centrally manages TDE master keys over a direct network connection, eliminating the need for local wallet files, reducing operational and security challenges of wallet file management such as periodic password rotation, wallet file backups, and wallet file recovery.  Using Oracle Key Vault with TDE enables sites to scale their TDE deployments to hundreds or thousands of databases in different locations while improving operational efficiencies, reducing TCO, and enabling consistent key management policies.  A RESTful API allows for secure, automated on-boarding of any number of current or future TDE-enabled databases without any further intervention by the OKV administrators.

Oracle Key Vault also integrates with popular Hardware Security Modules (HSM) from nCipher and Safenet (now Thales) to establish a Root of Trust (RoT) relationship where the secret that unlocks OKV is stored on a tamper-resistant, specialized, FIPS 140-2 level 3 certified hardware module.

Oracle Key Vault supports hybrid cloud deployments, so organizations migrating to the Oracle Cloud can use it to support TDE deployments in both their cloud and on premises databases.
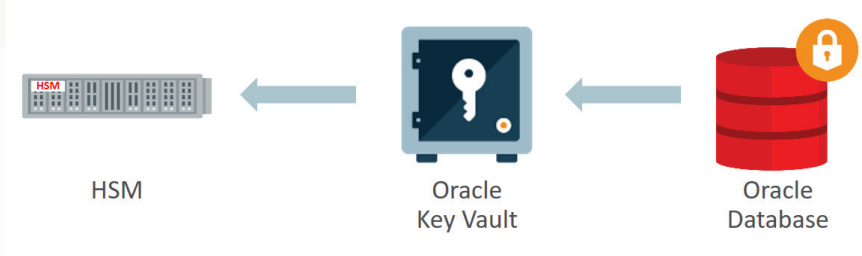


Figure 3. Oracle Key Vault and HSM as Root of Trust for TDE

**Encryption Impact for Common Operational Activities**

Essential day-to-day database operational activities can potentially leak sensitive data when not performed properly, making bypass easy.  Examples of these activities include database backup and restore, data movement, high-availability clustering, and replication.

**Example integrations with Oracle Advanced Security TDE** 66

| DATABASE TECHNOLOGIES | EXAMPLE POINTS OF INTEGRATION | TDE SUPPORT |
|---|---|---|
| High-Availability Clusters | Oracle Real Application Clusters (RAC), Oracle Data Guard | ✅ |
| Backup and Restore | Oracle Recovery Manager (RMAN), Oracle Secure Backup | ✅ |
| Export and Import | Oracle Data Pump Export and Import | ✅ |
| Database Replication | Oracle GoldenGate | ✅ |
| Pluggable Databases | Oracle Multitenant | ✅ |
| Engineered Systems | Oracle Exadata Smart Scan | ✅ |
| Storage Management | Oracle Automatic Storage Management (ASM) and ASM Cluster File System (ACFS) | ✅ |
| Data Compression | Oracle Standard, Advanced , and Hybrid Columnar Compression | ✅ |