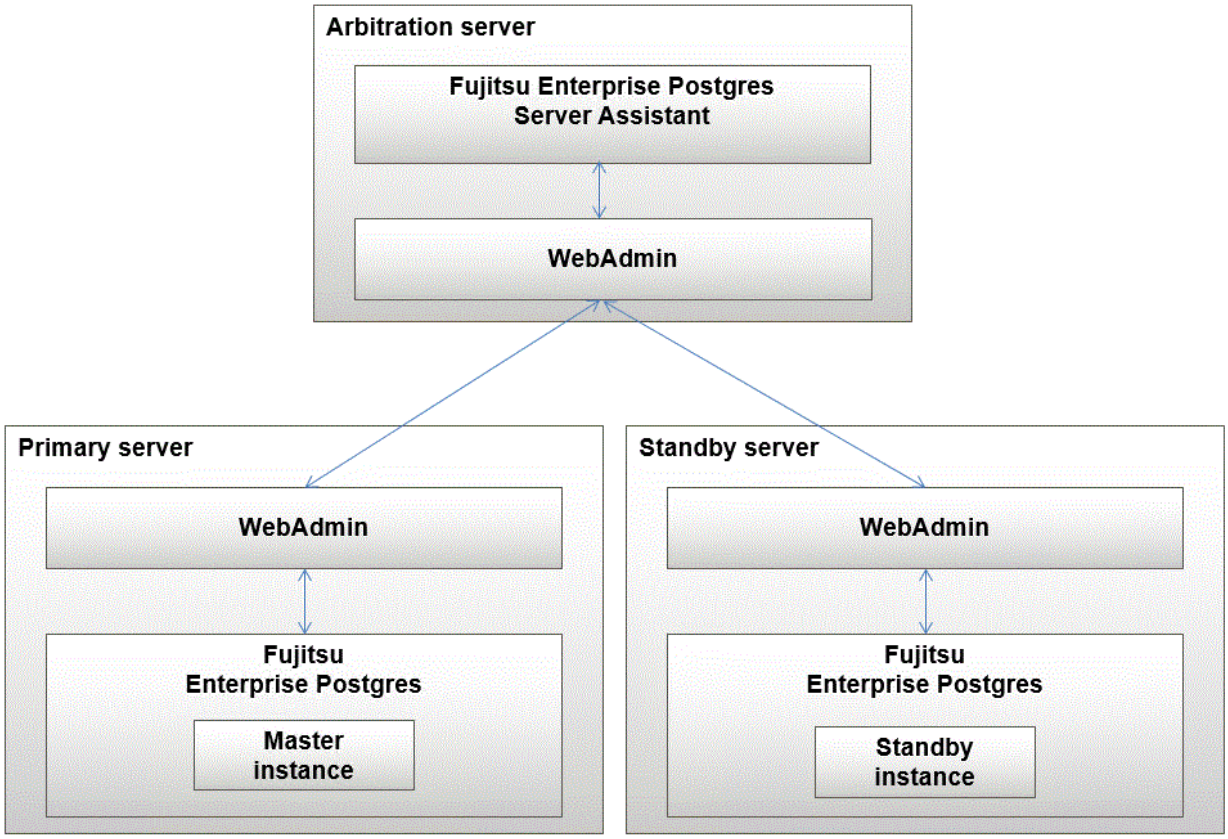
H.1.2 Multiserver Configuration

A multiserver configuration enables you to create and operate instances stored on multiple database servers. As shown in the figure below, WebAdmin can be installed on a dedicated WebAdmin server and used to collectively manage the instances stored on the database servers.

Multiserver configuration



Also, when setting up the arbitration server by WebAdmin during database multiplexing mode, install WebAdmin on the arbitration server.



H.2 Installing WebAdmin in a Single-Server Configuration

To install WebAdmin in a single-server configuration, the Fujitsu Enterprise Postgres Server component and WebAdmin must be installed on the same machine.

Select the following items when installing Fujitsu Enterprise Postgres in a single-server configuration:

- Fujitsu Enterprise Postgres Advanced Edition or Fujitsu Enterprise Postgres Standard Edition
- WebAdmin

H.3 Installing WebAdmin in a Multiserver Configuration

In a multiserver configuration, install WebAdmin on one server, and both WebAdmin and the Fujitsu Enterprise Postgres Server component on any number of database servers.

Select the following items when installing Fujitsu Enterprise Postgres in a multiserver configuration:

- WebAdmin server:
  - WebAdmin
- Database server:
  - Fujitsu Enterprise Postgres Advanced Edition or Fujitsu Enterprise Postgres Standard Edition
  - WebAdmin

Also, when setting up the arbitration server by WebAdmin during database multiplexing mode, select the following when installing Fujitsu Enterprise Postgres.

- Arbitration server
  - Fujitsu Enterprise Postgres Server Assistant
  - WebAdmin

See

Refer to the Installation and Setup Guide for Server Assistant for details on how to install the Server Assistant.

Appendix I Supported contrib Modules and Extensions Provided by External Projects

Fujitsu Enterprise Postgres supports PostgreSQL contrib modules, and extensions provided by external projects.

Refer to the following for details on the supported contrib modules:

- "Additional Supplied Modules" in the PostgreSQL Documentation
- "Additional Supplied Programs" in the PostgreSQL Documentation

Information

You can also check the list of available extensions using the pg_available_extensions view.

Refer to "OSS Supported by Fujitsu Enterprise Postgres" in the General Description for information on supported extensions provided by external projects.

Appendix J Deploying Virtual Machines by Cloning

Learn how to install Fujitsu Enterprise Postgres on a virtual machine, clone the virtual machine, and deploy a new virtual machine.

J.1 If you are installing only

There are no guidelines for installing Fujitsu Enterprise Postgres on a virtual machine only and cloning a virtual machine.

J.2 If you are creating an instance

When creating an instance on a virtual machine and cloning the virtual machine, the following precautions must be taken:

- Clone the virtual machine while the instance and WebAdmin are stopped.
- Modify the IP address and host name settings in files such as postgresql.conf and pg_hba.conf if they are different for each replicated machine.
- Use transparent data encryption on the replicated machine. Instances that use transparent data encryption cannot be cloned for use.
- If you cloned the virtual machine that contains the WebAdmin server, reinstall WebAdmin and import the instance that WebAdmin created.

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