THALES

Vormetric Data Security Platform

Vormetric Protection for Teradata Database

Installation and Reference Guide

Version 6.1.3

Doc v1

December 20, 2018

Vormetric Data Security Platform
Vormetric Protection for Teradata Database
Version 6.1.3
December 20, 2018, *Installation and Reference Guide* v1

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Contents

PREFACE

This manual describes how to install and implement Vormetric Protection for Teradata Database (VPTD) on your Teradata nodes.

DOCUMENTATION VERSION HISTORY

The following table describes the changes made for each document version.

Documentation Changes

Document Version	Date	Changes
6.1.3	12/7/18	Added content to describe user restriction based on identity.
6.0.2. v1	5/10/18	Updated illustrations. Added new features: Dynamic masking, install, uninstall and upgrade over a TD cluster.
5.2.5 v2	1/25/17	Add integrated installer (vptd-*).
5.2.5 v1	12/16/16	GA release of 5.2.5 document.
5.2.5 Beta v1	9/2/16	Added UDFs for Unicode block cipher and FPE encryption: encrypt_cbc( ), decrypt_cbc( ), encrypt_fpe( ), and decrypt_fpe( ).

ASSUMPTIONS

This documentation assumes knowledge of the Teradata database.

The system administrator must have root permissions for the systems on which Vormetric Protection for Teradata Database software is installed.

GUIDE TO VORMETRIC PROTECTION FOR TERADATA DATABASE DOCUMENTATION

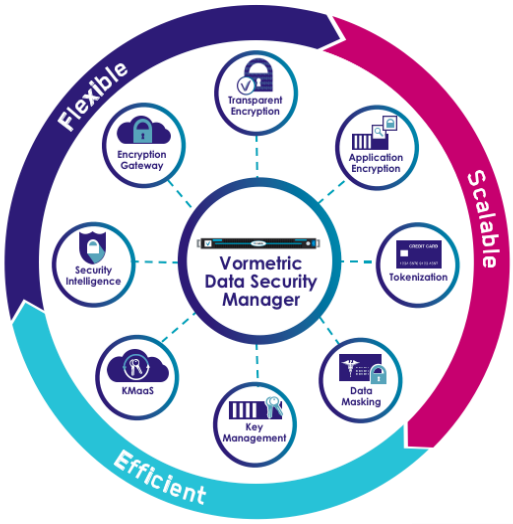
The following related documents are available to registered users on the Vormetric Web site at https://support.vormetric.com

1. **Data Security Manager (DSM) Installation and Configuration Guide**. Use this to install the Data Security Manager.
2. **Vormetric Protection for Teradata Database Installation and Reference**. This document. For security professionals who want to protect their Teradata Database.
3. **Vormetric Security Intelligence Configuration Guide**. Use this to integrate your Vormetric Tokenization event logs with the ArcSight ESM, Splunk, or IBM QRadar
4. **Vormetric Data Security (VDS) Platform Event and Log Messages Reference** (~700 pages, 0% pictures). A listing of all the VDS Platform event and log messages with severity, long and short form, and description.

VORMETRIC DATA SECURITY PLATFORM—OVERVIEW

The Vormetric Data Security (VDS) Platform protects data wherever it resides. The platform solves security and compliance issues with encryption, key management, privileged user access control, and security intelligence logging. It protects data in databases, files, and Big Data nodes across public, private, hybrid clouds and traditional infrastructures.

Figure 1: The Vormetric "Solar System"



The platform consists of products that share a common, extensible infrastructure. At the heart of the platform is the Data Security Manager (DSM), which coordinates policies, keys, and the collection of security intelligence, all of which is managed and observed through your browser. In addition to the DSM, the Vormetric Data Security Platform consists of the following products:

- **Vormetric Application Encryption (VAE)** provides a framework to deliver application-layer encryption such as column- or field-level encryption in databases, Big Data, or PaaS applications. VAE is an application encryption library providing a standards-based API to do cryptographic and encryption key management operations into existing corporate applications.
- **Vormetric Cloud Encryption Gateway (VCEG)** safeguards files in cloud-storage environments, including Amazon S3 and Box. VCEG encrypts sensitive data before it is saved to the cloud, enabling security teams to establish visibility and control around cloud assets.
- **Vormetric Key Management (VKM)** centralizes 3rd-party encryption keys and stores certificates securely. It provides standards-based enterprise encryption key management for Transparent Database Encryption (TDE), KMIP-compliant devices, and offers vaulting and inventory of certificates.
- **Vormetric Protection for Teradata Database** provides granular controls to secure assets in Teradata environments. It simplifies the process of using column-level encryption in your Teradata database. It provides documented, standards-based APIs and user-defined functions (UDFs) for cryptographic and key management operations.

- **Vormetric Security Intelligence** provides comprehensive logging combined with Security Information Event Management (SIEM) systems to detect advanced persistent threats and insider threats. In addition, the logs satisfy compliance and regulatory audits.
- **Vormetric Tokenization with Dynamic Data Masking (VTS)** replaces sensitive data in your database with unique identification symbols called tokens. This reduces the number of places that clear-text sensitive data reside, and thus reduces the scope of complying with PCI DSS and corporate security policies.
- **Vormetric Transparent Encryption (VTE)** secures any database, file, or volume across your enterprise without changing the applications, infrastructure, or user experience.

SERVICE UPDATES AND SUPPORT INFORMATION

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- support@thalesesecurity.com
- (877) 267-3247

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- http://enterprise-encryption.vormetric.com/contact-sales.html
- sales@thalesesec.net
- (408) 433-6000

Vormetric Protection for Teradata Database (VPTD)

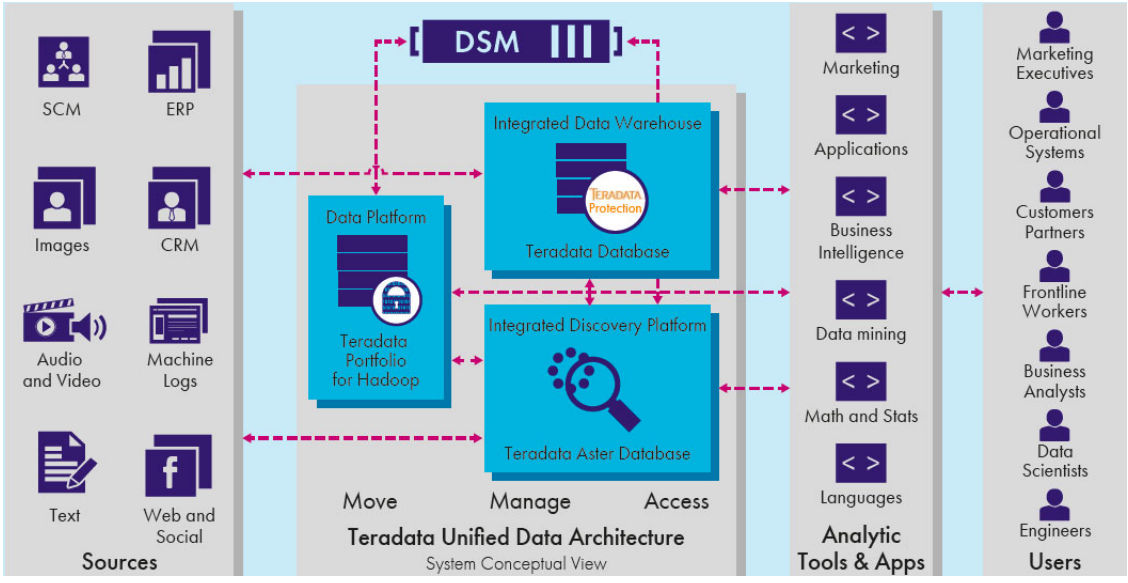
1

Vormetric Protection for Teradata Database (VPTD) is essentially Vormetric Application Encryption (VAE) in the Teradata environment. It enables column-level encryption of Teradata databases. This chapter describes how VPTD provides protection in the Teradata database environment. It contains the following sections:

Overview

A Teradata database consists of a Parsing Engine (PE) and any number of Access Module Processors (AMP) that exist on *nodes.* Nodes are servers that can host multiple virtual AMPs (VAMPs) and, optionally, the parsing engine itself.

Figure 2: Typical Teradata deployment



A Teradata site consists of one or more nodes. Each Teradata site requires a *Data Security Manager* (DSM).

The following Teradata **User Defined Functions** (UDFs) must be provided by Vormetric and installed in the Teradata database:

- *encrypt_cbc()* – Encrypts a string provided in Unicode format
- *decrypt_cbc()* – Decrypts data that was encrypted using *encrypt_cbc()* and returns a string in Unicode format
- *encrypt_fpe()* – Performs format preserving encryption on a string provided in Unicode format
- *decrypt_fpe()* – Decrypts data that was encrypted using *encrypt_fpe()*
- *encrypt_string()* – Provided for backward compatibility. Encrypts a string provided in Latin characters
- *decrypt_data()* – Provided for backward compatibility. Decrypts data that was encrypted using *encrypt_string()* and returns a string in Latin characters
- *encrypt_char()* – Encrypts Latin character sets. Note that this is not compatible with the ciphertext output of *encrypt_string()* for the given plain text and key combination.
- *decrypt_char()* – Decrypts Latin character sets.

Each Teradata node requires a:

- Vormetric Key Agent
- Vormetric Application Encryption (VAE) Teradata installation file, which contains a Cryptoserver
- Connection to the *Data Security Manager* (DSM)

VPTD Operation

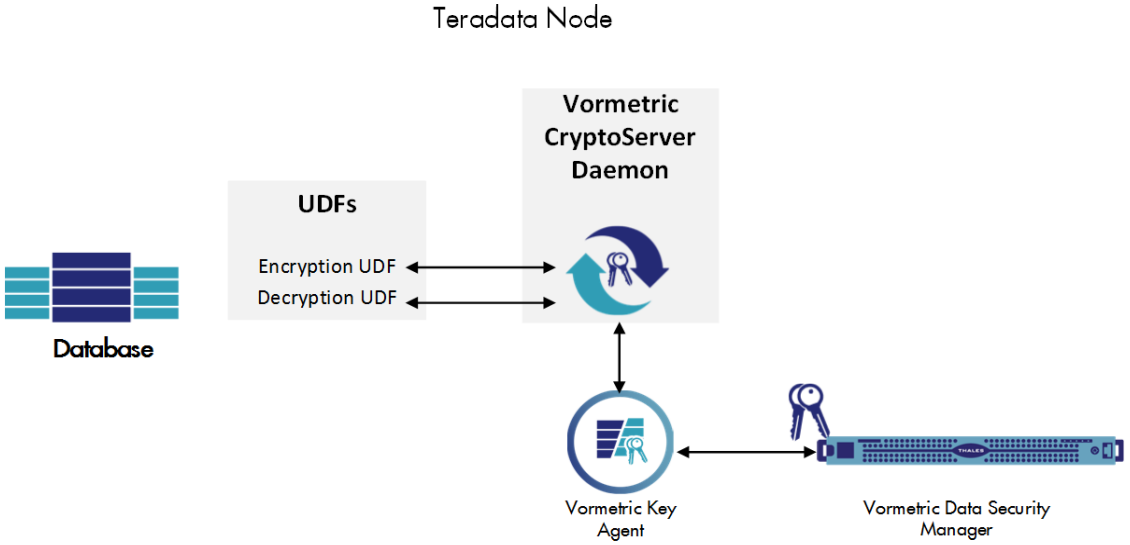
Once these components are installed, you have access to the UDFs that can be used to encrypt and decrypt Teradata database columns.[1] These UDFs can run in two modes: **Normal** Mode and **Fast** Mode.

Normal Mode

The following figure shows VPTD running in the Normal Mode.

1.You also have access to the VAE API library. See the *VAE Installation Guide and API Reference* for details.

Figure 3: Teradata node with VPTD running in the Normal Mode



In the Normal mode, `encrypt_cbc()`, `encrypt_fpe()`, or `encrypt_string()` sends a cleartext string to the Vormetric Local Cryptoserver Daemon. The Key Agent obtains a key from the DSM and encrypts the cleartext string. The encrypted string is then returned.

Likewise, `decrypt_cbc()`, `decrypt_fpe()`, or `decrypt_data()` sends an encrypted text string to the Vormetric Local Cryptoserver Daemon. The Key Agent obtains the key from the DSM and decrypts the string. The cleartext string is then returned.

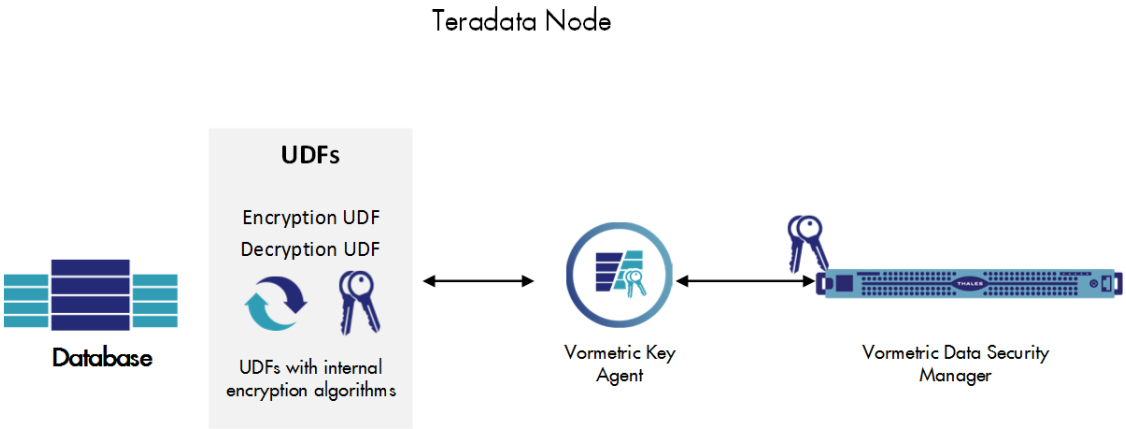
For more information about performance details and how to enable Normal and Fast Mode, see .

See "Vormetric Protection for Teradata Database UDFs" on page 33 for examples of how to use these UDFs.

Fast Mode

The following figure shows VPTD running in the Fast Mode.

Figure 4: Teradata node with VPTD running in the Fast Mode



In the Fast Mode, the encryption UDF `encrypt_cbc()`, `encrypt_fpe()`, or `encrypt_string()` encrypts a cleartext string locally inside the UDF. The encrypted string is then returned.

Likewise, the decryption UDF `decrypt_cbc()`, `decrypt_fpe()`, or `decrypt_data()` decrypts an encrypted text string locally inside the UDF. The cleartext string is then returned.

For more information about performance details and how to enable Normal and Fast Mode, see "Configure Vormetric Protection for Teradata" on page 26.

See "Vormetric Protection for Teradata Database UDFs" on page 33 for examples of how to use these UDFs.

Managing User Access Control (Whitelist and Blacklist)

VPTD supports coarse level access control and identity-based access control. Whitelisting and blacklisting VPTD users is particularly useful for preventing internal threats to your Teradata database.

To control which users can execute the UDFs, create blacklists and whitelists for the UDFs, add users to the `deny_decrypt.conf` black list and to prevent the user from executing decryption UDFs. Add users to the `allow_decrypt.conf` white list, to allow only that specific user to execute decryption UDFs.

By whitelisting approved users of the middleware (the business logic), all others, including the Teradata DB administrators, are blocked from accessing sensitive data.

For configuration options and details see "Configuring Access Control" on page 21.

Creating Profiles for Invoking UDFs

To streamline the invocation of the `encrypt_cbc()`, `decrypt_cbc()`, `encrypt_fpe()` and `decrypt_fpe()` UDFs, VPTD uses the file *profiles.conf*. This file contains named profiles that include several values required as input to these UDFs. Provide the profile name as a parameter when invoking the UDF. The UDF looks up the profile name and uses the parameters that are grouped under that profile name.

NOTE: Profiles are not supported for the `encrypt_string()` and `decrypt_data()` UDFs.

For more information, see "encrypt_char()" on page 38.

Components

This section describes the components of the VDS product that are relevant to Application Encryption.

Data Security Manager

The DSM is the central component of the VDS Platform. It consists of a policy engine and a central key and policy manager. The DSM stores and manages host encryption keys, data access policies, administrative domains, and administrator profiles.

Key Agent

The Vormetric Key Agent provides a library that implements the PKCS#11 interface. This library is a dynamically loadable library (dll) on Windows and a shared object (so) on Linux and UNIX. The Key Agent's PKCS#11 library communicates over a secure channel to the DSM for all significant functionality. This is sometimes called the Vormetric Application Encryption Agent.

Vormetric Protection for Teradata Database supports single and multi-part encryption and decryption using AES 128, and AES 256. It does not store or manage other kinds of cryptographic objects as described in the PKCS #15 specification such as certificates, passwords, or any custom made PKCS#11 objects.

Vormetric Local Cryptoserver Daemon

In the Normal mode, Vormetric Local Cryptoserver Daemon accepts requests from the UDFs, forwards them to the Vormetric Key Agent for processing, and returns the Key Agent output to the respective UDF.

PKCS#11 Application Encryption Library

In addition to the Teradata UDFs, VPTD also provides APIs in the Vormetric library that are a subset of the PKCS#11 specification version 2.20. They are platform-independent cryptographic tokens, and are traditionally used for HSMs (hardware security modules) and smartcards.

These APIs support real-time I/O encryption and decryption of “at rest” data and log files. Data is encrypted by adding these APIs to existing applications.

VAE APIs support the following functionality:

- create a key
- find a key
- destroy a key
- export a key
- import a key
- encrypt
- decrypt
- sign
- wrap key

Key Cache Options

You can choose to store keys on the DSM or export them to a local key cache. By default, keys are stored in the local key cache. For greater security, you can keep the keys on the DSM; however, that will affect performance. Table 1 on page 10, compares the advantages of each option.

Table 1: Key storage options

Performance	- Network round trip slows performance.	- Very fast for bulk encryption or high volume transactions of data.
Security	- Most secure. The key never leaves the DSM. - In compliance with PCI security standards.	- Key is stored on the client in memory. - In compliance with PCI security standards.

2 Installing and Deploying VPTD

This chapter describes how to install and configure the Vormetric Protection for Teradata Database on your Teradata host. It contains the following sections:

Prerequisites for Installing VPTD on a Teradata Node

The following is required to install Vormetric Protection for Teradata Database:

- A hardware DSM 6.0.1 or later, (to find your DSM version, open the Management Console and choose **System > About**). For DSM installation instructions, see *DSM Installation and Configuration Guide*.
- Access to the DSM from all Teradata nodes.
- The Teradata nodes must run Teradata 16.10, 16.00, 15.00, 15.10, 14.00, or 14.10 on SLES 11 nodes. For each node you need:
  - Root password to Teradata nodes
  - The IP address or FQDN of the node
  - Installation executable file for Vormetric Protection for Teradata version 6.1.3 for Teradata. For example:

    `vptd16.10-6.1.3-7-sles11sp2plus-x86_64.bin`

This installs the following:

- Vormetric Protection for Teradata, including the Vormetric Key Agent software
- UDFs
- Vormetric Local Cryptoserver Daemon
- Sample installation script (*install_udfs.bteq.sample*)
- Sample UDF profile configuration file (*profiles.conf.sample*)
- Sample Cryptoserver configuration file (*vormetric_local_crypto_server.conf.sample*)
- Mask configuration file (*mask.conf.sample*)

Installation Overview

The following are the high-level steps for installing Vormetric Protection for Teradata Database on a Teradata node.

1. Collect configuration information in the "Vormetric Protection for Teradata Installation Checklist" on page 12.
2. "Add the Teradata Node to the DSM Database" on page 17.
3. "Install Vormetric Protection for Teradata on the Teradata Node" on page 18.
4. "Configure Vormetric Protection for Teradata" on page 26.
5. "Deploy Vormetric Protection on a Teradata Node" on page 29.

Vormetric Protection for Teradata Installation Checklist

Use this table to verify prerequisites and collect the information you need for the installation.

Table 2: VPTD Installation Checklist

Checklist item	Status
Hardware DSM, version 6.0.1 or later	
Obtain Vormetric Protection for Teradata installation file from Vormetric. Example: (vptd16.10-6.1.3-7-sles11sp2plus-x86_64.bin)	
Host system clock set to the correct time zone.	

Table 2: VPTD Installation Checklist

Checklist item	Status
Fully Qualified Domain Name (FQDN) of the DSM(page 13)	
Root password for the Teradata node	
IP address or Fully Qualified Domain Name (FQDN) of the Teradata node. (page 13)	
Symmetric encryption key, cached on the host. (page 15)	

How to Get the FQDN of the DSM

Log in to the Management Console and look at the dashboard.

1. Open a browser and enter the DSM URL.

   This is either the host name if configured in DNS, or its IP over HTTPS of the DSM.

2. Enter the default login and password. The default login is `admin`. The default password is `admin123`.

NOTE: You are asked to change the default password upon first login. Remember this new password or you will not be able to log in again!

3. The FQDN is at the top.

Teradata Node Name Resolution

You can map a Teradata node name to an IP address using a Domain Name Server (DNS). DNS is the most preferred method of host name resolution.

You can also modify the *hosts* file on the DSM or identify a host using only the IP address.

- If you use DNS to resolve host names, use the FQDN for the host names.
- If you do NOT use a DNS server to resolve host names, do the following on all of the DSMs and the protected Teradata nodes:
  - **Modify the *host* file on the DSM:** To use names like *serverx.domain.com,* enter the node names and matching IP addresses in the */etc/hosts* file on the DSM using the `host`

command under the `network` menu of the Admin CLI (see See “Using the Admin CLI” on page 14. For example:

```
network$ host add grimes-dev1 192.168.42.12
SUCCESS: add host
network$ host sh
name=localhost6.localdomain6 ip=::1
name=linux32-48215.sacdbackup.com ip=192.168.48.215
name=rgrimes-dev1 ip=192.168.42.12
SUCCESS: show host
```

You must do this on *each* DSM, since entries in the host file are not replicated across DSMs.

- **Modify the `hosts` file on the protected hosts:** Enter the DSM host names and matching IP addresses in the */etc/host*s file on the Teradata node. *You must do this on EACH protected node making sure to add an entry for all DSM nodes (if using HA).*

OR

- **Use IP addresses:** If using IP addresses as protected Teradata node names, you must enable Agent IP in the DSM (see “agentip” Enable/Disable in the “network” menu in the CLI. This is described in “Using the Admin CLI” on page 14). With Agent IP enabled, you can have some hosts identified by host name and some by IP simultaneously. In other words, they don't all need to use an IP address when Agent IP is enabled.

Using the Admin CLI

Access the CLI menu as follows:

1. Start the serial console application.
2. If the login prompt is not displayed, press the **Enter** key to wake up the connection.
3. Log into the appliance. The default System Administrator name and password are *`cliadmin`* and *`cliadmin123`*.

Example

At the prompt, type *cliadmin* followed by the password. At the prompt type "*network*". See the example below:

```
network$ agentip show
agent ip address support : off
SUCCESS: agent ip address support showed.
network$ agentip on
WARNING: The Security Server will restart automatically after enabling
agent IP address support!
Continue? (yes|no)[no]:yes
SUCCESS: Agent IP address support is enabled and the server restarted.
network$ agentip show
agent ip address support : on
SUCCESS: Agent IP address support showed.
network
```

Obtaining a Data Encryption Key for Your VPTD Deployment

This section contains two subsections:

- "Creating a Data Encryption Key" on page 15
- "Using an Encryption Key Not Created with DSM5.2.2or later" on page 16

Creating a Data Encryption Key

1. Go to **Keys > Agent Keys > Keys** in the Management Console to open the *Agent Keys* window.
2. Click **Add** to open the **Add Agent Key** window.
3. Enter a key name, description, and security algorithm.
   - **Name**: Name of key. 64 character limit.
   - **Description**: Optional key description. 265 character limit.
   - **Template**: A key template with a set of predefined attributes. To create a valid Teradata key, select **Default_SQL_Symmetric_Key_Template** and do not change any of the custom attribute values.
   - **Algorithm**: Algorithm used to create the key.
   - **Key Type**: Location for the encryption key. **Stored on Server** keys are downloaded to non-persistent memory on the host. Each time the key is needed, the host must retrieve the key from the DSM. **Cached on Host** downloads and stores (in an encrypted form) the key in persistent memory on the host. For performance reasons, **Cached on Host** is highly recommended for Teradata installations. For Fast Mode (configuration file setting '*udfaes*

on', see "Deploy Vormetric Protection on a Teradata Node" on page 29), key type **Cached on Host** is MANDATORY.

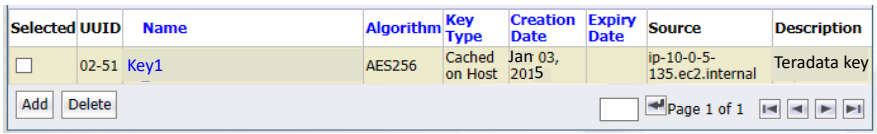
- **Unique to Host**: This check box is displayed when **Cached on Host** is selected. When enabled, it makes the encryption key unique. The key is downloaded to the host, encrypted using the host password, and stored. These keys are used for locally attached devices, as files encrypted by them can be read only by one machine. Do not enable this check box for cloned systems, RAID configurations, clustered environments, or any environment that uses host mirroring. Requires that **Key Creation Method** is set to *Generate.*
- **Key Creation Method**: Select to generate a key using a random seed (**Generate**) or by **Manual Input**.
- **Expiry Date**: Date the key expires.
- **Key Refreshing Period (minutes)**: Used only with Oracle Database TDE and Microsoft SQL Server TDE. How long to keep the key in the local key cache before it is refreshed.

  Example:

  Name: Key1
  Description: Teradata key
  Algorithm:AES256

  All other values are the default.

4. Click **OK**. Your new key is created and displayed in the *Agent Keys* window.



5. Create as many keys as desired.

Using an Encryption Key Not Created with DSM5.2.2or later

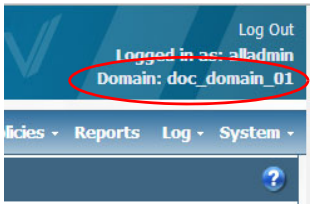
If you try to use a key created with DSM 5.2.1 or another environment in the VPTD environment, it will not work. You must first modify the key's attributes in the DSM Management Console GUI (**Keys** > [Select a key] > **Attributes):**

Cryptographic Usage Mask	127
Object Type	Symmetric Key
x-VormApplicationName	Vormetric Key Agent
x-VormCanBePlainText	true
x-VormCanNeverBeExported	true
x-VormCanNeverBePlaintext	true
x-VormCanObjectPersist	true

Add the Teradata Node to the DSM Database

Your Teradata node names must be added to the DSM database before Vormetric Protection for Teradata is installed. This section describes how to do this. To add the Teradata node to the DSM database, you must have the Teradata node's Fully Qualified Domain Name (FQDN—54 character max) or IP address.

1. Log on to the Management Console as a Security Administrator with *Key* and *Policy* roles or as an administrator of type *All*.
2. Switch to the domain containing the Teradata node you want to protect. Click **Domains > Switch Domains.** The *Switch Domains* window opens.
3. Select the domain that will contain the Teradata host and click **Switch to domain**. The domain in which you are working is displayed in the upper right corner of the Management Console.



4. Select **Hosts > Hosts** in the menu bar. An empty *Hosts* window opens.
6. Click **Add**. The *Add Host* window opens.
7. Enter the following information:
   - **Host Name**: Enter FQDN of the Teradata Node. The IP address or host name will work, but the FQDN changes the least. Host names cannot contain an underscore.
   - **Description**: Optional. Enter text to identify the node or its function. Limited to 256 characters.
   - **Registration Allowed Agents**: Select the agents that will run on the node system. In this case it will be **Key**.
   - **License Type**: Choose the type of license that will run on this host. Options are **Perpetual**, **Term**, and **Hourly**, depending on the system license.
8. Click **Ok**. You are returned to the *Hosts* window.
9. Click the host name link that you just added to the DSM database. This opens the **General** tab of the *Edit Host* window. Make sure the **Registration Allowed** and **Communication Enabled** check box are checked for the Key Agent.
10. Your node is added to the DSM database.
11. Repeat for all your protected Teradata nodes.

Install Vormetric Protection for Teradata on the Teradata Node

The following steps describe how to install Vormetric Protection for Teradata for the first time.

Install Vormetric Protection for Teradata

1. Log on with root access to the host where you will install Vormetric Protection for Teradata.
2. Copy or mount the installation file to the host system.
3. Start the installation. Type:

   ```
   # ./vptd-<product-version-build-system>.bin
   ```

   Example:

   ```
   vptd16.10-6.1.3-7-sles11sp2plus-x86_64.bin
   ```

4. The text of the License Agreement appears. Page through the agreement, then type *y* and press **Enter** to accept. The installation proceeds.
5. At the agent registration prompt, type *y* or press **Enter** to proceed with registration, or type *n* if you plan to register later.

   ```
   Do you want to continue with agent registration? (Y/N) [Y]:
   ```

6. Continue to follow the prompts:

   a: Enter the fully qualified host name of the primary DSM, and then press **Enter.**

   b: Verify the host name, and then press **Enter**.

   c: The installer shows a numbered list of host names and prompts you to choose one. From the list, type the number of the host name of your local machine, and then press Enter. This name must match the name of the host that was added to the DSM by the Security Administrator.

Example:

```
Please enter the host name of this machine, or select from
the following list. The name you provide must precisely
match the name used on the "Add Host" page of the
Management Console.
[1] host1.example.com
[2] sys41017-priv.example.com
[3] sys41017-vip.example.com
[4] 10.3.41.127
Enter a number, or type a different host name or IP address
in manually:
What is the name of this machine? [1]: 1
Generating certificate...done.
Signing certificate...done.
```

7. At the following prompt, choose whether you want to register to the Security Server using a shared secret or using fingerprints.

```
Would you like to register to the shared Security Server using a
registration shared secret (S) or using fingerprints (F)? (S/F)
[S]:
```

The rest of this procedure is based on fingerprint registration. The advantages and disadvantages of each security method are beyond the scope of this document. Refer to the DSM documentation for complete details.

8. At the prompt, press **Enter** to enable cloning prevention ability, by associating the installation with existing hardware.

Example:

```
It is possible to associate this installation with the hardware
of this machine. If selected, the agent will not contact the DSM
or use any cryptographic keys if any of this machine's hardware is
changed. This means that if the machine is copied (for example, a
clone of a virtual machine), the copy will not function
correctly. This can be rectified by running this registration
program again.
Do you want to enable this functionality?  (Y/N) [Y]:
```

9. The CA certificate fingerprint is displayed:

```
The following is the fingerprint of the CA certificate. Please
verify that it matches the fingerprint shown on the Dashboard page
of the Management Console.  If they do not match, it can indicate
an unsuccessful setup or an attack.
4C:10:12:72:1B:56:7D:93:A4:71:0D:93:B9:47:CF:A0:8F:D4:5A:E9
Do the fingerprints match? (Y/N) [N]: Y
```

   At this stage of the installation, you, the host administrator, and DSM Security Administrator must exchange information to confirm that the agent host and DSM share valid certificates. This step verifies that nobody is intercepting and modifying traffic between the DSM and agent. It is a security feature.

   a. **Host Admin:** Send the fingerprint to the DSM Security Administrator and wait for confirmation.

   b. **DSM Security Admin**:

   - Log on to the DSM Management Console and navigate to the domain where the Teradata node was added.
   - Click the **Dashboard** tab.
   - Match the fingerprint from the Host Admin with the **EC CA fingerprint** on the Dashboard.
   - Advise the Host Admin of the results.

   c. **Host Admin:** If the fingerprints match, type *y* and then press **Enter**. “Installation success.” is displayed.

NOTE: If this is a Key Agent installation, you are prompted for a password for the Key Agent library.

10. Enter the password for the Key Agent library and confirm your entry. Password minimum length for PIN is 8 characters and maximum length is 63 characters.

```
Please enter a password for the Key Agent library.
Accesses to this library will be protected by this password.
NOTE: If using Oracle RAC, passwords must be the same on all nodes.
Please enter password:
Enter again to confirm:
Successfully registered the Vormetric Key Agent with the primary
Vormetric Data Security Server on test-vormetric.com.
```

NOTE: Do not forget this password. You will need it later during Vormetric Protection for Teradata Database deployment. To change the password, you must re-register the agent.

Configuring Access Control

VPTD provides the following user access control configuration options:

- "Identity-Based Access Control (Recommended)" on page 21
- "Coarse-Level Access Control (Default)" on page 23

Access control parameters are defined in the *vormetric_local_cryptoserver.conf* file. Set *identityacl* to *on* to indicate identity-based access control is enforced.

When *identityacl* is set to off, or not configured, coarse-level access control is enforced by default. Identity-based access control uses the same files (*allow_encrypt.conf* and *allow_decrypt.conf)* to contain the access control definitions.

NOTE: The formats of coarse and identity based access is different in the whitelist (*allow_encrypt.conf* and *allow_decrypt.conf)* files. However, the format of the blacklist (*deny_encrypt.conf* and *deny_decrypt.conf*) files is same for both modes of access control.

Identity-Based Access Control (Recommended)

Use the identity-based access control to control access at the database column level. Keys can be assigned to encrypt/decrypt one or more database columns, this provides column-level access control based on identity.

Access to database encryption and decryption operations are defined in the `allow_encrypt.conf` and `allow_decrypt.conf` configuration files, based on key value pairs. The encryption key is the key and a comma separated list of users who may access that encryption key, is the associated value.

Modified Whitelist for Decryption

The modified *allow_decrypt.conf* file has the following format:

```
[<denied behavior>]
<key name>: <comma separated list of allowed users>
```

Where, **denied behavio**r will be one of the following:

- **deny -** Access is denied. This is the default behavior

- **blank** - Blank value will be returned.
- **ciphertext** - encrypted column value will be returned
- **zero** - 0 will be returned
- **custom text** - Administrator defined custom string specified under double quotes, for example: *"Access Denied".*

A sample *allow_decrypt.conf* file:

```
[ciphertext]
Name_Address_key:User1,User3

["Access Denied]
Phone_key:User2,User3

[zero]
SSN_key:User3
```

Configuration Notes:

1. Multiple key-user mappings can share the same denied behavior.
2. wildcard * denotes all users. When * is used, the denied behavior field is ignored.

NOTE: For installation specifics see step 2 of "Deploy Vormetric Protection on a Teradata Node" on page 29.

Modified Whitelist for Encryption

The modified *allow_encrypt.conf* has the following format:

```
<key name> : <comma separated list of allowed users>
```

Consider the following example of a *allow_encrypt.conf* configuration:

```
Name_Address_key:User1,User3
Phone_key:User2,User3
SSN_key:User3
```

NOTE: Unlike decryption, encryption does not support any custom deny behavior. When users attempts to encrypt a column using a key that it does not have access to, the operation is denied.

Coarse-Level Access Control (Default)

With coarse-level access control, users listed in white list could access all the database tables.

NOTE: Identity based access control goes one step further, by specifying which key can be used by which user.

To configure coarse-level control, decide whether you are *blacklist-centric*—you have a list of users to block access to a command and all others are unblocked, or *whitelist-centric*—you have a list of users to allow access to a command and all others are blocked. Choose which orientation makes the most sense for your situation, then create the following four files in `/etc/vormetric` with 600 permissions (read/write by root only):

```
allow_encrypt.conf
allow_decrypt.conf
deny_encrypt.conf
deny_decrypt.conf
```

Add the logins of users, one line per user, to either deny (blacklist) or allow (whitelist) access to do encrypting or decrypting. User names must be entirely capitalized. The wildcard character (*) indicates “all users” and it is allowed in the whitelist, but not the blacklist. No other regular expressions are permitted. Make your configuration blacklist-centric by putting just a * in the whitelist and adding user names in the blacklist. Make it whitelist-centric by leaving your blacklist empty and putting user names in the whitelist.

If you are whitelist-centric, only users in `allow_decrypt.conf` will be able to decrypt data, and only users in `allow_encrypt.conf` will be able to encrypt data. If you are blacklist-centric, only users in `deny_decrypt.conf` will not be able to decrypt data, and only users in `deny_encrypt.conf` will be not able to encrypt data.

We recommend whitelisting approved users of the middleware (the business logic). This will block all others, including the Teradata DB administrators from accessing sensitive data.

The Linux system administrator must then replicate these files to all other Teradata nodes.

Verify the Installation

The following steps verify installation.

1. Run the following commands on the Teradata node to confirm that all components of VPTD were entered into the rpm database, which means that VPTD was installed successfully.

   ```
   rpm -qa | grep vae-td
   rpm -qa | grep vee-key
   ```

2. Open the DSM Edit Host window and verify that **Registration Allowed** and **Communication Enabled** are selected for the Key Agent.

Modify the Key Cache

You can modify two settings in the key cache at application level or on the DSM.

By default, keys are cached on the host, with a time-to-live value of 10080 minutes (7 days).

- You can choose to cache the key on the DSM or on the host.
- You can also modify how long the key stays in the local key cache before it is re-fetched from the DSM.

By accepting the default setting “Cached on Host”, the cryptographic key will be cached within the Key Agent library on the particular host (Teradata node).

The setting “Stored on Server” means that the key never leaves the DSM and thus all cryptographic operations with this key are performed on the DSM itself, not on the host.

These two settings are a trade off between speed and security. In most cases, end users will not be willing to accept the performance penalty of the “Stored on Server” setting, which is extreme.

To Modify the Key Cache on the DSM:

1. Log on to the DSM as an administrator of type Security Administrator.
2. Click the **Domains** tab, and switch to the domain where the key is installed.
3. Click **Keys > Agent Keys**, and then click on the name of the key you want to modify. If you have many keys, search for a key on the Management Console using the **Keyname contains**: field. The *Edit Agent Key* window opens.
4. In the **Key Type** drop-down menu, select **Cached on Host** or **Stored on Server** (DSM).
5. In the **Key Refreshing Period (minutes)** field, enter the number of minutes you want the key in the local key cache before it is refreshed from the DSM.
6. Click **Ok**.

Install VPTD in Silent Mode

A Silent Mode installation means that all requisite input is provided in a file and VPTD is invoked using the -s option. To install VPTD in Silent Mode:

1. Create a config file containing following fields:

```
SERVER_HOSTNAME=<hostname>
AGENT_USEIP=Yes
PKCS11_PASSWORD=<password>
```

2. Obtain VPTD and copy it to the directory that contains the config file that you just created.

3. Type:

`# ./vptd<product-version-build-system>.bin -s <config file path>`

Example

`# ./vptd16.10-6.0.2-53-sles11sp1-x86_64.bin -s <config file path>`

The following fields are optional for the Config file:

Table 3: Options for the Silent Mode installation configuration file

Name	Function	Required
SERVER_HOSTNAME	Host name of DSM	Yes
SERVER_IP	Synonym for SERVER_HOSTNAME	No
AGENT_USEIP	Uses IP address instead of host name	No
AGENT_HOST_NAME	Uses the name of the machine instead of IP	No
AGENT_HOST_PORT	Port number to expose	No
STRONG_ENTROPY	Use /dev/random on linux	No
PKCS11_STANDALONE	Non-server mode for PKCS11 agent	No
PKCS11_PASSWORD	Password for PKCS11 agent	Yes `(pkcs11 only)`
ONEWAY_COMMS	Set when one-way communication required	No
USEHWSIG	Associate hardware to keys+certs (1|0)	No
SHARED_SECRET	Use given registration shared secret	No
HOST_DOMAIN	Registration domain	Yes (If SS provided)
HOST_GROUP	Registration host group	No

Table 3: Options for the Silent Mode installation configuration file

Name	Function	Required
HOST_DESC	Host description	No

Configure Vormetric Protection for Teradata

After installing VPTD as described in "Install Vormetric Protection for Teradata on the Teradata Node" on page 18, do the following steps to configure VPTD and get the system up and running.

NOTE: This procedure must be done only once regardless of the number of nodes.

1. Choose between Normal Mode and Fast Mode.

   Before configuring Vormetric Protection for Teradata, you must first determine whether you will run in the Normal Mode or the Fast Mode. This decision will affect the configuration settings.

   The table below outlines the various attributes of each mode and how they are enabled.

Table 4: Comparison of Normal Mode and Fast Mode

	Normal Mode (`udfaes off`)	Fast Mode (`udfaes on`)
Teradata Protected Mode (comment out the *`alter function`* lines in install_udfs.bteq)	• Supported by 5.2.2 and later releases. • Encryption/decryption done on cryptoserver.	• 5.2.3 and later releases. • Encryption/decryption done locally inside the respective UDF.
Teradata Unprotected Mode (Default)	Not generally used.	• Recommended for maximum performance. • Encryption/decryption done locally inside the respective UDF.

   Specify the Teradata Protected or Unprotected Mode in the BTEQ file. Specify the *`udfaes`* parameter (Fast Mode or Normal Mode) in the Vormetric Local Cryptoserver Daemon configuration file (see "Deploy Vormetric Protection on a Teradata Node" on page 29).

2. Create a Basic Teradata Query (BTEQ) script from the provided sample to install the UDFs.

   a. Change directories:

   ```
   # cd /opt/vormetric/DataSecurityExpert/agent/pkcs11/teradata/udfs/
   ```

b. Copy the UDF sample script *install_udfs.bteq.sample* to a file named *install_udfs.bteq* in the same directory. Keep *install_udfs.bteq.sample* as a reference, and use *install_udfs.bteq* as your working BTEQ script.

Edit *install_udfs.bteq* as per the embedded instructions. Replace the words in capital letters with real values. For example, change *USERNAME* and *PASSWORD* to a real user name and password.

```
bteq << $EOF

* Replace Teradata USERNAME and PASSWORD with a site-specific username
and password.

.logon USERNAME,PASSWORD;

* Replace DBC with the database from which you want to derive the
vormetric user.
* Note that the USER who installs the UDFs into the system must be set to
the latin
* char set. After the UDFs are installed, the character set for this
particular
* user MAY be changed to something else, for instance UNICODE. But during
the UDF
* installation, the user's character set MUST be latin.

create user vormetric from DBC as perm=10000000 password=SOMEPASSWORD
default character set latin;

grant create function on vormetric to vormetric;
grant alter function on vormetric to vormetric;
grant drop function on vormetric to vormetric;
grant execute function on vormetric to public;

.logoff
.logon vormetric,SOMEPASSWORD;
```

```
database vormetric;

replace function encrypt_string (inputString varchar(16384),
inputKeyname varchar(256)) returns varbyte(16400) specific
encrypt_string language c no sql not deterministic parameter style sql
called on null input external name
'co:udf_encrypt_string:./udf_encrypt_string.o';

replace function decrypt_data (inputString varbyte(16400), inputKeyname
varchar(256)) returns varchar(16384) specific decrypt_data language c no sql
not deterministic parameter style sql called on null input external name
'co:udf_decrypt_data:./udf_decrypt_data.o';

replace function encrypt_char (inputString varchar(16384), inputKeyname
varchar(256), inputCharcolumnsize INTEGER) returns varbyte(16000) specific
encrypt_char language c no sql not deterministic parameter style sql called on
null input external name 'co:udf_encrypt_char:./udf_encrypt_char.o';

replace function decrypt_char (inputString varbyte(16000), inputKeyname
varchar(256), inputCharcolumnsize INTEGER) returns varchar(16384) specific
decrypt_char language c no sql not deterministic parameter style sql called on
null input external name 'co:udf_decrypt_char:./udf_decrypt_char.o';

replace function encrypt_cbc (inputString varchar(8192) CHARACTER SET UNICODE,
inputKeyname varchar(256)) returns varbyte(16400) specific encrypt_cbc language
c no sql not deterministic parameter style sql called on null input external
name 'co:udf_encrypt_cbc:./udf_encrypt_cbc.o';

replace function decrypt_cbc (inputString varbyte(16400), inputKeyname
varchar(256)) returns varchar(8192) CHARACTER SET UNICODE specific decrypt_cbc
language c no sql not deterministic parameter style sql called on null input
external name 'co:udf_decrypt_cbc:./udf_decrypt_cbc.o';

replace function encrypt_fpe (inputString varchar(8192) CHARACTER SET UNICODE,
inputKeyname varchar(256)) returns varchar(8192) CHARACTER SET UNICODE specific
encrypt_fpe language c no sql not deterministic parameter style sql called on
null input external name 'co:udf_encrypt_fpe:./udf_encrypt_fpe.o';

replace function decrypt_fpe (inputString varchar(8192) CHARACTER SET UNICODE,
inputKeyname varchar(256)) returns varchar(8192) CHARACTER SET UNICODE specific
decrypt_fpe language c no sql not deterministic parameter style sql called on
null input external name 'co:udf_decrypt_fpe:./udf_decrypt_fpe.o';

* Comment out the following lines to run the UDFs in a separate process.
* By default, UDFs run in a separate process ("protected mode"), which incurs a
performance penalty of up to 20x or 25x or 30x
alter function encrypt_string execute not protected;
alter function decrypt_data execute not protected;
alter function encrypt_char execute not protected;
alter function decrypt_char execute not protected;
alter function encrypt_cbc execute not protected;
alter function decrypt_cbc execute not protected;
alter function encrypt_fpe execute not protected;
alter function decrypt_fpe execute not protected;

.logoff
.quit
```

c. If you want to run in the Teradata Protected Mode, comment out the *alter function* lines. Leave them as is to run in the Teradata Unprotected Mode.

d. By default the BTEQ script installs the UDFs in the newly created database called *vormetric*. You may change the installation script to install them in the location of your choice.

e. Run the BTEQ script. Example:

```
# [/opt/vormetric/DataSecurityExpert/agent/pkcs11/teradata/udfs]#
./install_udfs.bteq
```

3. After this script has successfully run, the UDFs are installed in the newly created database with the default name vormetric.

Deploy Vormetric Protection on a Teradata Node

After installing Vormetric Protection for Teradata Database on the node, configure and deploy the application.

NOTE: This procedure must be done for every node.

1. Log in as root user on the node.
2. Optional: Set up VPTD white lists or black lists. Refer to "Managing User Access Control (Whitelist and Blacklist)" on page 8 and "Configuring Access Control" on page 21 to evaluate user access control options, and to determine how to leverage these features in your implementation.
3. Create a new profile configuration file based on the provided sample.

   ```
   # cd /etc/vormetric
   # cp profiles.conf.sample profiles.conf
   ```

   Keep *profiles.conf.sample* as a reference, and use *profiles.conf* as your working configuration file. Modify this file to serve your purposes. For more information, see "encrypt_char()" on page 38.
4. Create a Vormetric Local Cryptoserver Daemon configuration file.

   ```
   # cd /etc/vormetric
   # cp vormetric_local_crypto_server.conf.sample
   vormetric_local_crypto_server.conf
   ```

   Keep *vormetric_local_crypto_server.conf.sample* as a reference, and use *vormetric_local_crypto_server.conf* as your working configuration file.

Modify the following lines in the Vormetric Local Cryptoserver Daemon configuration file */etc/vormetric/vormetric_local_crypto_server.conf*:

```
Copyright (c) 2018 by <Your_Company>
iv <Initialization_Vector>
loglevel <desired_loglevel>
timeout <desired_whitelist-blacklist_polling_interval>
cryptoconf_timeout <in min>
udfaes <on_or_off>
```

where:

- ***Your_Company***: Name of your company.
- ***IV*:** Initialization vector, a 16 byte 32 hex char number. This must be the same for all nodes. Example: *0149AB83FC68D3C1395ABC4692DF931C*
- ***Loglevel***: Desired log level for logging events. Examples: *Debug*, *info*, *warn*, *error* or *fatal*.
- ***Timeout***: The period, in minutes, between when the white list and black list are polled for changes and possible refresh. The default of 5 minutes should be adequate, but if you change your black/white list, you must wait up to 5 minutes before the changes take effect.
- **Cryptoconf_timeout**: BTEQ session cache for IV is cleared after this interval.
- **udfaes**: Specifies Normal Mode (`udfaes off`) or Fast Mode (`udfaes on`).

5. Invoke the Vormetric Local Cryptoserver with the `-e` command line option. Example:

   # /opt/vormetric/DataSecurityExpert/agent/pkcs11/teradata/bin/vormetric_loca_crypto_server -e

   You are prompted for the PIN which you created in the last step of "Install Vormetric Protection for Teradata on the Teradata Node" on page 18. This PIN is written in encrypted form to the last line of *vormetric_local_crypto_server.conf*.

6. If you are using the Monit process supervision tool, then configure the */etc/monitrc* file.

   Add these five lines:

```
check process vormetric_local_crypto_server with pidfile
/var/run/vormetric_local_crypto_server.pid
   start program = "/etc/init.d/vormetric_local_crypto_server
start"
   stop  program = "/etc/init.d/vormetric_local_crypto_server
stop"
   if failed unixsocket /tmp/vormetric then restart
   if 5 restarts within 5 cycles then timeout
```

7. Start the Vormetric Local Cryptoserver Daemon:

   # /etc/init.d/vormetric_local_crypto_server start

Teradata database users now have access to the UDFs (see "Vormetric Protection for Teradata Database UDFs" on page 33) and the VAE C API library.

8. Test the UDFs. In the following example, replace SOMEPASSWORD with your actual Teradata user password. The following example tests one of the UDFs. It is recommend to to issue additional SQL requests to test all UDFs.

```
[/etc/vormetric]# bteq .logon vormetric,vormetric
Teradata BTEQ 14.10.00.10 for LINUX. PID: 11978
Copyright 1984-2014, Teradata Corporation. ALL RIGHTS RESERVED.
Enter your logon or BTEQ command:
.logon vormetric,SOMEPASSWORD
*** Logon successfully completed.
*** Teradata Database Release is 14.10.03.02
*** Teradata Database Version is 14.10.03.02
*** Transaction Semantics are BTET.
*** Session Character Set Name is 'ASCII'.
*** Total elapsed time was 2 seconds.
BTEQ -- Enter your SQL request or BTEQ command:
select vormetric.encrypt_string('hello world','KEY1');
select vormetric.encrypt_string('hello world','KEY1');
*** Query completed. One row found. One column returned.
*** Total elapsed time was 2 seconds.
encrypt_string('hello world','KEY1')
--------------------------------------------------------------------------
-
490C35C33A5E07587ED4A6AFB15A16C9
```

Automated install over a Teradata cluster

This feature detects a cluster and ensures that the installation is performed on all of the nodes in the cluster. The user does not have to do anything to make the installer look for the Cluster. This feature is built in. If the Cluster exists, the installer will find it. However, any change made in the configuration file is not propagated automatically on all nodes. It must be done manually on all of the nodes by the Admin.

When trying to install VPTD on a node, the installer detects the presence of the cluster and tries to install the same VPTD on the other nodes. This requires that the installation is performed in the "silent install" mode. This means that all requisite input is given in a file and VPTD is invoked with the -s option. If you use the Fingerprint method of registration, then the user must ensure that all of the nodes are added to the DSM prior to VPTD install.

Upgrade VPTD

The intent of this feature is to detect a cluster and ensure that the upgrade is performed on all of the nodes in the cluster.

NOTE: You must ensure that the crypto server daemon is not running on any single node before the uninstall begins.

When trying to upgrade the VPTD on a node, the installer detects the presence of the cluster and tries to upgrade the same VPTD on the other nodes. If there is a single node, then it upgrades the VPTD from that node as well.

You can upgrade VPTD from v5.2.5.xx to 6.1.3.xx or 6.1.3.xx to 6.1.3.xx. It does not update the existing user modified configuration files. It adds the new configuration files, sample configuration files with new features and binary files.

After the upgrade, the user must follow the manual steps to remove the existing UDFs from the database and perform the new UDFs installation.

Vormetric Protection for Teradata Database UDFs

3

Vormetric Protection for Teradata Database supports several UDFs to perform encryption and decryption operations on the Teradata database. This chapter contains the following sections:

Invoking the UDFs

To call one of the user-defined functions (UDFs) described in this chapter, you must invoke the Teradata BTEQ query tool using the following command:

ASCII login:

```
# bteq [.logon <UserID>,<Password>]
```

Unicode login:

```
# bteq -e UTF8 -c UTF16 [.logon <UserID>,<Password>]
```

You can then call the UDFs as follows:

```
BTEQ -- Enter your SQL request or BTEQ command:
select vormetric. <UDF name>(<UDF parameters>);
```

See the examples in the rest of this chapter.

You can also perform other BTEQ functions at the prompt. For more information about BTEQ, see Teradata documentation.

encrypt_cbc()

Description

Given a cleartext string in Unicode format and a profile name (see "encrypt_char()" on page 38), returns its encrypted equivalent.

```
function encrypt_cbc (inputString varchar(8192) CHARACTER SET
UNICODE, inputKeyname varchar(256)) returns varbyte(16400)
```

The input string must adhere to BTEQ requirements, such as escaping special characters. For example, if the input string contains an apostrophe, use a double apostrophe: *'It''s a beautiful day'*.

Example

The following example encrypts a credit card number. This assumes that a profile has been set up in *profiles.conf* with the name *ccnum* and the encryption method *aes_cbc_pad*.

```
# select vormetric.encrypt_cbc('1234-9876-5678-6543', 'ccnum');

# select vormetric.encrypt_cbc('1234-9876-5678-6543', 'ccnum';
```

System Response

```
*** Query completed. One row found. One column returned.
*** Total elapsed time was 2 seconds.

vormetric.encrypt_cbc('1234-9876-5678-6543', 'ccnum'
--------------------------------------------------------------------------
BE08C791A97E8FAC725DA39AFC071BD30A32C70C514E00B8D6D420501EF8B9D60F06537
CE93
```

decrypt_cbc()

Description

Given an encrypted string created using *encrypt_cbc()* and a profile name (see "encrypt_char()" on page 38), returns its decrypted cleartext.

```
function decrypt_cbc (inputString varbyte(16400),
  inputKeyname varchar(256)) returns varchar(8192) CHARACTER
  SET UNICODE
```

Example

The following example decrypts a credit card number. It is assumed that a profile has been set up in *profiles.conf* with the name *ccnum* and the encryption method *aes_cbc_pad*.

```
# BTEQ -- Enter your SQL request or BTEQ command:
select
vormetric.decrypt_cbc('BE08C791A97E8FAC725DA39AFC071BD30A32C70C514E00B8D6D420
501EF8B9D60F06537CE93'xb,'ccnum');

#select
vormetric.decrypt_cbc('BE08C791A97E8FAC725DA39AFC071BD30A32C70C514E00B8D6D420
501EF8B9D60F06537CE93'xb,'ccnum');

*** Query completed. One row found. One column returned.
*** Total elapsed time was 1 second.

vormetric.decrypt_cbc('BE08C791A97E8FAC725DA39AFC071BD30A32C70C514E00B8D6
D420501EF8B9D60F06537CE93'xb,'ccnum')
--------------------------------------------------------------------------
1234-9876-5678-6543
```

encrypt_fpe()

Description

Given a cleartext string in Unicode or Latin characters and a profile name (see "encrypt_char()" on page 38), returns its encrypted equivalent.

```
function encrypt_fpe (inputString varchar(8192) CHARACTER
  SET UNICODE, inputKeyname varchar(256)) returns
  varchar(8192) CHARACTER SET UNICODE
```

To accept Latin characters as input, the *encrypt_fpe()* call must refer to a profile that uses a predefined Latin character set. For more information, see "Using profiles.conf with FPE" on page 42.

If there are characters in the plain text input which are not specified in the character set, they will be left in their current positions, unchanged, in the tokenized output. If the plain text input is less than 2 characters (not counting characters that are not specified in the character set), the output of the UDF is the same as the plaint ext input. FPE can tokenize only strings with 2 or more characters.

The input string must adhere to BTEQ requirements, such as escaping special characters. For example, if the input string contains an apostrophe, use a double apostrophe: *'It''s a beautiful day'*.

Example

The following example encrypts a customer's first and last name. It is assumed that a profile has been set up in *profiles.conf* with the name *tokenize_name* and the encryption method *fpe*.

```
# select vormetric.encrypt_fpe('John Doe','tokenize_name');

# select vormetric.encrypt_fpe('John Doe','tokenize_name');

*** Query completed. One row found. One column returned.
*** Total elapsed time was 2 seconds.

vormetric.encrypt_fpe('John Doe','tokenize_name')
------------------------------------------------------------------
OHBU cCj
```

decrypt_fpe()

Description

Given an encrypted string created using *encrypt_fpe()* and a profile name, returns its decrypted cleartext.

```
function decrypt_fpe (inputString varchar(8192) CHARACTER
  SET UNICODE, inputKeyname varchar(256)) returns
  varchar(8192) CHARACTER SET UNICODE
```

Example

The following example decrypts a customer's first and last name. It is assumed that a profile has been set up in *profiles.conf* with the name *tokenize_name* and the encryption method *fpe*.

```
BTEQ -- Enter your SQL request or BTEQ command:
  # select vormetric.decrypt_fpe('OHBU cCj','tokenize_name');

  # select vormetric.decrypt_fpe('OHBU cCj','tokenize_name');

  *** Query completed. One row found. One column returned.
```

```
*** Total elapsed time was 1 second.

vormetric.decrypt_fpe('OHBU cCj','tokenize_name')
--------------------------------------------------------------------------
John Doe
```

encrypt_string()

NOTE: The *encrypt_cbc()* and *encrypt_fpe()* UDFs are recommended. Use of *encrypt_string()* is not recommended.

Description

Given a cleartext string in Latin characters and a key, returns its encrypted equivalent.

```
function encrypt_string (inputString varchar(16384),
  inputKeyname varchar(256)) returns varbyte(16400)
```

The input string must adhere to BTEQ requirements, such as escaping special characters. For example, if the input string contains an apostrophe, use a double apostrophe: *'It''s a beautiful day'*.

NOTE: The initialization vector (IV) for *encrypt_string()* is taken from the file */etc/vormetric/vormetric_local_crypto_server.conf*.

Example

```
BTEQ -- Enter your SQL request or BTEQ command:
  # select vormetric.encrypt_string('clear text', 'KEY1');
  # select vormetric.encrypt_string('clear text', 'KEY1');

  *** Query completed. One row found. One column returned.
  *** Total elapsed time was 2 seconds.

  vormetric.encrypt_string('clear text','KEY1')
  ------------------------------------------------------------------------
  97E7BCEB7D8EA55A59BC83BD44609B0A
```

decrypt_data()

Description

Given an encrypted string created using *encrypt_string()* and the key used to encrypt data, returns its decrypted cleartext.

```
function decrypt_data (inputString varbyte(16400),
  inputKeyname varchar(256)) returns varchar(16384)
```

NOTE: Can not be used to decrypt data that was created using *encrypt_cbc()* or *encrypt_fpe()*. Use *decrypt_cbc()* or *decrypt_fpe()* instead.

Example

```
BTEQ -- Enter your SQL request or BTEQ command:
# select vormetric.decrypt_data('97E7BCEB7D8EA55A59BC83BD44609B0A'xb,'KEY1');

# select vormetric.decrypt_data('97E7BCEB7D8EA55A59BC83BD44609B0A'xb,'KEY1');

*** Query completed. One row found. One column returned.
*** Total elapsed time was 1 second.

vormetric.decrypt_data('97E7BCEB7D8EA55A59BC83BD44609B0A'XB,'KEY1')
--------------------------------------------------------------------------------
clear text
```

encrypt_char()

Description

Given a cleartext string in Latin characters, a key and column size returns its encrypted equivalent.

```
function encrypt_char (inputString varchar(16384), inputKeyname
varchar(256), inputCharcolumnsize INTEGER) returns varbyte(16000)
```

NOTE: The initialization vector (IV) for *encrypt_char()* is taken from the file /etc/vormetric/vormetric_local_crypto_server.conf. A sample IV = 000102030405060708090A0B0C0D0E0F.

Example:

```
CREATE SET TABLE VORMETRIC.testvar2 ,NO FALLBACK ,
     NO BEFORE JOURNAL,
     NO AFTER JOURNAL,
     CHECKSUM = DEFAULT,
     DEFAULT MERGEBLOCKRATIO
     (column1 INTEGER,
      column2 CHAR(13)
     );
```

```
 BTEQ -- Enter your SQL request or BTEQ command:

select  column1,vormetric.encrypt_char(column2, 'KEY-NEW' ,13) as
enc_col2 from testvar2;

select  column1,vormetric.encrypt_char(column2, 'KEY-NEW' ,13) as
enc_col2 from testvar2;

  *** Query completed. 3 rows found. 2 columns returned.
  *** Total elapsed  time  was 1 second.
     column1 enc_col2
----------- --------------------------------------------------
            3 FB8CAA2F658963C73233A59589633B22
            1 4C69855E490704EFF93DFEED957201F3
            2 5F252180E7F86AE27F7050E3CE514115
```

decrypt_char()

Description

Given an encrypted string created using encrypt_char(), the key used to encrypt data and column size returns its decrypted cleartext.

```
function decrypt_char (inputString varbyte(16000), inputKeyname varchar(256),
inputCharcolumnsize INTEGER) returns varchar(16384)
```

NOTE: Cannot be used to decrypt data that was created using *encrypt_string()*, *encrypt_cbc()* or *encrypt_fpe()*. Use *decrypt_data()*, *decrypt_cbc()* or *decrypt_fpe()* with those UDFs instead.

Example:

See the encrypt_char example code to create a table.

```
BTEQ -- Enter your SQL request or BTEQ command:


select  column1, '['  || vormetric.decrypt_char(
vormetric.encrypt_char(column2, 'KEY-NEW' ,13) , 'KEY-NEW' ,13)
||  ']'   as enc_dec_col2 from testvar2;


select  column1, '['  || vormetric.decrypt_char(
vormetric.encrypt_char(column2, 'KEY-NEW' ,13) , 'KEY-NEW' ,13)
||  ']'   as enc_dec_col2 from testvar2;

  *** Query completed. 3 rows found. 2 columns returned.

  *** Total elapsed  time  was 1 second.

     column1 enc_dec_col2
 ----------- --------------------------------------------------------

           3 [1236974      ]

           1 [1234567890123]

           2 [rt           ]
```

NOTE: Column size is maintained and filled with trailing spaces in output., which would not be possible using *encrypt_string*/*decrypt_data*.

profiles.conf

To streamline the invocation of the *encrypt_cbc()*, *decrypt_cbc()*, *encrypt_fpe()* and *decrypt_fpe()* UDFs, the file *profiles.conf* is used. This file contains named profiles that include several values required as input to these UDFs. Provide the profile name as a parameter when invoking the UDF. The UDF looks up the profile name and uses the parameters that are grouped under that profile name.

An example file named *profiles.conf.sample* is provided with the installation software. Make your own copy of this file and change the name to *profiles.conf*.

Be sure to set the file permissions for *profiles.conf* appropriately. The file should be owned by the root user, who can create and edit the file. Other users should be able to view the file, so they can see the profile names in order to reference them in their own UDF calls. It is not recommended to allow users other than root to edit *profiles.conf*. Set the file permissions to 644.

NOTE: Profiles are not supported for the *encrypt_string()* and *decrypt_data()* UDFs.

Using profiles.conf with Unicode Block Cipher UDFs

Profiles that are to be used with the UDFs *encrypt_cbc()* and *decrypt_cbc()* must contain the following key-value pairs:

```
method = aes_cbc_pad
iv = Initialization Vector Number
keyname = Name of the Vormetric encryption key to use
```

Following is a sample *profiles.conf* file that contains two profiles named *ccnum* and *address*:

```
[ccnum]
method = aes_cbc_pad
iv = 000102030405060708090A0B0C0D0E0F
keyname = KEY_1
[address]
method = aes_cbc_pad
iv = 0F0E0D0C0B0A09080706050403020100
keyname = KEY_1
```

With these profile definitions, the following UDF calls can be made:

```
encrypt_cbc('1234-9876-5678-6543', 'ccnum')
encrypt_cbc('2860 Junction Avenue, San Jose, CA 95134', 'address')
```

Using profiles.conf with FPE

Profiles that are to be used with the UDFs *encrypt_fpe()* and *decrypt_fpe()* must contain the following key-value pairs:

```
method = fpe
tweak = 8-byte tweak | auto
charset = One of the values specified in [character_sets]
keyname = Name of the Vormetric encryption key to use
```

If *tweak* is set to *auto*, the tweak is generated automatically for you.

In the *[character_sets]* section of *profiles.conf*, specify one or more named character sets which can be used to tokenize the cleartext input. Define each character set as one or more comma-separated Unicode ranges in UTF16 Big Endian format. Then, in *charset*, provide one of the names from this section.

Example

Following is a sample *profiles.conf* file for use with *encrypt_fpe()* and *decrypt_fpe()*. It defines several character sets, including a Latin character set, then defines two profiles named *tokenize_name* and *tokenize_address*,

```
[character_sets]
latin = 0020-007E
alphanumeric = 0030-0039,0041-005A,0061-007A
hindi = 0905-0939,0958-0961
custom = 0905-0939,0030-0039
[tokenize_name]
method = fpe
tweak = D8E7920AFA330A73
charset = latin
keyname = KEY_FPE_1
[tokenize_address]
method = fpe
tweak = auto
charset = alphanumeric
keyname = KEY_FPE_1
```

With these profile definitions, the following UDF calls can be made:

```
encrypt_fpe('John Doe', 'tokenize_name')
encrypt_fpe('2860 Junction Avenue, San Jose, CA 95134', 'tokenize_address')
```

Dynamic Masking for Tokenization

Masking allows the VPTD administrator to define one mask per user. The masking rules trigger during detokenization, using the UDF, `decrypt_fpe()`. It contains the following features:

- Define masks
- Support partial tokenization capability
- Add prefix and suffix to a token
- Support generation of one-time use token
- Support FPE-Luhn token type

Define Masks

Masks are defined using the configuration file: */etc/vormetric/masks.conf*. The format of *masks.conf* is similar to that of *profiles.conf*. It is an .ini file with sections and key-value pairs. The section name represents the Teradata username. Each section contains the following key value pairs representing the mask definition:

- **Showfirst**: A numeric value representing the number of characters at the beginning which display in the detokenized output. By default, this value is zero.

  For example, a *showfirst* value of 4 means that the output would look like 3454-XXXX-XXXX-XXXX.
- **Showlast**: A numeric value representing the number of characters at the end which display in the detokenized output. By default, this value is zero.

  For example, a *showlast* value of 4 means that the output would look like XXXX-XXXX-XXXX-8462
- **Maskchar**: The masking character used in the detokenized output. This is mandatory for a valid mask definition.

Warning! If *masks.conf* is not found, or a username is not found in masks.conf, then the detokenized output will be shown in its entirety.

Example:

```
# A sample masks.conf
[DBC]
showfirst = 4
showlast = 4
```

```
maskchar = 'X'
[VORMETRIC]
showfirst = 0
showlast = 0
maskchar = '*'
```

Support partial tokenization capability

You can now have partial tokenization on the input string. This is governed by the profile given as a parameter to the UDF. The following key-value pairs allow partial tokenization:

- **Keepleft**: A numeric value denoting the number of characters which will remain as they are at the beginning of the input string, while the rest of the string is tokenized.

  For example, a *keepleft* value of 4 for input 1234-5678-3456-7890 results in output similar to: 1234-6573-7412-8831.

- **Keepright**: A numeric value denoting the number characters which will remain as they are at the end of the input string, while the rest of the string is tokenized.

  For example, a *keepright* value of 4 for input 1234-5678-3456-7890 might result in output similar to: 6438-6573-7412-7890.

  Example:

  ```
  [tokenize_ccnum]
  method = fpe
  tweak = auto
  charset = digits
  keyname = KEY_FPE_CC
  keepleft = 4
  ```

Add prefix and suffix to a token

You can add a prefix and/or suffix to the tokenized output through a new key-value pair: **prefix** and **suffix, using the** profiles.conf file. If the prefix is defined as a string "Credit Card number: " then the output results in output similar to: Credit Card number: 1234-6352-1738-2343.

The size of the prefix/suffix is limited to 10 characters.

Example:

```
[tokenize_ccnum]
method = fpe
tweak = auto
charset = digits
```

```
keyname = KEY_FPE_CC
keepleft = 4
prefix = "Credit Card number: "
```

Generating of one-time use token

If you need to generate an irreversible token that can never be detokenized:

1. Use the key-value pair: irreversible.
2. Set it to **yes** to generate a one-time token.

   Example:

   ```
   [irreversible_token]
   method = fpe
   tweak = auto
   charset = digits
   keyname = KEY_FPE_CC
   irreversible = yes
   ```

FPE-Luhn token type

An Luhn check is a checksum algorithm used to verify if a credit card number is valid. Users use FPE so that legacy applications do not break while processing the encrypted data. Running a standard FPE for a credit card number might result in a string which looks like a credit card number, but might fail the Luhn check. VPTD now supports generating an FPE token which will pass the Luhn check. For this, VPTD had added a method called `fpeluhn` in *`profiles.conf`*. The charset for this profile is ASCII digits, and the keepright directive will not work with this token type.

FPE-Luhn in Teradata is compatible with VTS. It requires 3 or more characters to tokenize.

```
[tokenize_ccnum]
method = fpeluhn \\ New method to enforce Luhn check validation for the output
tweak = auto
charset = digits
keyname = KEY_FPE_CC
```

4 VPTD Ongoing Operations

This chapter describes ongoing operations for Vormetric Protection for Teradata Database. This chapter contains the following sections:

Log Messages

See `/var/log/messages` for error messages originating from the Vormetric Local Cryptoserver Daemon.

See `/var/log/vormetric/pkcs11_root.log` for information messages originating when encrypt or decrypt operations are performed by the local Cryptoserver Daemon on behalf of the UDFs.

Troubleshooting

During ongoing operation of Vormetric Protection for Teradata Database, the following issues may arise if the appropriate steps are not taken to avoid them. Be aware of these considerations and take the recommended steps to ensure smooth operation.

Be Sure Teradata User Can Access /tmp/vormetric

The Vormetric Teradata UDFs and the and local Vormetric Cryptoserver communicate through the named socket /tmp/vormetric. The UDFs run in the Teradata context, so this socket must have access permission set to 666 to allow access to the Teradata user. If only the root user has permission to access /tmp/vormetric, the UDF can not communicate with the Cryptoserver and the UDF will fail.

Cache Key on Host When Turning Off udf_aes

If using the *encrypt_fpe()* and *decrypt_fpe()* UDFs with the *udf_aes* option off, be sure the encryption key created on the Vormetric DSM is cached on the host.

Otherwise, the UDF generates the following error:

```
error '500 - C_EncryptInit failed'
```

Set Width of BTEQ Session to Avoid Truncated UDF Output

If you are using *encrypt_cbc()* to encrypt long strings, use the following steps to ensure the output of the encryption UDF is not truncated. If the BTEQ session width is too narrow, characters can be lost from the end of the returned string.

1. Invoke BTEQ with the following command:

   # bteq -e UTF8 -c UTF16

2. At the BTEQ prompt, run the following command. Instead of 1000, substitute any value that ensures the width is sufficient:

   # .set width 1000

3. Run the following command:

   # .set session charset "utf8"

Flush the Cache to Remove Old Profiles

When you change the files *profiles.conf*, *mask.conf*, or *vormetric_local_crypto_server.conf*, the updates are not necessarily recognized immediately. Information from an older configuration file could be cached. To be sure the most up-to-date information is available, flush the BTEQ cache using the following steps.

Caution: The database is restarted during this procedure. If any critical operations are underway, wait until they have finished.

After changes are made to either *profiles.conf* or *vormetric_local_crypto_server.conf*:

1. Restart the Cryptoserver.
2. Run the following command:

   # tpareset -f flushing

3. Run the following command:

   ```
   # pdestate -a
   ```

4. Look for output similar to the following. If this output is not seen, repeat the *pdestate -a* command.

   ```
   PDE state is RUN/STARTED.
   DBS state is 4: Logons are enabled - Users are logged on
   ```

Properly Escape Characters in Input Strings

If an improperly formatted string is passed as input to BTEQ, such as when calling the UDFs encrypt_fpe or encrypt_cbc, the BTEQ session stops and waits indefinitely. The input string must adhere to BTEQ requirements, such as escaping special characters. For example, if the input string contains an apostrophe, use a double apostrophe: 'It''s a beautiful day'. For more information about the requirements for input strings, see Teradata BTEQ documentation.

Locking Down Internet-facing Servers Supporting VPTD

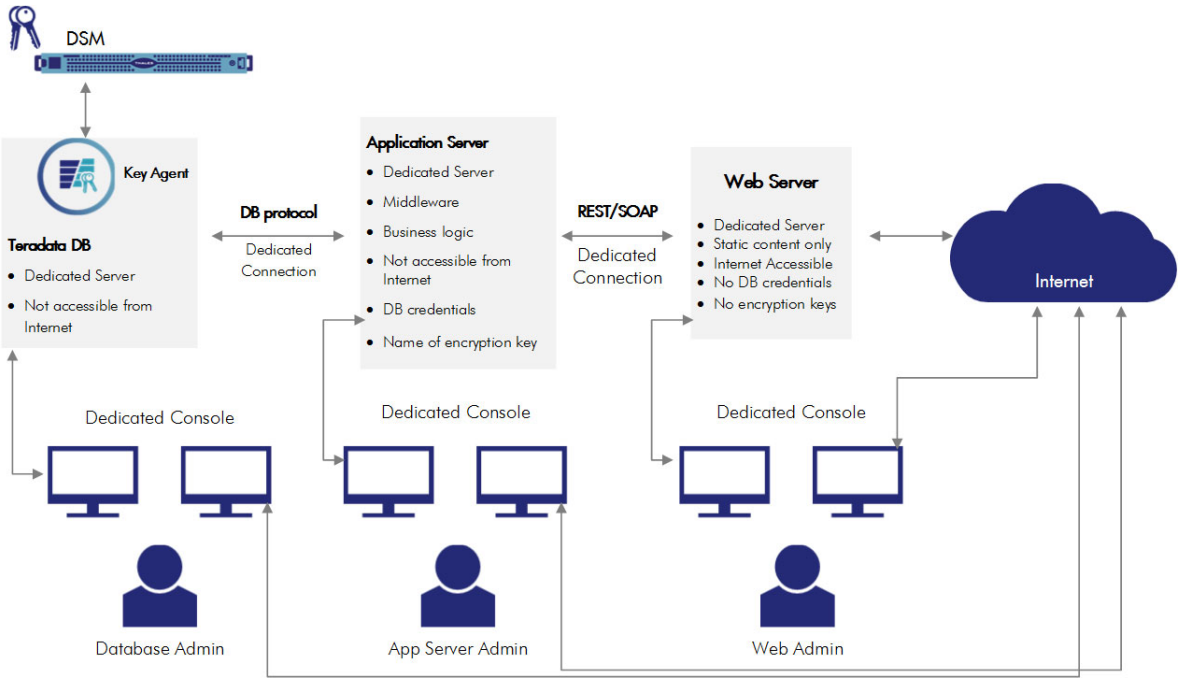
5

This chapter contains the following sections:

Security Tips for Vormetric Protection for Teradata Database

We recommend having at least two dedicated servers—a Web Server and an Application Server—between the Teradata DB and the Internet. This is shown in the following figure.

Figure 6: High Security Deployment for Teradata Deployment



- **Web Server**. The Internet-facing Web Server should be dedicated (a separate machine—virtual ok--with separate address space, IP, firewall, and so on). You must assume the Web Server will be penetrated, and so ensure that it does not contain DB credentials, encryption key names, or any sensitive data. It can contain static content such as static web pages, graphics and video, but it should not contain business logic or have direct access to the Teradata database. It should have such security features as firewalls, but you should not overload it with functionality.

  The Web Server's access to the Teradata DB should be through an Application Server. The Web Server's access to the secure data should come in the form of REST or SOAP API calls to the Application Server, which are fairly traceable, testable, and can be limited in scope.
- **Application Server** should be dedicated and should not be accessible from the Internet. It will have Teradata DB credentials and the name of encryption keys, but not the encryption keys themselves. It will contain the organization's business logic, and when the Application Server receives REST/SOAP requests from the Web Server, it will retrieve the required data from the Teradata DB and send it to the Web Server which will send it along to the requester.
- **Teradata DB** should be dedicated and inaccessible from the Internet. It should pass data only to the Application Server with the appropriate credentials. It should contain the Vormetric Application Encryption (VAE) agent, which is connected to the DSM.

To support separation of duties, each of the above servers should be administered by a different administrator, a Web Administrator, Application Server Administrator, and Database Administrator. The Web Administrator will not have access to the database, nor access to the key name. The Database Administrator has access to the encrypted data, but lacks the key name to decrypt the data. The Application Server Administrator could decompile the middleware and extract the database credentials and the key name(s), but this is not a straight-forward process as long as the application logic is compiled.

Each administrator should perform their administrative duties on their respective servers using a UNIX/Linux or OSX machine, not a Windows machine, which is more vulnerable to hacking. Furthermore, this administrator machine should have an air gap (physical and electronic isolation) from other computers.

The connection from these server administration machines to the dedicated servers should use the following security enhancements:

- Disable unused services such as printer daemons, mail servers and so on.
- Restrict the IP addresses that can log in. For example, only allow connections from corporate headquarters. This can be configured in the SSH configuration and settings.
- Change the SSH port from the default 22 to a random port number (example: 50712). In `/etc/ssh/sshd_config` change port 22 to port 50712
- Disallow SSH password login and use a key pair login instead (see below).

To Disallow SSH Password Login and Use a Key Pair Login

To set up SSH login to disallow passwords and use only key-pair login, first change the following two parameters in the */etc/ssh/sshd_config* file:

```
PasswordAuthentication no
ChallengeResponseAuthentication no
```

The SSH server will only allow login for users with an SSH key which has been added to *~/.ssh/authorized_keys* file.

Generate user-specific SSH keys by using *ssh-keygen*, which yields a private key file and a public key file (example: *id_rsa* and *id_rsa.pub*).

The private key file must remain in the workstation you use to access your production server. The public key file, however, needs to be appended to the *authorized_keys* file on the server.

Specify a password during key file generation. We strongly recommend password-protecting your private key. If you don't password-protect your private key, anyone with access to your computer conceivably can SSH (without being prompted for a password) to your account on any remote system that has the corresponding public key. You may use an SSH key without a password for automated administration tasks such as administrative shell scripts. However, restrict the scope of these keys by prefixing them with the particular command for which they will be used. For example:

```
command="rsync --server --sender -vlHogDtprxe.iLsf --numeric-ids .
/srv" ssh-rsa AAAA ...
```

These SSH keys used for automation tasks should not use root access. If root access is required, use *sudo*.

You may consider denying root logins by setting the *PermitRootLogin* to *no* in the *sshd_config* file, or allow them only for logins which are tied to a particular command using the *forced-commands-only* option.

6 Uninstalling VPTD

This chapter contains the following sections:

Uninstall Vormetric Protection for Teradata Database

When trying to uninstall VPTD on a node, the uninstaller detects the presence of the cluster and will try to uninstall VPTD from the other nodes that contain the same version of VPTD. If there is only a single node, then it uninstalls VPTD from that node.

The uninstall script also ensures that the crypto server daemon is not running on any single node before uninstalling.

NOTE: You cannot call the uninstaller from within */opt/vormetric*. You must be outside of this location.

1. Uninstall the VAE executable on Teradata:

```
rpm -qa | grep vae
vae-td14.10-6.0.2-94
rpm -e vae-td14.10-6.0.2-94
```

2. Uninstall files in */opt/vormetric/DataSecurityExpert/agent* using */opt/vormetric/DataSecurityExpert/agent/key/bin/uninstall*. These include:
   - Vormetric key agent
   - */opt/vormetric/DataSecurityExpert/agent/pkcs11/teradata/udfs/install_udfs.bteq.sample*
   - */opt/vormetric/DataSecurityExpert/agent/pkcs11/teradata/udfs/<**renamed bteq.sample file**>*
   - /*opt/vormetric/DataSecurityExpert/agent/pkcs11/Teradata/bin/vormetric_local_crypto_server*
3. Uninstall any files that are present in */etc/vormetric*/ with *rm -f*.

4. Remove Teradata UDFs by default in a specific database named “vormetric”. Either drop the database or remove the UDFs (user-defined functions) by issuing the following commands in the bteq shell:

```
DROP FUNCTION encrypt_cbc;
DROP FUNCTION decrypt_cbc;
DROP FUNCTION encrypt_fpe;
DROP FUNCTION decrypt_fpe;
DROP FUNCTION encrypt_string;
DROP FUNCTION decrypt_data;
DROP FUNCTION encrypt_char;
DROP FUNCTION decrypt_char;
```

5. Remove the *init.d* script to start the local crypto server:
   - Delete /etc/init.d/vormetric_local_crypto_server

Automated uninstall over a Teradata cluster

The intent of this feature is to detect a cluster and ensure that the uninstall is performed on all of the nodes in the cluster.

NOTE: You must ensure that the crypto server daemon is not running on any single node before the uninstall begins.

When trying to uninstall VPTD on a node, the uninstaller would detect the presence of the cluster and try to uninstall the same VPTD on the other nodes. If there is a single node then it will also uninstall the VPTD from that node as well.

The uninstaller resides in the following directory:

/opt/vormetric/DataSecurityExpert/agent/pkcs11/teradata/bin

To uninstall VPTD:

1. Type:

```
# /opt/vormetric/DataSecurityExpert/agent/pkcs11/teradata/bin
  /vptd_uninstall
```

2. Remove Teradata UDFs by default in a specific database named “vormetric”. Either drop the database or remove the UDFs (user-defined functions) by issuing the following commands in the bteq shell:

```
DROP FUNCTION encrypt_cbc;
DROP FUNCTION decrypt_cbc;
DROP FUNCTION encrypt_fpe;
DROP FUNCTION decrypt_fpe;
DROP FUNCTION encrypt_string;
DROP FUNCTION decrypt_data;
DROP FUNCTION encrypt_char;
DROP FUNCTION decrypt_char;
```

Warning! The uninstaller cannot be called from */opt/vormetric* or *opt/vormetric* sub-directories. You can call the uninstaller from any other directory.