

SSL encrypted mode configuration for CAST Storage Service and PostgreSQL

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Summary: Instructions for configuring CAST Storage Service/PostgreSQL and CAST AIP related applications to function in SSL encrypted mode.

Introduction

Out of the box, both CAST Storage Service and PostgreSQL are not preconfigured to function in SSL encrypted mode, i.e. to accept incoming encrypted database connections for enhanced security. However, SSL encrypted mode can be configured if required. The configuration process involves specific steps described in this document:

- Generate SSL certificates/keys
- Configure CAST Storage Service/PostgreSQL to accept incoming SSL connections
- Configure CAST AIP core and related applications to function in SSL mode
- Configure CAST AIP Console/AIP Node to function in SSL mode
- Configure standalone CAST Dashboards to function in SSL mode

Which CAST applications can currently connect in SSL mode?

See the table in [CAST Storage Service - Deployment requirements](#).

Configuration process

Generate SSL certificates/keys

The first step is to generate the SSL certificates/keys that are required by both the CAST Storage Service/PostgreSQL instance and CAST applications.

Install OpenSSL

To generate the required SSL certificates, [OpenSSL](#) must be installed on the server hosting your CAST Storage Service/PostgreSQL instance.

OpenSSL installation on Windows

- Download and install OpenSSL from <http://gnuwin32.sourceforge.net/packages/openssl.htm> (note that this will install an older release - 0.9.8).
- Create a **System** and **User** Environmental variable as follows:
 - Variable Name - **OPENSSL_CONF**
 - Variable Value - location of the **openssl.cnf** file, for example: **%PROGRAMFILES%\GnuWin32\share\openssl.cnf**

OpenSSL installation on Linux

OpenSSL may be preinstalled on your chosen Linux distribution. To check, run the following command:

```
openssl version
```

If OpenSSL is not installed, follow the appropriate installation instructions. For example:

```
Debian based: apt-get install openssl  
RedHat/CentOS based: yum install openssl
```

Certificate/key generation



Note that you may wish to consult PostgreSQL documentation for more information <https://www.postgresql.org/docs/9.6/ssl-tcp.html>.

Create a root key and certificate for the server hosting CAST Storage Service/PostgreSQL (root.crt, root.key) - ensure you change any settings, in particular the **-subj option** to suit your own environment:

```
openssl genrsa -des3 -out root.key 1024  
openssl rsa -in root.key -out root.key  
openssl req -new -key root.key -days 365 -out root.crt -x509 "/CN=root.yourdomain.com"
```

Create a server key and certificate for the server hosting CAST Storage Service/PostgreSQL (server.crt, server.key) - ensure you change any settings, in particular the **-subj option** to suit your own environment:

```
openssl genrsa -des3 -out server.key 1024  
openssl rsa -in server.key -out server.key  
openssl req -new -key server.key -out server.csr -subj "/CN=server.hostname"  
openssl x509 -req -in server.csr -CA root.crt -CAkey root.key -days 365 -out server.crt -CAcreateserial
```

Create the client certificates/keys to be used with CAST applications (postgresql.crt, postgresql.key, postgresql.pk8, postgresql.pfx) - ensure you change any settings, in particular the **-subj option** to suit your own environment:

```
openssl genrsa -des3 -out postgresql.key 1024  
openssl rsa -in postgresql.key -out postgresql.key  
openssl req -new -key postgresql.key -out postgresql.csr -subj "/CN=operator"  
openssl x509 -req -in postgresql.csr -CA root.crt -days 365 -CAkey root.key -out postgresql.crt -CAcreateserial  
openssl pkcs8 -topk8 -in postgresql.key -out postgresql.pk8 -outform der -nocrypt  
openssl pkcs12 -export -out postgresql.pfx -inkey postgresql.key -in postgresql.crt -password pass:
```

Finally, copy the following "server" certificates and keys to the folder in which your **postgresql.conf** file is located:

- **root.crt**
- **server.key**
- **server.crt**

The **postgresql.conf** file located is here:

```
Windows: %PROGRAMFILES%\CAST\CASTStorageService3\db_data  
  
Linux: Run the following commands in psql on the host server to locate the postgresql.conf file:  
  
psql -U postgres  
show config_file;
```

Configure CAST Storage Service/PostgreSQL to accept incoming SSL connections

Edit postgresql.conf to enable SSL

Edit the **postgresql.conf** file located here:

```
Windows: %PROGRAMFILES%\CAST\CASTStorageService3\db_data
```

Linux: Run the following commands in psql on the host server to locate the postgresql.conf file:

```
psql -U postgres
show config_file;
```

Modify the file as follows and then save the file:

```
# - Security and Authentication -

ssl = on                                # (change requires restart)
ssl_cert_file = 'server.crt'           # (change requires restart)
ssl_key_file = 'server.key'            # (change requires restart)
ssl_ca_file = 'root.crt'                # (change requires restart)
```

Edit pg_hba.conf file to enable SSL

Edit the `pg_hba.conf` file located here:

```
Windows: %PROGRAMFILES%\CAST\CASTStorageService3\db_data
```

Linux: Run the following commands in psql on the host server to locate the postgresql.conf file:

```
psql -U postgres
show hba_file;
```

Modify the file as follows to allow IPv4 and IPv6 (where appropriate) connections using SSL by adding "`hostssl`" entries and an appropriate authentication METHOD (see <https://www.postgresql.org/docs/9.6/auth-pg-hba-conf.html> for more information about this):

```
# TYPE DATABASE USER ADDRESS METHOD

# "local" is for Unix domain socket connections only
local all all peer
# IPv4 local connections:
host all all 127.0.0.1/32 md5
host all all 0.0.0.0/0 md5
# Allow IPv4 loopback with SSL + password + a check on SSL cert
hostssl all all 127.0.0.1/32 md5 clientcert=1
# Allow any IPv4 with SSL + password + a check on SSL cert
hostssl all all 0.0.0.0/0 md5 clientcert=1
# IPv6 local connections:
host all all ::1/128 md5
host all all ::0/0 md5
# Allow IPv6 loopback with SSL + password + a check on SSL cert
hostssl all all ::1/128 md5 clientcert=1
# Allow any IPv6 with SSL + password + a check on SSL cert
hostssl all all ::0/0 md5 clientcert=1
```



- The `hostssl` entries given above are purely **for example only**. Please ensure that you tailor this file to your own environment and that the authentication METHOD is appropriate.
- The mix of `host` and `hostssl` entries above will allow **both SSL and non-SSL connections**. If you prefer to block non-ssl connections, comment out all the lines starting with "host" by adding a # at the start of the line.

Restart CAST Storage Service/PostgreSQL instance

Finally restart your CAST Storage Service or PostgreSQL instance to ensure the changes you have made are taken into account.

Configure applications to function in SSL mode

To force CAST AIP core and related applications/CAST Imaging to connect to CAST Storage Service or PostgreSQL in SSL mode, the following is required:

- an `SSLParameters.ini` file needs to be created and then configured on all AIP Core instances (AIP Nodes) / CAST Imaging instances
- a Windows environment variable (System or User according to your own requirements) needs to be created referencing the ini file on all AIP Core instances (AIP Nodes) / CAST Imaging instances
- configure the `aip-node-app.properties` on all AIP Core instances (AIP Nodes)

Create and configure `SSLParameters.ini` file on all AIP Core (AIP Node) instances / CAST Imaging instances

Supported CAST applications are configured to look for a file called `SSLParameters.ini` via an **environment variable** that is defined on the host server. This `SSLParameters.ini` file allows you to configure SSL mode for multiple CAST Storage Services/PostgreSQL instances and determine where the required client side certificates and keys are located.

You can store the `SSLParameters.ini` file:

- **on the server's local file system** - in this situation, all servers hosting CAST applications that must use SSL mode to connect to a CAST Storage Service/PostgreSQL instance must have a copy of the `SSLParameters.ini` file, therefore if you need to make an update to the file, you will need to make the update on all servers where the file exists.
- **on a shared network drive** - in this situation, the `SSLParameters.ini` file is stored on a shared network drive that is accessible from all servers hosting CAST applications that must use SSL mode to connect to a CAST Storage Service/PostgreSQL instance. The advantage of this is that there is only one copy of the `SSLParameters.ini` file and the configuration is valid for all servers

Create the `SSLParameters.ini` file using a text editor and use the following syntax:

```
[HOST:PORT]
ssl=true
sslmode=require
sslrootcert=root.crt
ssljdbckey=postgresql.pk8
sslkey=postgresql.key
sslcert=postgresql.crt
sslpx=postgresql.pfx

[HOST:PORT]
ssl=true
sslmode=require
sslrootcert=root.crt
ssljdbckey=postgresql.pk8
sslkey=postgresql.key
sslcert=postgresql.crt
sslpx=postgresql.pfx
```

HOST: PORT	Refers to the target CAST Storage Service/PostgreSQL instance. For example: <ul style="list-style-type: none">• SERVER1:2282• 192.168.20.52:2282• SERVER2:5432 You can add as many <code>HOST:PORT</code> sections as you require.
ssl=	Signifies that the connection to the target server specified in <code>HOST:PORT</code> must use SSL mode (true).
sslmode=	Value should be one of the following: <ul style="list-style-type: none">• require• verify-ca• verify-full• disable More details about this is mentioned in https://www.postgresql.org/docs/13/libpq-ssl.html . This variable will match the PostgreSQL SSL parameter <code>PGSSLMODE</code> .

All other options	<p>Refers to the location of the client certificates and keys generated previously with OpenSSL. The certificates and keys need to be copied to the location you have chosen. The location of these certificates and keys is flexible:</p> <ul style="list-style-type: none"> • They can be stored on a shared network drive • They can be stored on the server's local file system - in this situation, the certificates and keys need to be available on all server's that must use SSL mode <p>You can use the following path syntax:</p> <ul style="list-style-type: none"> • Local drive: D:\keys\postgresql.key • Direct path: \\SERVER\certs\root.crt • Mapped drive on server: S:\certs\root.crt >>> Appropriate permissions required. <p>CAST highly recommends that you separate the storage and place the .crt files in one folder and all other keys (.pk8, .key, .pfx) in another folder - i.e. do not mix the two together.</p>
sslrootcert=	<p>Give the full path of root.crt file (the crt file which is generated using OpenSSL for trusted certificate authorities). This variable will match the PostgreSQL SSL parameter PGSSLROOTCERT.</p>
sslkey=	<p>Give the full path of postgresql.key file (the key file which is generated using OpenSSL for client certificate). This variable will match the PostgreSQL SSL parameter PGSSLKEY.</p>
sslcert=	<p>Give the full path of postgresql.crt file (the key file which is generated using OpenSSL for client private key). This variable will match the PostgreSQL SSL parameter PGSSLCERT.</p>
ssljdbckey=	<p>Give the full path of postgresql.pk8 file (this is the key file which is generated using OpenSSL based on client certificate (postgresql.crt) and client private key (postgresql.key) using pk8 for JDBC connections).</p>
sslpfx=	<p>Give the full path of postgresql.pfx file (this is the key file which is generated using OpenSSL based on client certificate (postgresql.crt) and client private key (postgresql.key) using pkcs12 for .NET connections).</p>



- Ensure that the service (or the user who launches the CAST applications programs) is dedicated.
- Do not put certificates and .key files in the same folder
- Create a dedicated folder for .key files and only give access to the dedicated CAST user
- Do not use a password on the .pfx file, otherwise you will have to enter the password each time you restart
- If you are using AIP Console to manage the AIP Node, and you have defined a **dedicated** CAST Storage Service/PostgreSQL instance just for the Measurement schema (see the screen **Configure Measurement Database** in **Complete start-up wizard**), you must ensure that you define an entry for this CAST Storage Service/PostgreSQL instance in the SSLParameters.ini file and this entry **MUST** be present on all AIP Nodes that are being managed in AIP Console.

Create environment variable on all AIP Core (AIP Node) instances / CAST Imaging instances

Create a Windows environment variable (System or User according to your own requirements) on each server hosting CAST applications that must use SSL mode to connect to a CAST Storage Service/PostgreSQL instance. Use the following syntax:

- Variable Name - **CASTCONNECTIONEXTRAPARAMETERS**
- Variable Value - location of the **SSLParameters.ini** file, for example: <FULLPATH>\SSLParameters.ini

Configure AIP Node (for AIP Console) to function in SSL mode

If you are using AIP Console to manage the AIP Node, the following configuration must be performed on **each AIP Node** (i.e. a machine on which CAST AIP Core has been installed and is being managed in AIP Console) that must use an encrypted SSL connection to the target CAST Storage Service /PostgreSQL instance.

Edit the following file:

```
%PROGRAMDATA%\CAST\AipConsole\AipNode\aip-node-app.properties
```

Find the following section:

```
# =====
# CSS Server parameters
# -----
database.server.name=my_css_server:2282
database.server.user=operator
database.server.ssl=
database.server.ssl.iniPath=
# to encrypt the password use aip-encryption-tool
database.server.password=CRYPTED2:90B1A6EC1618661401B724DB5AC34595
database.name=postgres
```

Update the **database.server.ssl** and **database.server.ssl.iniPath** parameters as follows:

```
# =====
# CSS Server parameters
# -----
database.server.name=my_css_server:2282
database.server.user=operator
database.server.ssl=true
database.server.ssl.iniPath=<PATH_TO>/SSLParameters.ini
# to encrypt the password use aip-encryption-tool
database.server.password=CRYPTED2:90401B724DB5AC34595
database.name=postgres
```

database.server.ssl	Set this option to true to enforce an encrypted SSL connection. Without this option, a standard non-encrypted connection will be used.
database.server.ssl.iniPath	Set this to the path where your SSLParameters.ini file is located.

Restart Microsoft Windows on all AIP Nodes / CAST Imaging instances

Finally restart Microsoft Windows on all AIP Nodes/ CAST Imaging instances so that all changes are taken into account.

Configure standalone CAST Dashboards to function in SSL mode

There are two ways to force the standalone CAST Dashboards to function in SSL mode:

- By **modifying the URL** that points to the CAST Storage Service/PostgreSQL instance (this method must be used for Dashboards deployed in **Linux** environments, but can also be used in Microsoft Windows environments)
- By **using the SSLParameters.ini file and an environment variable** (this method should be used for Dashboards deployed in Microsoft Windows environments)

Method 1: Modify the connection URL

Edit the following file:

```
WAR 2.x
CATALINA_HOME\webapps\

```

Locate the following section in the file:

```

## DATASOURCE
# Resource1 is the datasource name used in domains.properties
# Adapt server name (localhost) and port (2282) if required
# You can add multiple datasources if you want to connect to multiple CSS Servers. Datasource name must be
unique
# You have to configure your domains names and relative schema names in domains.properties
restapi.datasource[0].url=jdbc:postgresql://localhost:2282/postgres
restapi.datasource[0].username=operator
restapi.datasource[0].password=CastAIP
restapi.datasource[0].poolname=Resource1
restapi.datasource[0].minimumIdle=10
restapi.datasource[0].maximumPoolSize=20

```

Modify the `restapi.datasource[0].url=jdbc:postgresql://localhost:2282/postgres` line to point to the certificate files you generated previously:

```

restapi.datasource[0].url=jdbc:postgresql://my_server:2282/postgres?
ssl=true&sslrootcert=\\\\my_host\\share\\root.crt&sslcert=\\\\my_host\\share\\postgresql.
crt&sslkey=\\\\my_host\\share\\postgresql.pk8&sslmode=verify-ca

```

This is broken down as follows:

ssl=true	Force the connection to use SSL mode.
sslrootcert=\\\\my_host\\share\\root.crt	Specifies the location of the root.crt certificate file. In this example, the file is located on a network share <code>\\my_host\\share\\root.crt</code> . Back slashes in the path MUST be escaped with a backslash.
sslcert=\\\\my_host\\share\\postgresql.crt	Specifies the location of the postgresql.crt certificate file. In this example, the file is located on a network share <code>\\my_host\\share\\postgresql.crt</code> . Back slashes in the path MUST be escaped with a backslash.
sslkey=\\\\my_host\\share\\postgresql.pk8	Specifies the location of the postgresql.pk8 certificate file. In this example, the file is located on a network share <code>\\my_host\\share\\postgresql.pk8</code> . Back slashes in the path MUST be escaped with a backslash.
sslmode=verify-ca	See the table in https://www.postgresql.org/docs/13/libpq-ssl.html#LIBPQ-SSL-PROTECTION for more information.

Finally restart the application server so that all changes are taken into account.

Method 2: Using the SSLParameters.ini file and an environment variable

- Create and configure **SSLParameters.ini** file on host server [as described above](#).
- Create an **environment variable** on the host server [as described above](#).
- Finally restart the application server so that all changes are taken into account.

Notes

Any custom scripts that you use to connect to your CAST Storage Service / PostgreSQL instance will need to be refactored to take advantage of the encrypted SSL connection should you wish to.