VERMONT HEALTH CONNECT

Find the plan that's right for you.

CGI

Experience the commitment®

VT HBE - Database Design Document

Version 1.0

April 25, 2013

Table of Contents

1 Introduction 1
2 Referenced Documents 1
3 Overview 2
4 Assumptions / Constraints / Risks 3
4.1 Assumptions 3
4.2 Constraints 4
4.3 Risks 4
5 Design Decisions 4
5.1 Key Factors Influencing Design 5
5.2 Functional Design Decisions 5
5.3 Database Management System Decisions 5
5.4 Security and Privacy Design Decisions 6
5.5 Performance and Maintenance Design Decisions 7
6 Detailed Database Design 7
6.1 Environments 8
6.2 Databases Architecture/ Settings: 12
6.3 Logical Data Model: 12
6.4 Physical Data Model: 12
6.5 Database Management System Files 12
7 Database Administration and Monitoring 13
7.1 Roles and Responsibilities 13
7.2 System Information 14
7.2.1 Database Management System Configuration 14
7.2.2 Database Support Software 15
7.2.3 Security and Privacy 15
7.2.4 Operational Implications 16
7.2.5 Data Transfer Requirements 16
8 Glossary 19
9 Acronyms 20
Appendix A - Physical Data Model (PDM) 22
Appendix B - Entity Relationship Diagram for the PDM 23
Appendix C – Database Request Form 24

Table of Figures

Exhibit 1: Referenced Documents 2
Exhibit 2: VT HBE DBMS Vendor/ Versions 6
Exhibit 3: Development and Production Environment Structure Model 9
Exhibit 4: VT HBE Development Inventory List 10
Exhibit 5: VT HBE Development Inventory/Application List 11
Exhibit 6: RACI Matrix for the VT HBE Data Management Plan 14
Exhibit 7: VT HBE Database Support Software 15
Exhibit 8: Glossary 19
Exhibit 9: Acronyms 20

Revision History

Version	Date	Modified By	Description
1.0	04/25/2013	Adeniyi Alofe, Dirk Daeninck	Delivered to SOV for review

1 Introduction

The database design covers specific database objects (tables, views, indexes, packages, functions and procedures) that will be implemented in the database, the specific data maintenance and accessibility management, and the environment (hardware configuration, servers and the database architecture) in which the database/data will operate. The Vermont Health Benefit Exchange (VT HBE), designed to help register the indigenes of the state of Vermont in Affordable Health Care (AHC) programs, will be administered and managed with a physical and logical database design, presented with a relational database model. The logical database design will accomplish the need to compile and clearly represent the business processes and requirements, in relation to the VT HBE project. The physical database design is based on requirements gathered during the logical database modeling process for the VT HBE.

The Oracle software packages will form the core of the VT HBE. The software packages will include; Red Hat Linux Operating System database, Oracle Enterprise Manager (OEM), Oracle Business Intelligence Enterprise Edition (OBIEE), Service-Oriented Architecture (SOA), Enterprise Content Management (ECM), Oracle Internet Directory (OID), Oracle Data Integrator (ODI), Data Warehouse Administration Console (DAC), and Siebel.

The challenge in privacy protection is sharing data while protecting personal information. For typical e-commerce systems that store payment information and healthcare systems with confidential personal/health data, as is the case for the VT HBE, the ability to control what information to reveal, to whom, and when has become a growing concern. One of the keys to privacy protection in the cloud environment is the strict separation of sensitive data from non-sensitive data, followed by the encryption of sensitive elements. Most of the current technology infrastructures that will be adopted for the VT HBE for data storage, integration, management, and maintenance will resolve a substantial part of the of the security and privacy concerns and will give room for future improvements and modifications as new improved technologies are developed.

Finally, since the VT HBE project requires that vital information for Vermonters are gathered, stored, and used solely for the purpose of helping the residents of the state access and enroll in affordable health care plans, the database used will meet the storage requirements and will be accessible 24/7. Information will be protected, will present accurate data, and will be easily maintained. Redundant data will be minimized.

2 Referenced Documents

The CGI Federal Cloud Layout and the VT HBE Development Inventory List, developed by the CGI technical team, were incorporated into this document in Exhibit 4: Development and Production Environment Structure Model and Exhibit 5: VT HBE Development Inventory List. These exhibits show an structure of both the development and production environment, including all applications, databases, operating systems, configuration specifications, and storage systems.

Information in the VT HBE High Level Requirements Documents provided input for this document.

Exhibit 1: Referenced Documents

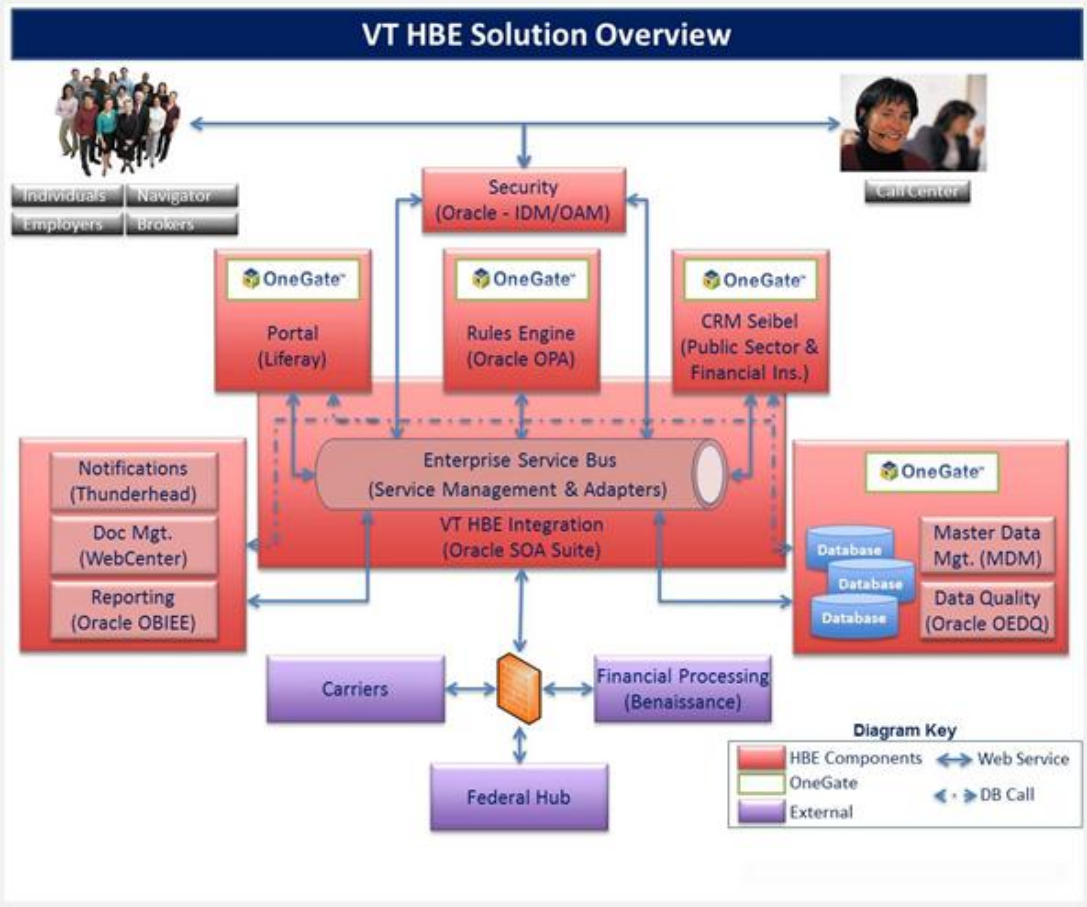
Document Name	Document Number	Issuance Date
CGI Federal Cloud Layout	N/A	04/05/2013
VT HBE Development Inventory List	N/A	03/20/2013
VT HBE High Level Requirements Document	N/A	N/A
VT HBE High Level Requirements Document Solution High Level Overview chart	N/A	N/A

3 Overview

This document provides a detailed logical data model (logical database design and relational model) of the databases that will be used for the VT HBE project. The logical database design describes the different parts of the design of the overall database system for the VT HBE. The main operation environments, where the servers, databases, and applications will reside, and the supporting storage area network (SAN) system are defined. The database systems, web, and the applications will interface with the help of efficient integration tools.

The VT HBE project was initiated due to the Patient Protection and Affordable Care Act (PPACA) law aimed at decreasing the number of uninsured Americans, reducing the overall cost of healthcare, improving healthcare, and streamlining the delivery of healthcare. The database must be able to store records and attributes, must be able to represent a simple and a complex entity model, and the database tables and rows must have unique names. A two-dimensional table structure will be used for data storage and retrieval. The relational database attributes and functions are described in this document. The development inventory list is presented in a detailed table layout in Exhibit 5: VT HBE Development Inventory List. The production inventory list is very similar to the development inventory list with the exception of clustered databases. A graphical picture of the development database and the production database is presented in Exhibit 4: Development and Production Environment Structure Model. The following diagram illustrates the database in context of the broader VT HBE system:

Exhibit 2: VT HBE Context



4 Assumptions / Constraints / Risks

4.1 Assumptions

The database design takes into consideration key assumptions. The design is also based on a conceptual understanding of the relationships between the attributes and the real world and/or the immediate environment to avoid confusion. As assumptions are validated the related design elements become validated – when elements of assumptions prove to be incorrect, further design decisions may be necessary to help ensure that the design meets the required business need.

Some key assumptions relevant to the database design:

- Normal forms/ functional dependency. The tables presented in the database are in the higher stage of normal forms, since this is better than tables in the lower stage in terms of data redundancy and anomaly control. In terms of normal forms, it is assumed that normalization can be done at any point in time.
- The databases (in both the development and production environments), have metadata that supports other applications like Siebel, OBIEE, ECM, SOA, OID, DAC, Master Data Management (MDM), and Portal.
- The original structure of database will remain substantially unchanged, but the data used to configure the products is subject to change.

- Oracle best practices will be adopted in the database maintenance, management, and tuning process.
- All hardware and software needed is readily accessible and available. Access is not limited.

4.2 Constraints

These few factors have been identified as potential restrictive measures, however, it is not anticipated that they will prevent the project from achieving its expected goals.

Constraints and mitigate plans on the database design of the VT HBE system include:

- Physical database servers will be located in remote areas. The production, stage, and disaster recovery environments will have separate/independent database servers and storage to satisfy optimal maintenance and security requirements. Oracle encryption will be required on certain portions of the data stores to support Vermont security requirements. Each function will utilize active/passive server pairs, leveraging the Phoenix Datacenter with comparable servers in the Philadelphia datacenter disaster recovery environment. Oracle Data Guard will provide the necessary synchronization (active ↔ passive and disaster recovery site). Log files size must be configured to support the following:
  - Establish an estimated Recovery Point Objective (RPO) of 30 minutes through data replication to eliminate the time consuming and logistical issues associated with recovering data from tape.
  - Plan for an Recovery Time Objective (RTO) of 4 hours by using scheduled devices located at the Philadelphia datacenter. These devices would be allocated to the VT HBE solution and built out and configured in the recovery environment at the time of a disaster declaration, accessing the already present and replicated data.
- Each environment has a requirement for Oracle database services. Due to high transaction volume, Oracle services will utilize Red Hat Enterprise physical servers in production. The development, test, and training environments will share a common collection of database servers and storage.

4.3 Risks

- Cloud computing presents some risks for database management, specifically related to the potential for user privacy violations. If user data is accessed without permission, users of the VT HBE may be reluctant to disclose their necessary information in the system. However, the oracle products/applications have reduced this risk by allowing for security checks in the form of encryptions and access control.
- Possible new health laws and rules in the future based on state or federal government decisions can result in the need for unanticipated changes. To accommodate any possible future changes, there is room for future reviews and database alteration as may be required.
- As with all implementations, future improved applications have the potential to cause deployed applications to become outdated. To prevent this from having adverse effects on the existing systems, administrators continuously undergo training to keep up to date with improving technologies. There will also be room for re-engineering and restructuring.

5 Design Decisions

The major reasons for the decision to adopt a customized design for the VT HBE are explained in this section. The database design decisions were made solely to suit the objectives, requirements, and time factors of the plan. The decisions were not influenced by any special interest, body, group, or individual.

The database design was carefully observed and approved by highly experienced technical professionals.

5.1 Key Factors Influencing Design

Key requirements that will help ensure a high-quality implementation of the VT HBE were taken into consideration when deciding on the best database design plan. The plan will best suit the business processes and other required processes for the VT HBE. The key factors considered for the design plan were:

- The need to help ensure maximum success in the VT HBE project resulted in the decision to have multiple environments (test, quality assurance, staging and production) for both servers/applications and data sources to be used in the plan. This allows software development to be put through the necessary scrutiny with little to no interference. The software will be able to undergo thorough testing before actually going life.
- High Availability (HA), tuning, recovery and backups, trouble shooting and easy database control, will be possible with the use OEM and/or Grid control. These are made available as standalone instances and Real Application Clusters (RAC) that will be used in the development and production environments respectively.
- To address the need for enough storage to accommodate large transaction data, and to have software that can accommodate multiple databases running on a single server as well as accommodate multiple instances and nodes, the Oracle Database Enterprise Edition and SAN are preferred. The SAN is a dedicated network that will provide access to consolidated, block level data storage as required in the database design for the VT HBE plan. The SAN will also make devices accessible to servers so that they will appear as if they are locally attached to the operating system.
- The database design also considered important factors such as integration that will unify different processes and products (both external and internal), performance, and the likelihood of future expansion and security needs.
- The general purpose/transaction process and data warehouse templates will be used. The general purpose/transaction process template is preferred to support Online Transaction Processes (OLTP) that will house applications like Siebel, Portal, MDM, SOA and ECM. The data warehouse template is preferred to support and On-Line Analytical Processes (OLAP) which will house applications like OBIEE, ODI, DAC, and OID.
- The data warehousing template will be an additional template in the production environment to address the factors related to performance processing, Business Intelligence, partitioning large quantities of data for performance reporting, and archiving requirements.

5.2 Functional Design Decisions

Considering the different types of users (employer, employee, broker, customer service, operational support, navigator, and individual) expected to access the VT HBE solution, simplified hardware and software devices are used. Low coupling will be used to allow each modular part of the devices to have only one responsibility performed with minimal side effects on other parts/components. The detailed layout of the components of the VT HBE plan is shown in the database layout diagram in Exhibit 4: Development and Production Environment Structure Model Database below.

The database components provided by external vendors, which will be a part of the VT HBE, is described in Exhibit 3: VT HBE DBMS Vendor/Versions below.

5.3 Database Management System Decisions

This table describes the Database Management System (DBMS) components by vendor and version.

The components outlined in Exhibit 3 are then illustrated on the CGI federal cloud database layout further in Exhibit 4: Development and Production Environment Structure Model Database. As the system is currently being designed and configured, more information will be provided as new information is gathered in the course of the development stage.

Exhibit 3: VT HBE DBMS Vendor/ Versions

Components	DBMS Vendor	Versions
Siebel Customer Relationship Management (CRM)	Oracle/Exeter	8.1.1
Thunderhead ECM	Thunderhead	5.1.1
Liferay	Exeter	8.1.1
OneGate	Exeter	3.2
Oracle SOA Suite	Oracle	11.2.0.3 Enterprise Edition
Oracle Add-ons: ▪ Advanced Security Option ▪ Partitioning Option ▪ Management and Performance Packs (OEM)	Oracle	11.2.0.3 Enterprise Edition
OBIEE	Oracle	11.2.0.3 Enterprise Edition
MDM	Oracle	11.2.0.3 Enterprise Edition
ODI	Oracle	11.2.0.3 Enterprise Edition
DAC	Oracle	11.2.0.3 Enterprise Edition
Security (OID)	Oracle	11.2.0.3 Enterprise Edition
Miscellaneous Exchange Objects	Oracle	11.2.0.3 Enterprise Edition

Citizens will access all resources through OneGate, which is installed in OLTP database like Siebel, SOA, ECM (Thunderhead), other portals, and MDM. Customer service partners will access OneGate, Siebel, OBIEE, Identity Manager (IDM), and other solutions through a wide area network. Navigators will access OneGate.

Each application system is distributed on the main installed databases based on its function as a part of the VT HBE. The metadata for support, Oracle SOA Suite, and Oracle Identity Manager (Security) functions are housed in various databases/schemas, also leveraging the Oracle and SQL (Structured Query Language) Server products already installed for the products.

Applications like OBIEE, ODI and DAC, which will primarily be used for ancillary processes such as sales, marketing, management reporting, business process management, financial reporting, etc. will function in an On Line Analytical Processing (OLAP) database. This will allow users to analyze multidimensional data interactively from multiple perspectives.

5.4 Security and Privacy Design Decisions

Security and Privacy Control is a very important aspect of the VT HBE plan. As mentioned earlier in the risk section, the privacy of Vermonters calls for protection and the access of all the users in this plan need to be controlled. A detailed security plan is described in the D-24 System Security Plan document.

5.5 Performance and Maintenance Design Decisions

Database performance tuning and maintenance will all be done using Oracle best practices. Database maintenance activities include; configuring the database for recoverability (scheduling regular backups, multiplexing control files and redo logs, retaining archive copies of redo logs), configuring the fast recovery area for simplified back up storage management, and configuring and using Oracle Enterprise Manager/Grid control to simplify monitoring and maintenance. The major user interfaces that will be deployed in the managing the VT HBE databases are; Oracle Enterprise Manager (OEM), SQL, SQL Developer, and Tool for Oracle Application Developers (TOAD).

This section explains in detail how the necessary maintenance practices will be carried out on the VT HBE databases:

- **Database Backups**:
  Recovery manager (RMAN), the oracle recommended method of backing up, will be used to back up the database control files, data files, and redo logs files. Oracle Secure Backup will be used to compliment the backup process. This will allow adding back up to tape and back up of operating systems. These back up processes are preferred for reasons mentioned earlier, and because Oracle Secure Backup and RMAN provide an end-to-end backup solution for oracle environments (centralized tape backup management for file system data and the Oracle database, and backups of any data anywhere on the network).
  This back up practice is chosen as the backup procedure on the VT HBE plan due to the benefits it provides and because it help ensure reliable data protection at lower cost and complexity.
  - **Backup type**: A one-time weekly full backup will be used to back up the VT HBE databases. This will back up all data blocks within a chosen file and perform incremental backups six days a week. This allows all information that has changed since a previous backup to be backed up.
  - **Backup mode**: The backup mode for the databases could be online (inconsistent) or offline (consistent), depending on the arising situation and what is required. The preferred mode of backing up is backing up without shutting down the database (Hot/ Online / Inconsistent backup).
  - **Backup automation/command line**: The backup setting will be configured on OEM to allow backup automation scheduled to recur at the correct intervals. The OEM interface will also allow backup reports to be viewed and monitor fast recovery area. The command line will also be used as required to back up the database.
- **Performing the VT HBE database recovery**: Both the OEM and command line interfaces would be used in the recovery of damaged control files, data, and redo log files. All of these must be functioning to open a database. It is important to make sure that the database is available to be accessed by users, even while the process is being carried out.
- **Data movement/transfer requirements**: Data transfers will be resolved with the use of SQL Loader, a tool that loads data from external files into the tables of an oracle database. It is a powerful data parsing tool engine that puts little limitation on the format of the data in the data file.
- **Working with support on the VT HBE plan**: Oracle Support Services (OSS) provides an around-the-clock (24/7) solution to all Oracle customers. This solution will be relied on for the needed support on the VT HBE plan. Support is delivered through the My Oracle Support web site, telephone, and by using Oracle Direct Connect remote diagnostic tools. The state of Vermont (SOV) has an existing Customer Support Identifier (CSI) number that will provide access to all the needed/available patches, documentation, and troubleshooting information.

6 Detailed Database Design

The Vermont HBE solution will integrate effectively with various external solution partners. The solution is based on an SOA foundation, which gives the Exchange the ability to integrate with its partners through open standards-based implementation. Integration will be enabled via the internet edge using web services and other integration protocols. This section describes the detailed database design.

6.1 Environments

There are two major environments designed for the VT HBE. Each environment consists of Oracle Red Hat Physical servers on which the databases are created. There are also two mount points (u01 and u02) created, each having at least 30 gigabytes (GB) of storage capabilities to allow for bigger storage space.

Development Environment:

The development environment is where software development processes will take place. This is also a server tier designated for production practices for software development, integration, and staging. All the detailed information about the databases, applications and the virtual machines configuration, operating system specification, and allocated memory specifications, are laid out in Exhibit 5: VT HBE Development Inventory List and Exhibit 6: VT HBE Development Inventory/Application List below. The development environment that will support the VT HBE solution will involve the following components:

- Virtual machines (VM Guests dedicated to a specific environment) hosted within the existing CGI Government Cloud
- Red Hat Linux 5.9 with FIPS modules and 6.x with FIPS modules
- Databases
  - Oracle 11g
    - Initial Oracle for development will leverage virtual machines within the development (then migrate to physical database server)
    - Oracle databases will reside on stand-alone physical servers integrated to the Cloud
- Web Logic: To be determined.

Production Environment:

The production environment is where the VT HBE will go live. This environment is still a work in progress, but a graphical picture of the design has been documented in Exhibit 4 below. The production inventory list is still being worked out, but will be very similar to the development inventory list with the exception of clustered databases. In the production environment, Oracle real application database cluster provides opportunity for load balancing and HA (keeping the Oracle database server products available and running across a set of multiple server nodes accessing a common database residing on shared SAN).

Exhibit 4 provides a simplified summary of the database of the VT HBE database design and the component applications from different vendors.

Exhibit 4: Development and Production Environment Structure Model

The following diagram shows a simple Development and Production environment structure model:
CGI Federal Cloud Database Layout

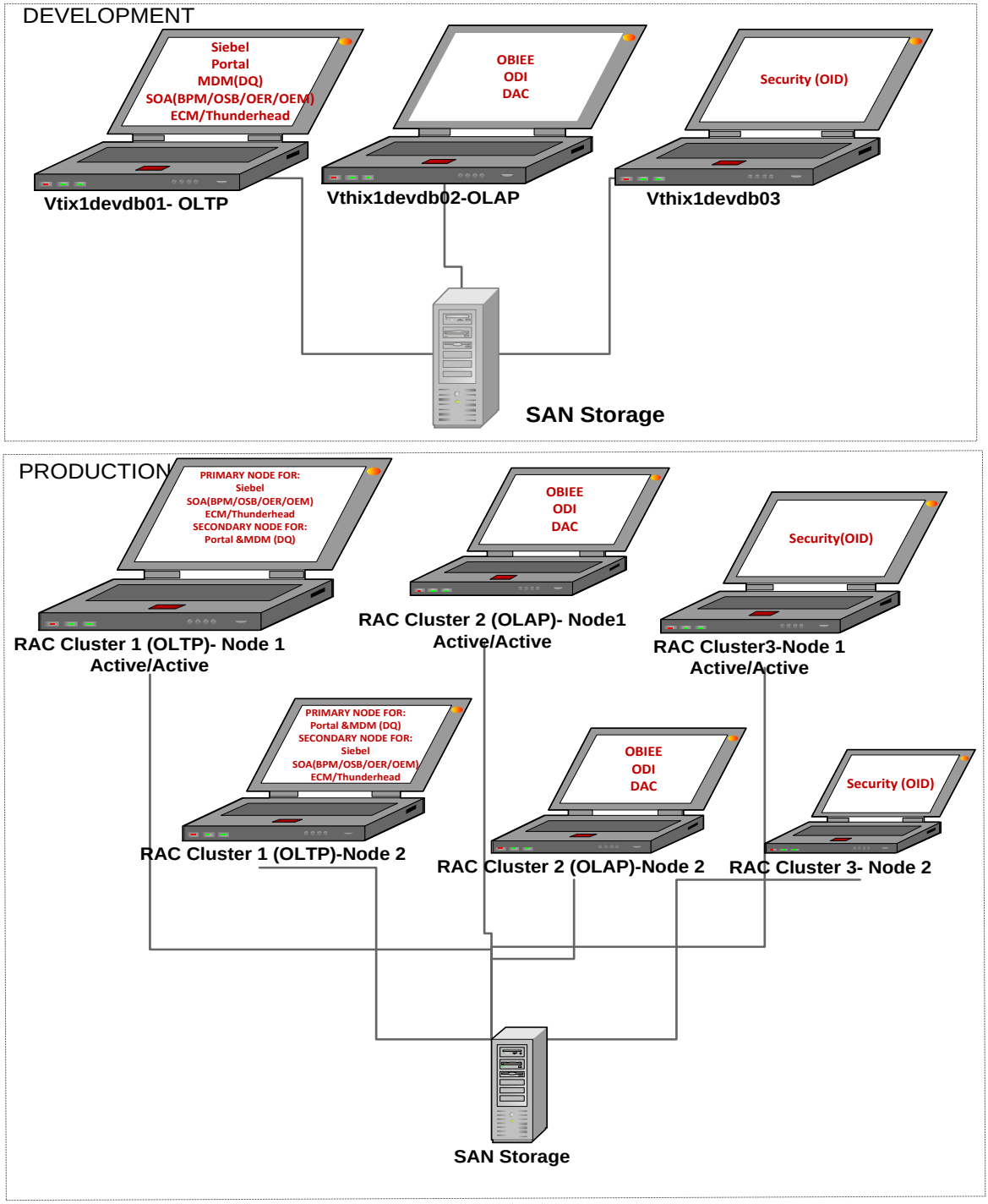


Exhibit 5: VT HBE Development Inventory List

Tier	Virtual Machine Name	Name on Visio	IPv4 Address	O/S	# vCPU	Memory (GB)	Mount Point 1	Mount Point 2
Web	vthix1devweb01	ESB1-httpd-01		Linux 5.9 64bit	2	4	(/u01 - 50GB)	(/u02 - 30GB)
Web	vthix1devweb02	sieb-ws-01	172.22.186.12	Linux 5.9 64bit	2	4	(/u01 - 50GB)	(/u02 - 30GB)
Web	vthix1devweb03	Liferay1-sw-01		Linux 5.9 64bit	4	8	(/u01 - 50GB)	(/u02 - 30GB)
Web	vthix1devweb04	Console1-ws-01	172.22.186.14	Linux 5.9 64bit	2	4	(/u01 - 50GB)	(/u02 - 30GB)
Web	vthix1devweb05	(new addition, not on Visio)	172.22.186.15	Windows 2008 R2	2	4	(C drive - 50GB)	(D drive - 30GB)
App	vthix1devapp01	Sieb-appom-01		Linux 5.9 64bit	8	16	(/u01 - 50GB)	(/u02 - 50GB)
App	vthix1devapp02	Sieb-appgw-01		Linux 5.9 64bit	8	16	(/u01 - 50GB)	(/u02 - 50GB)
App	vthix1devapp03	Sieb-apprpt-01		Linux 5.9 64bit	2	4	(/u01 - 50GB)	(/u02 - 50GB)
App	vthix1devapp04	Liferay-app1		Linux 5.9 64bit	2	4	(/u01 - 50GB)	(/u02 - 50GB)
App	vthix1devapp05	Thunderhead1-app-01	172.22.187.15	Linux 5.9 64bit	2	4	(/u01 - 50GB)	(/u02 - 50GB)
App	vthix1devapp06	Mdm-app-01	172.22.187.16	Linux 5.9 64bit	2	4	(/u01 - 50GB)	(/u02 - 50GB)
App	vthix1devapp07	Opa-app-01	172.22.187.17	Linux 5.9 64bit	2	4	(/u01 - 50GB)	(/u02 - 50GB)
App	vthix1devapp08	OIM-app-01	172.22.187.18	Linux 5.9 64bit	2	4	(/u01 - 50GB)	(/u02 - 50GB)
App	vthix1devapp09	Dir-app-01	172.22.187.19	Linux 5.9 64bit	2	4	(/u01 - 50GB)	(/u02 - 50GB)
App	vthix1devapp10	Dir-app-03	172.22.187.20	Linux 5.9 64bit	2	4	(/u01 - 50GB)	(/u02 - 50GB)
App	vthix1devapp11	apppres-01	172.22.187.21	Linux 5.9 64bit	2	4	(/u01 - 50GB)	(/u02 - 50GB)
App	vthix1devapp12	App-SOA-01	172.22.187.22	Linux 5.9 64bit	2	4	(/u01 - 50GB)	(/u02 - 50GB)
App	vthix1devapp13	App-SOAOSR0	172.22.187.23	Linux 5.9 64bit	2	4	(/u01 - 50GB)	(/u02 - 50GB)
App	vthix1devapp14	App-SOAOER	172.22.187.24	Linux 5.9 64bit	2	4	(/u01 - 50GB)	(/u02 - 50GB)
App	vthix1devapp15	App Mgt-MGMT0	172.22.187.25	Linux 5.9 64bit	2	4	(/u01 - 50GB)	(/u02 - 50GB)
Database	vthix1devdb01	db-Standalone-01	172.22.188.11	Linux 5.9 64 bit	12	32	(/u01 - 50GB)	(/u02 - 50GB)
Database	vthix1devdb02	db-Standalone-02	172.22.188.12	Linux 5.9 64 bit	12	32	(/u01 - 50GB)	(/u02 - 50GB)
Database	vthix1devdb03	db-Standalone-03	172.22.188.13	Linux 5.9 64 bit	12	32	(/u01 - 50GB)	(/u02 - 50GB)

Exhibit 6: VT HBE Development Inventory/Application List

Tier	Virtual Machine (VM) Name	Name on Visio	IPv4 Address	Application
Web	vthix1devweb01	ESB1-httpd-01		OneGate /Liferay (HBE Portal)
Web	vthix1devweb02	sieb-ws-01	172.22.186.12	Siebel-SWE
Web	vthix1devweb03	Liferay1-sw-01		OBIEE Web Front Ends
Web	vthix1devweb04	Console1-ws-01	172.22.186.14	Master Data Management (MDM) App.Mang.Web Frontend
Web	vthix1devweb05	(new addition, not on Visio)	172.22.186.15	Oracle WebCenter Capture - Index/Scan/Commit, Forms/Barcode recognition server and Import server components
App	vthix1devapp01	Sieb-appom-01		Object Manager AOM
App	vthix1devapp02	Sieb-appgw-01		Siebel Gateway / FS / EIM / EAI / Workflow / Assignment MGR
App	vthix1devapp03	Sieb-apprpt-01		Siebel Report Server Windows
App	vthix1devapp04	Liferay-app1		OneGate/Liferay Application Server Container
App	vthix1devapp05	Thunderhead1-app-01	172.22.187.15	Thunderhead Web Center Content
App	vthix1devapp06	Mdm-app-01	172.22.187.16	MDM
App	vthix1devapp07	Opa-app-01	172.22.187.17	OPA Engine / Windows Desktop Client / Oracle Policy Modeler (OPM)
App	vthix1devapp08	OIM-app-01	172.22.187.18	Oracle Identity Manager / Oracle Access Manager
App	vthix1devapp09	Dir-app-01	172.22.187.19	WebLogic OVD
App	vthix1devapp10	Dir-app-03	172.22.187.20	WebLogic OID
App	vthix1devapp11	apppres-01	172.22.187.21	OBI Presentation Services Plugin / IBI Presentation Services / OBI Cluster Controller / WebLogic
App	vthix1devapp12	App-SOA-01	172.22.187.22	OSB / BPM / Coherence / BAM / Healthcare Adaptor / HIPAA Accelerator / Web Logic / FTP
App	vthix1devapp13	App-SOAOSR0	172.22.187.23	OSB / BPM / Coherence / BAM / Healthcare Adaptor / HIPAA Accelerator / Web Logic / FTP
App	vthix1devapp14	App-SOAOER	172.22.187.24	OSB / BPM / Coherence / BAM / Healthcare Adaptor / HIPAA Accelerator / Web Logic / FTP
App	vthix1devapp15	App Mgt-MGMT0	172.22.187.25	Application Management for Siebel
Database	vthix1devdb01	db-Standalone-01	172.22.188.11	OLTP Transaction Cluster
Database	vthix1devdb02	db-Standalone-02	172.22.188.12	OLAP Analytics Cluster
Database	vthix1devdb03	db-Standalone-03	172.22.188.13	IDM, OAM, Configuration metadata, Security Cluster

6.2 Databases Architecture/ Settings:

Development:

Databases:

- IHSDEV01 on DB01 for SIEBEL, PORTAL, MDM (MDM and Data Quality (DQ)), SOA (Business Process Management (BPM), Oracle Service Bus (OSB), Oracle Enterprise Repository (OER), OEM) and ECM
- IHSDEV02 on DB02 for OBIEE (OLAP, ODI, DAC)
- IHSDEV03 on DB03 for SECURITY

Production:

Real Application Clusters (RAC):

Three RACs will be used, with each cluster having two nodes each. The cluster design will help improve HA of the databases as needed. The following subsections describe the logical an physical data models and the Database Management System Files.

6.3 Logical Data Model:

The VT HBE LDM, is based on a core LDM provided by the One-Gate system. The LDM will evolve through the development cycle to provide a common understanding of VT HBE data elements and requirements. This document will reflect this evolution and will be updated with the tested, production representation during implementation.

Appendix B, Entity Relationship Diagram for PDM provides the logical data model for the core OneGate application.

6.4 Physical Data Model:

The VT HBE model is derived from the logical data model. This involves the actual design of the database according to the requirements established during logical modeling. In the PDM, objects are defined at the schema level. Objects, such as tables and columns, are created based on entities and attributes defined during logical modeling. Constraints are also defined, including primary keys, foreign keys, other unique keys, and check constraints. Views can be created from database tables to summarize data or to provide the user with another perspective of certain data. Other objects, such as indexes and snapshots, are also be defined during physical modeling. The OneGate data model is referenced as the representative model. This model will evolve along with the LDM.

Appendix A, Physical Data Model provides the PDM for the core OneGate application.

6.5 Database Management System Files

A relational database management system (RDBMS) will be the structure used for the database file creation and administration. All the RDBMS tools will be used in data retrieval, storage and modification as required. Indexes will be created and dropped, as appropriate, to improve the performance of data retrieval queries. Sequences will be used to generate numeric values as needed.

The storage of data in the database will be in the disks and data files. The address space and tertiary memory will not be less than 4GB per database and increased as needed. Secondary and tertiary storage will be made available as needed since that provides support for large scale multidimensional database management systems like the VT HBE.

7 Database Administration and Monitoring

Proactive database maintenance practices will be easier with the sophisticated Oracle Database used in the VT HBE to maintain and monitor the databases. Some of these practices will include:

- Using the snapshots in Automatic Workload Repository (AWR), a built-in storage in Oracle databases, to analyze workload information and using automated tasks to perform routine maintenance like regular backups, refreshing optimizer statistics, and database health checks.
- A database administrator will respond to critical errors or problems that cannot be resolved automatically and require administrators to be notified. The server generated alerts will be resolved in quick time considering the recommendations provided by the alerts on how to resolve the errors.
- Help ensure that HA, database errors and problems will be resolved while the database is up and running. The database administrator will respond swiftly to alerts generated and consider the recommended resolution advised in resolving the problems.
- The Automatic Database Diagnostic Monitor (ADDM) will be viewed and managed through all available interfaces. The recommendations generated in advisory for resolution will be considered.
- The OEM improved monitoring and maintenance tool will be used to its maximum potential.
- Performance monitoring, which is necessary to keep the Oracle database running smoothly, will be one of the top maintenance priorities. Location bottlenecks and problem areas will be regularly checked using all available and accessible performance measurement criteria or database metrics such as network performance, disk input/output speed, to the time spent working on individual application operation.
- The Oracle best practices, as mentioned earlier in the performance and maintenance decisions in section 5, will be strictly followed for the purposes of backup and recovery of control, data and redo log files, as well as for all security and privacy decisions.

7.1 Roles and Responsibilities

The D-20 VT HBE Data Management Plan outlines the details of the data management plan.

The roles and responsibilities necessary to help ensure this data plan is well implemented and maintained are outlined in Exhibit 7: RACI Matrix for the VT HBE Data Management Plan, using the Responsible, Accountable, Consulted and Informed (RACI) matrix approach to data architecture resource approach.

Exhibit 7: RACI Matrix for the VT HBE Data Management Plan

	Integration Manager	Security Manager	Data Modeler	System Administrator	Database Administrator
Metadata Management	C	C	RA	C	RA
Data Base – Design, Installation, configuration and Operational Management, Backup and Recovery and HA	I	R	I	R	RA
Data Security Model	I	RA	I	R	RA
Integration	RA	I	I	R	C
Data Architecture Design and Management	I	I	RA	C	RA
Operating System Installation & Configuration	I	R	I	RA	R
Data Quality Management	R	R	RA	R	RA
Data Governance	R	R	RA	R	RA
Data Modeling	I	I	RA	C	I

Key:

- **R** = Responsible (performs the task)
- **A** = Accountable (answerable for completion of the task)
- **C** = Consulted (provides information/assistance)
- **I** = Informed (kept appraised of the activity)

7.2 System Information

The Oracle databases created for the VT HBE plan is the RDBMS. The RDBMS provides an open, comprehensive, integrated approach to information management. It is very important that information for the large data volume expected with the VT HBE can be stored and retrieved with ease in the database. The RDBMS will be an immediate recommendation for this purpose.

The RDBMS will also help with preventing unauthorized access and provide efficient solutions for failure recovery.

The databases are configured with the configuration management standard, which helps ensure that performance will be consistent during the life cycle of the databases.

7.2.1 Database Management System Configuration

Section 6 of this document explained in detail the configuration of the servers and databases, for the development and production environments. The vendors of all the support software are tabulated in Exhibit 8: VT HBE Database Support Software. Shared storages will be used in both environments. A non-clustered system will be used in the development environment while the clustered system, where multiple instances on separate servers for the same shared database, will be used in the production environment. Each database instance is associated with one and only one database.

The memory structures are made up both the Program Global Area (PGA) and the System Global Area (SGA). The PGA contains is a non-shared memory created by oracle database that contains data and control information for a server or background processes. The SGA on the other hand is a group of shared memory structures that contains data and control information for one oracle database instance.

7.2.2 Database Support Software

The main support software that will be used for database administration of each type is listed in the following table:

Exhibit 8: VT HBE Database Support Software

Utility Name	Version	Function and Major Operating Characteristics
Red Hat Linux	V5.8 64-bit	Operating system for Oracle DBMS.
Windows	2008 R2	Operating system for SQL Server DBMS.
Oracle	Enterprise Edition 11.2.0.3	DBMS for VT products and custom development.
Microsoft SQL Server	Enterprise Edition 2008 R2	DBMS for VT HBE products.
Oracle SQL Developer Data Modeler	3.1.2.704	Data modeling tool for custom development. Used to design and document non VT HBE schemas, generate the initial environment DDL, and produce detailed system reports.
Oracle SQL Developer	3.2.20.09	Client-side based GUI interface to databases. Used by the application database administrator and developers in the non-production environments to connect to Oracle databases, view table structures, and create test data.
Oracle Advanced Security	11.2.0.3	A separately licensed component of Oracle Enterprise Edition (EE). Includes Transparent Data Encryption (TDE) at the column and tablespace level as well as network encryption.
TOAD for Oracle	Client Version 9.7.2.5	A multi-tabbed browser that supports many applications.

All the software listed in this exhibit plays a big role in the database administration and will be used in the process. However, any improved application or software might be introduced in the future.

7.2.3 Security and Privacy

The importance of administering user security on the VT HBE plan cannot be overemphasized. The following processes keep track of who does what at what time, and to help ensure the user's privacy is protected:

- Database user accounts will be created and managed by either the system administrator or the database administrator. In other words, users with be authenticated and assigned storage area/table spaces.
- User privileges will be granted and revoked as needed and when necessary by either the Oracle database administrator or the system administrator.
- User roles will be created and managed by the authorized entities.

- User profiles will be created and managed by implementing standard password security features and by controlling resource usage.

7.2.4 Operational Implications

The VT HBE system will be required to interface real-time with multiple internal and external systems. The VT HBE database must be available to transitionally store and access interface related data entities and attributes.

These activities can only be performed with a change window:

- New database creation
- Refresh of production database to Quality Assurance (QA) or testing environment
- Disaster recovery setup
- Database recovery

These activities can be done without downtime, but preferably with a change window:

- User creation and administration
- Schema object creation and management
- Change in the backup plan

These are regular activities that do not require downtime:

- Space administration
- Regular backups
- Granting privileges to the user
- Recompilation of any invalid objects

7.2.5 Data Transfer Requirements

Data is transferred from one system to another system using the methods given by the RDBMS software. Those methods are designed to transfer in a secure way. Any manual data transfer will be done in a secure method.

The VT HBE system will transfer data as part of the interfaces, disaster recovery preparedness, and off-site backup requirements. Database replication from the operational data center to the disaster recovery site will be done over a secure Virtual Private Networks (VPN) connection. This same connection will be used for transferring the database backups for off-site storage. The specific mechanisms, as they relate to the DBMS for the various interfaces, will evolve with key design decisions throughout the development lifecycle and, this document will be maintained to reflect those decisions. The following interface dependencies will be addressed:

- Federal Hub Group 1 including the following services:
  - ID Proofing
  - SSA Composite
  - Verify Lawful Presence (basic)
  - APTC
- Federal Hub Group 2 including the following services:
  - Verify Lawful Presence (variations)
  - Enrollment Reconciliation
  - Appeals
  - Current Income

    - Annual Income
- Federal Hub Group 3 including the following services:
    - Monthly and 1095 End-of-Year Reporting to IRS
    - Quarterly Eligibility Verification
    - Account Transfer
- Carrier Enrollment
- Carrier Financial Management
- SERFF
- Exchange Accounting System
- State Data Validation Interfaces

Oracle provides different ways to transport data: Oracle Data Guard, Data Pump, SQL loader, External tables, and select into clause of PL/SQL. For database or schema movement, Transportable tablespaces can be used, depending on the nature of the required transfer.

Dataguard enables read-only access to a physical standby database for queries, sorting, and reporting. Dataguard allows fast incremental backups when offloading backups to a standby database. An Oracle Active Data Guard physical standby database can also provide disaster recovery and/or serve as a test database. Disaster recovery implementations using Data Guard require high speed dedicated connectivity between the primary and standby database. The preferred data transfer speed is 5 megabytes per second (MB/s).

Data Pump is a feature that enables very fast bulk data and metadata movement between Oracle databases. Oracle Data Pump provides new high-speed, parallel Export and Import utilities (expdp and impdp) as well as a Web-based Oracle Enterprise Manager interface.

SQL* Loader is a high-speed data loading utility that loads data from external files into tables in an Oracle database. SQL*Loader accepts input data in a variety of formats, can perform filtering, and can load data into multiple Oracle database tables during the same load session.

External tables allow users to preprocess input data before it is sent to the access driver. The ability to manipulate input data with a preprocessor program results in additional loadable data formats, and enhances the flexibility and processing power of external tables.

Transportable tablespaces allows you to quickly move a subset of an Oracle database from one Oracle database to another. Oracle databases on different platforms allow data to be moved between databases quickly. Using the cross-platform transportable table spaces method to move data is more efficient than the traditional method of export and import.

The following acceptable protocols will be used for data transfer:

- Secured
    - Secure Copy (SCP)
    - Secure File Transfer Protocol (SFTP)
    - Secure Shell (SSH)

Unsecured protocols will not be used as part of the VT HBE solution.

8 Glossary

Exhibit 9: Glossary

Term	Description
SGA (System Global Area)	Group of shared memory structures that contain data and control information for one oracle instance
PGA (Program Global Area)	Memory regions that contains data and control information for server and background processes
RDBMS (Relational Database Management System	A database management system that provides an open, comprehensive, integrated approach to information management
Redo Buffer Log	A memory structure that that caches redo information

9 Acronyms

Exhibit 10: Acronyms

Acronym	Description
ADDM	Automatic Database Diagnostic Monitor
AHC	Affordable Health Care
AWR	Automatic Workload Repository
BPM	Business Process Management
CMS	Centers for Medicare and Medicaid Services
CRM	Customer Relationship Management
CRUD	Create, Read, Update, Delete
CSI	Customer Support Identifier
DAC	Data Warehouse Administration Console
DBMS	Database Management System
DBMS	Database Management System
ECM	Enterprise Content Management
ERD	Enterprise Relationship Diagram
FIPS	Federal Information Processing Standard
HA	High Availability
ICD	Interface Control Document
IDM	Identity Manager
LDM	Logical Data Model
MDM	Master Data Management
OBI	Oracle Business Intelligence
OBIEE	Oracle Business Intelligence Enterprise Edition
ODI	Oracle Data Integrator
OEM	Oracle Enterprise Manager
OER	Oracle Enterprise Repository
OID	Oracle Internet Directory
OLAP	On-Line Analytical Processing
OLTP	On-Line Transaction Processing
OSB	Oracle Service Bus
OSS	Oracle Support Services
PDM	Physical Data Model
PGA	Program Global Area
PPACA	Patient Protection and Affordable Care Act
QA	Quality Assurance
RAC	Real Application Clusters
RACI	Responsible, Accountable, Consulted and Informed
RDBMS	Relational Database Management System

Acronym	Description
RMAN	Recovery Manager
RTO	Recovery Time Objective
SAN	Storage Area Network
SCP	Secure Copy
SDD	System Design Document
SFTP	Secure File Transfer Protocol
SGA	System Global Area
SOA	Service-Oriented Architecture
SOV	State of Vermont
SQL	Structured Query Language
SSH	Secure Shell
TOAD	Tool for Oracle Application Developers
VPN	Virtual Private Networks
VT HBE	Vermont Health Benefit Exchange

Appendix A - Physical Data Model (PDM)

The following PDM is a OneGate representation to support the project.

Refer to the OneGate HIX data model that describes the business entities (categories of data), and organizational units. The data model is contained in the *D-19 Database Design Document Appendix A.pdf* file posted with this deliverable on Ensemble.

Appendix B - Entity Relationship Diagram for the PDM

The following entity relationship was used for the PDM.

Refer to the OneGate HIX database design document which shows elaborate entity relationship diagrams for the physical data model. More diagrams will be included in future as they are developed.

The data model is contained in the *D-19 Database Design Document Appendix B.pdf* file posted with this deliverable on Ensemble.

Appendix C – Database Request Form

Use the following CMS-approved form to initiate, track, monitor, and implement changes to be made by the central database administrators to CMS enterprise databases.

The database request form is a formal questionnaire designed by developers and database administrators to track new database creation, objects, schemas and all database related requests.

The format that will be used for the VT HBE project is presented below:

Database Request Form

Lines 1-11 must be completed for every database request					
1.	Name of Requester/ Department				
2.	Date of Request	M	D	YY	
3.	Phone #:				
4.	Desired Completion date:	M	D	YY	
5.	How many people will be using database?				
6.	Purpose of database:				
7.	Desired database name:				
8.	Brief Description of what is needed/ expected				
9.	Other Information that needs to be collected.				
10.	Comments:				

Supervisors signature and DATE