Privacy

Insider Threats

Compliance

Oracle Database Vault

Under the Covers

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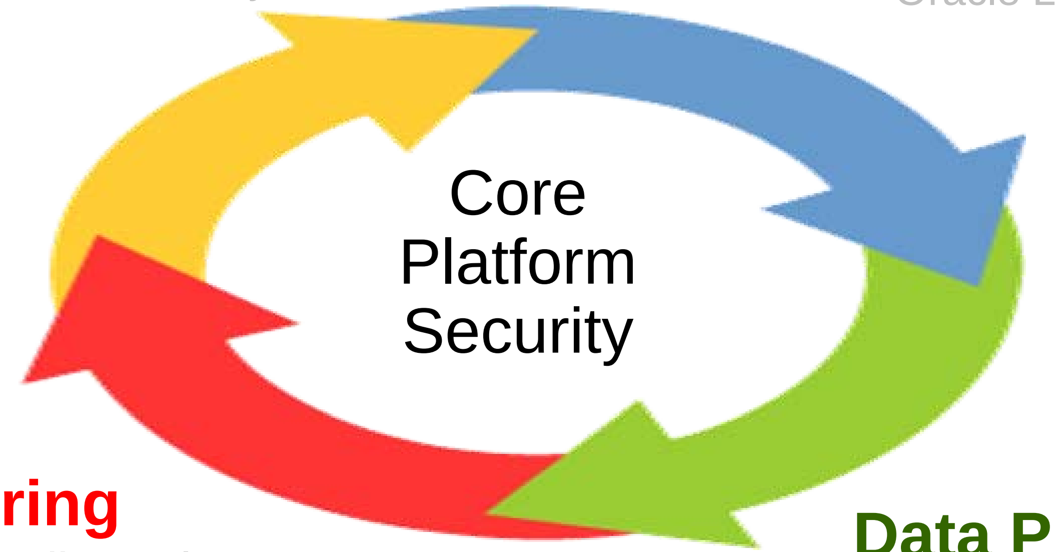
Data Security: Oracle Products

User Management

- Oracle Identity Management
- Enterprise User Security

Access Control

- **Oracle Database Vault**
- Oracle Label Security



Core
Platform
Security

Monitoring

- Oracle Audit Vault
- EM Configuration Pack

Data Protection

- Oracle Advanced Security
- Transparent Data Encryption
- Oracle Secure Backup

Agenda

- Current Techniques to Control Access
- High-level Goals for Database Vault
- Database Vault Architecture
- Database Vault Components
- Operating with Database Vault
- Case Studies
- For More Information

Controlling Access to Oracle Database

Current Techniques

- Controlling Network Access
  - Configure SQL-Net to control connection from specific addresses
- Controlling User Login
  - Define login trigger to control who can access the database
- Controlling Access and changes
  - Define DML triggers to control row level access
  - Create VPD and OLS policies per table and view
  - Define system triggers to control DDL commands
- Controlling access to sensitive roles
  - Integrate Application Roles to control privilege escalations
- Auditing to monitor access (if nothing else)

Limitations of Current Techniques

- Collection of security techniques
  - Lacks underlying common framework and management
  - Per object control required; Manageability issues
  - Lacks flexibility and may require application changes
  - Operational complexity with multiple components
- No protection from users with DBA privileges
  - DBA role with full access to user and business data
  - Only few apps built with least-privilege model
  - Various utilities require powerful administrator privileges
- Cannot meet new compliance requirements
  - Separation of Duty not enforced
  - Cannot control user creation, role assignment, etc.
  - No way to specify additional security policies on top of exiting apps
- Performance impact due to triggers or SQL modification

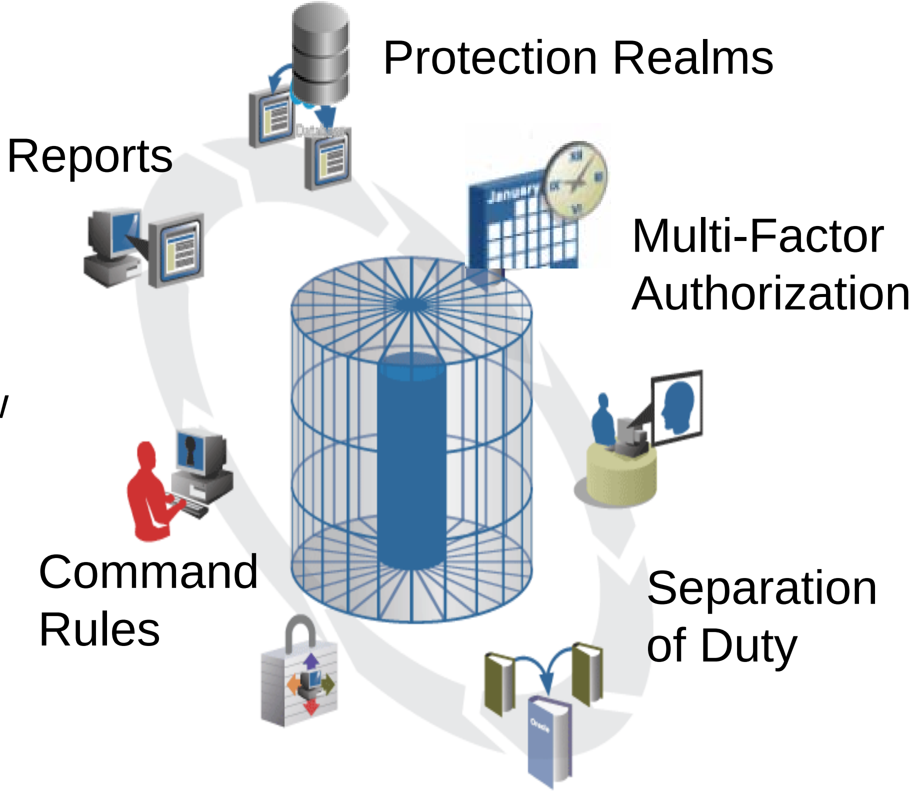
Oracle Database Vault Goals

Defense in Depth

- Integrated security framework to provide full control
  - Network, users, DBA, data, roles, SQL
  - Multi-factor Authorization and Policies across various checks
  - Protect and share data assets using environmental factors
- Compliance requirements
  - Built-in Separation of Duty (User mgmt, data mgmt, apps mgmt)
  - Group business data into individual administration units
  - Prevent misuse of powerful privileges
  - Support Database consolidation
- Operational requirements
  - No application changes
  - Minimal Performance impact
  - Easy-to-use PLUS customization flexibility
  - Hardened Database with seeded rules to lock down
  - Audit security relevant events

Oracle Database Vault

- **Controls on privileged users**
  - Restrict DBA access to application data
  - Provide Separation of Duty
  - Security for database and information consolidation
- **Enforce data access security policies**
  - Control who, when, where and how is data accessed
  - Make decision based on IP address, time, auth…
- **Available on Oracle 10gR2 and 9iR2**
- **Validated with PeopleSoft**
- **E-Biz & other Apps validation underway, including 3rd party**



Oracle Database Vault

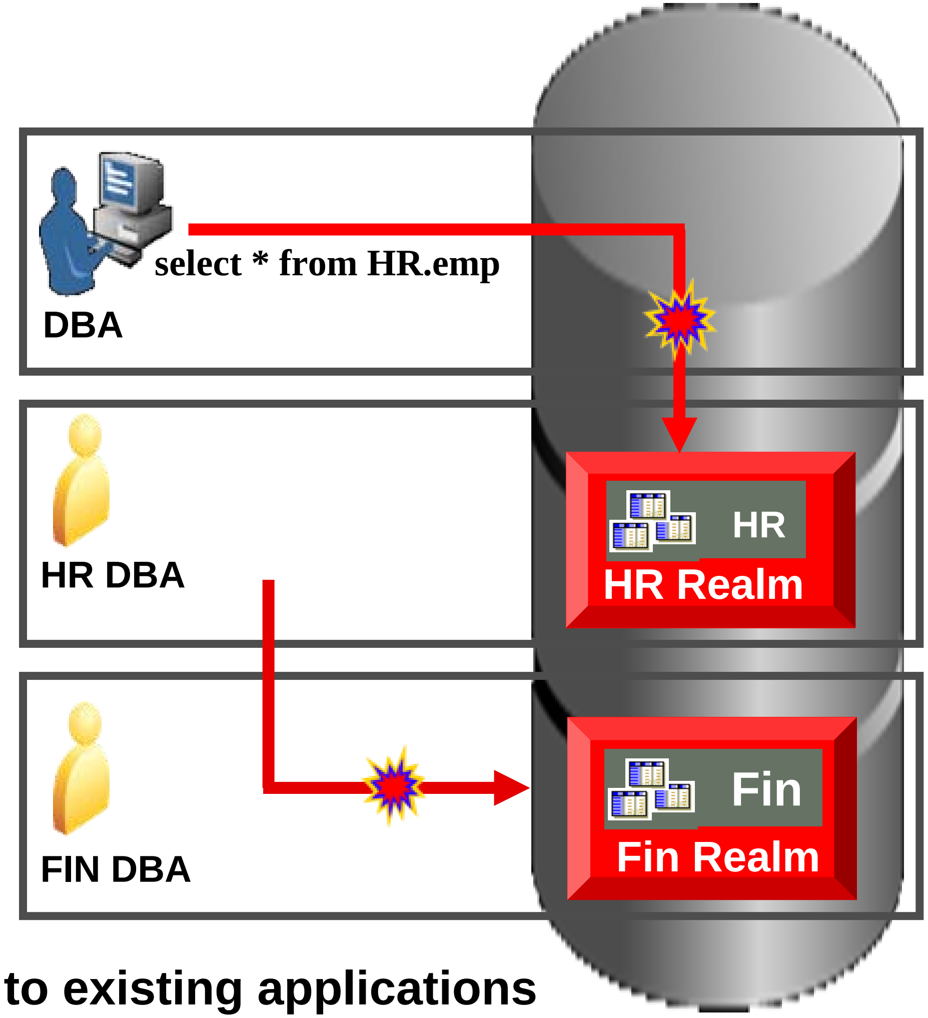
Protection Realms

- **Database DBA views HR data**

  Compliance and protection from insiders

- **HR DBA views Fin. data**

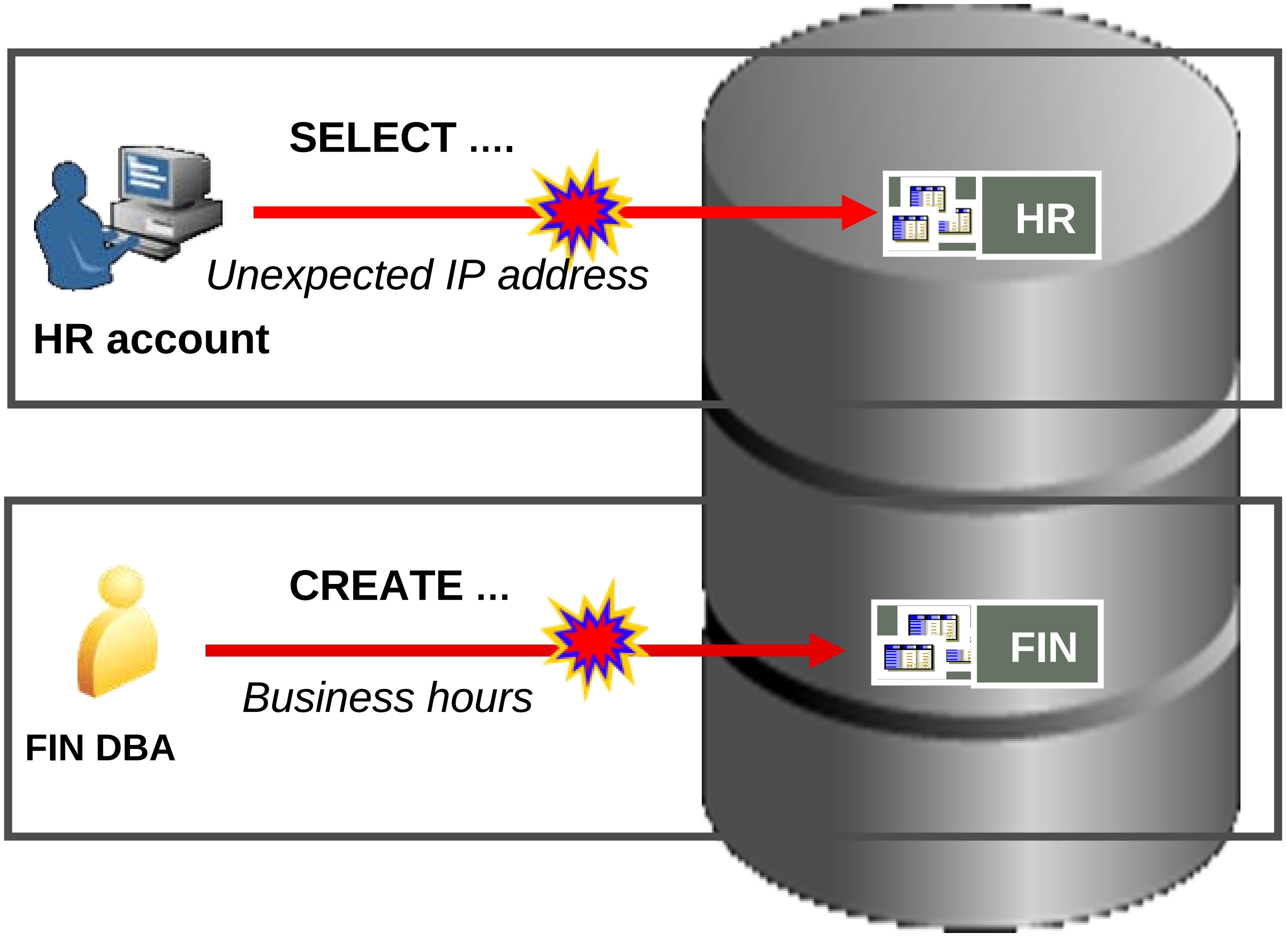
  Eliminates security risks from server consolidation



Realms can be easily applied to existing applications with minimal performance impact

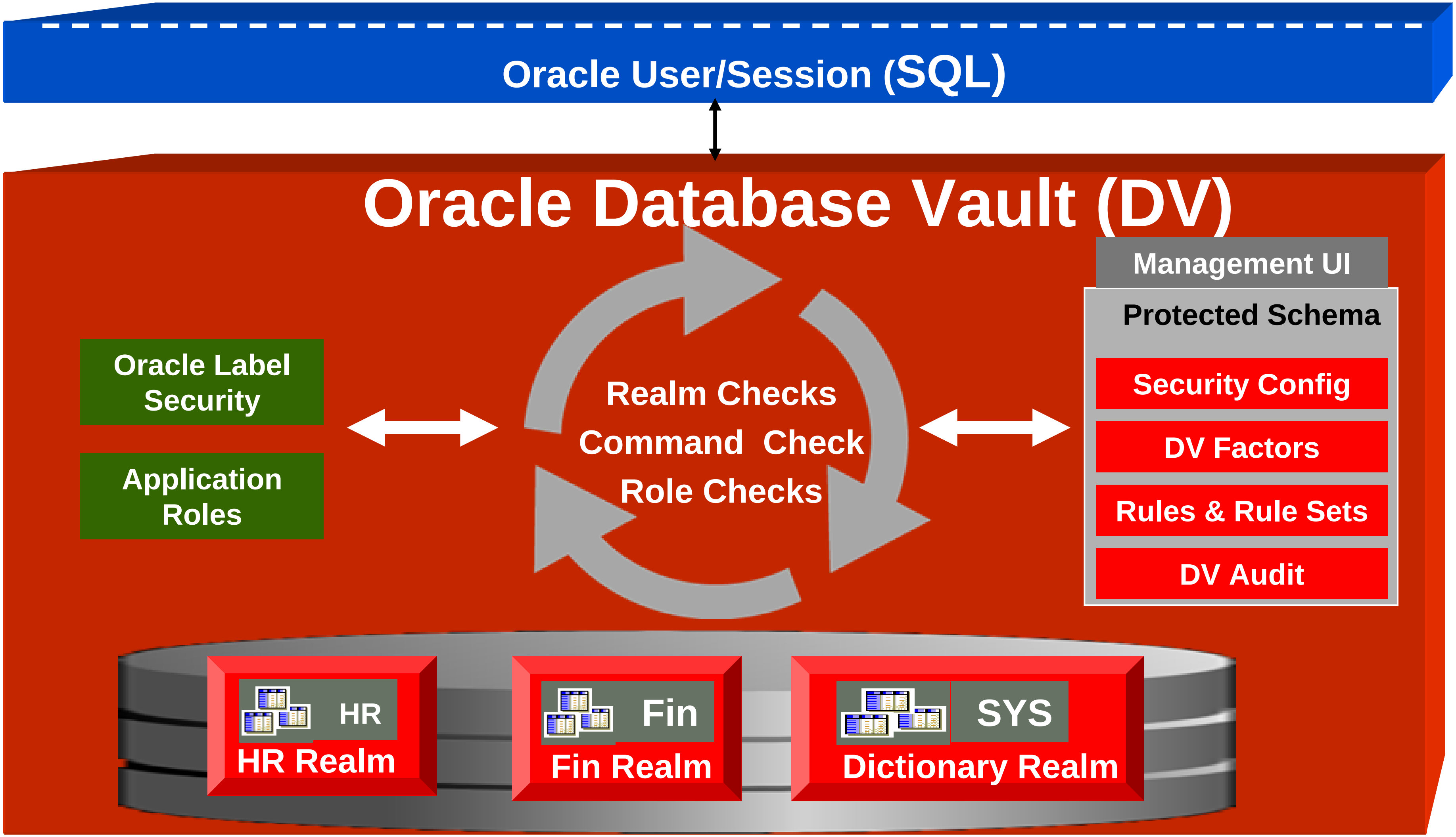
Oracle Database Vault

Custom Policies: Multi-factor Authorization



Database Vault – Under the Covers

Database Vault System Overview



Oracle User/Session (SQL)

Oracle Database Vault (DV)

Oracle Label Security

Application Roles

Realm Checks

Command Check

Role Checks

Management UI

Protected Schema

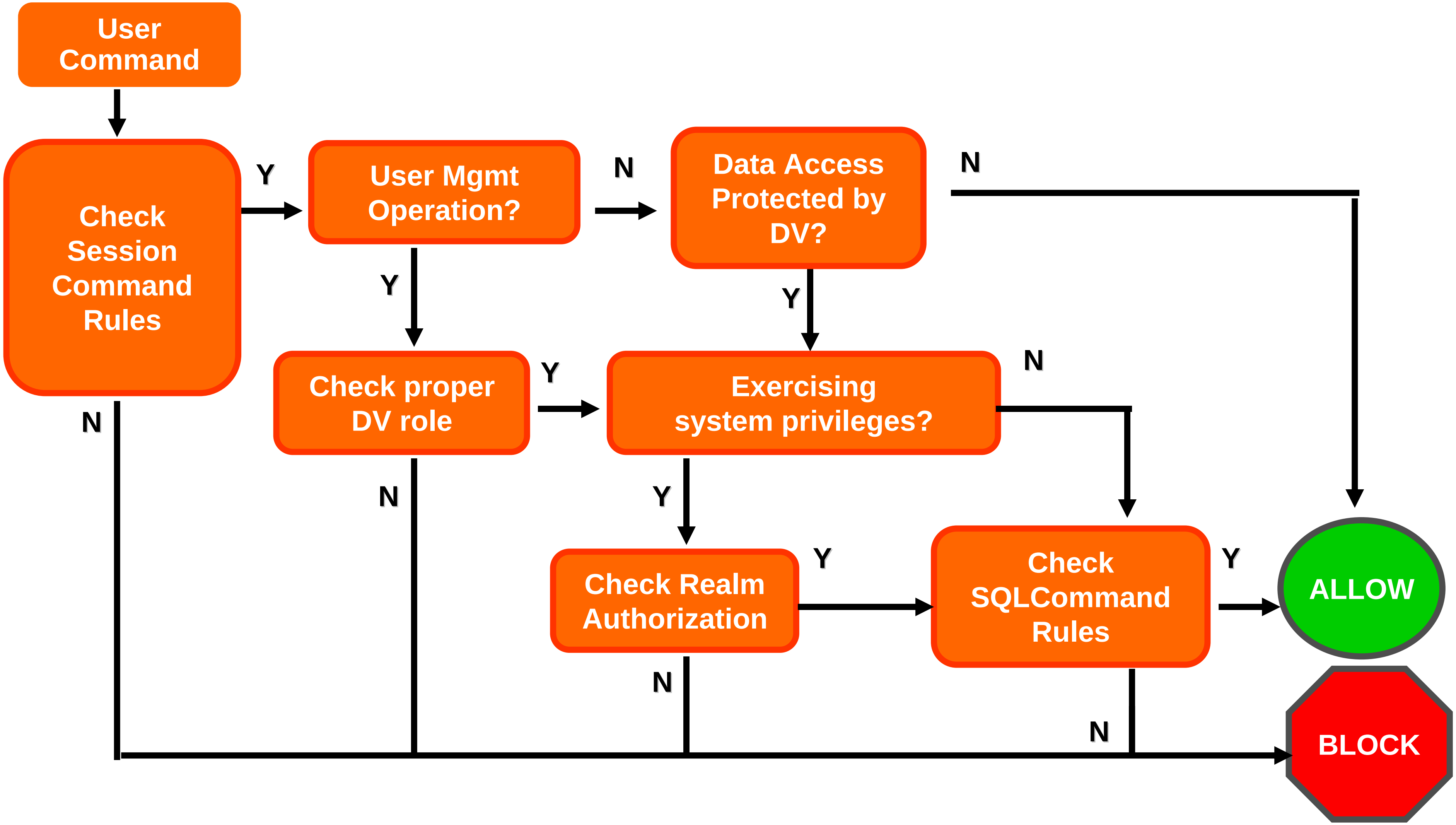
Security Config

DV Factors

Rules & Rule Sets

DV Audit

Database Vault Access Algorithm

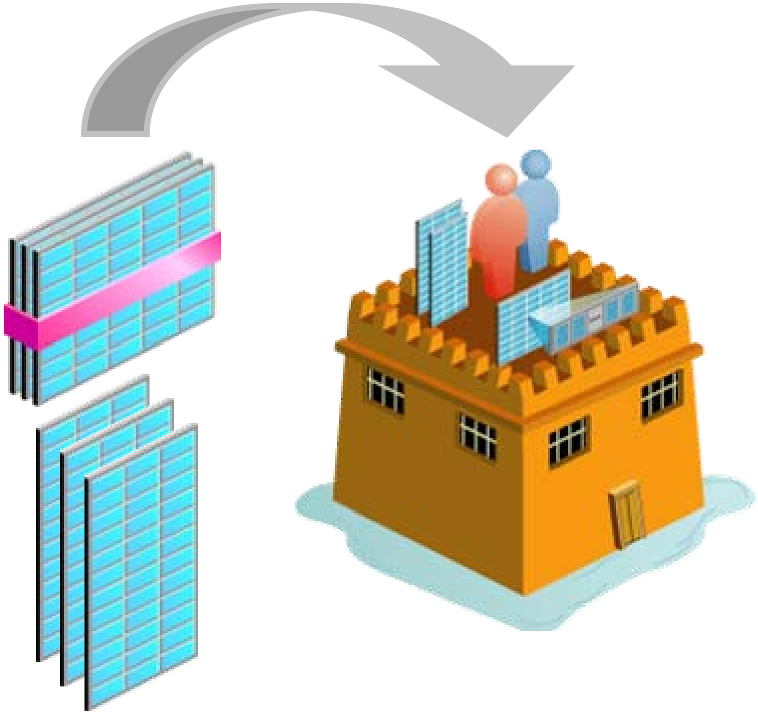

User Command
Check Session Command Rules
Y
User Mgmt Operation?
N
Data Access Protected by DV?
N
Y
Y
Check proper DV role
Y
Exercising system privileges?
N
N
N
Y
Check Realm Authorization
Y
Check SQLCommand Rules
Y
ALLOW
N
N
BLOCK

Key Components

- Protection Realms
- Decision Factors
- SQL Command Rules
- Usage Reports

Protection Realms

- Collections of schemas, objects and roles to be secured
- Controls SELECT, DML, DDL, EXECUTE on protected objects
- Prevents super user (ANY) access to security sensitive data
  - Does not impact direct object priv.
- Rule sets and factors for more control (introduced later)
- Realm owner determines:
  - Who can access the realm using system privileges
  - Grants/revokes applicable roles
- Authorization enforced at every data object access during SQL execution



Benefits of Data Protection with Realms

- Ability to restrict access to privileged users based upon a collection of objects
- Separation of Duty regarding user administration, and role management
- Ability to define additional realm authorization rules based upon requirements
- Limit damage even if privileges escalate to DBA
- Minimize risks associated with an army of DBAs for 7 * 24 operation whether in-house, outsourced
- No changes required to applications

Decision Factors

- Including additional operational and other application factors in controlling access to realm-data or other SQL commands
- User attributes (USERENV values)
  - Date/Time
  - IP Address, Machine
  - Proxy user name, …etc
- Application/Custom Attributes
  - Can be any other PL/SQL expressions
  - Define using application context
- Transparent to the Application
- Trusted environment attributes
  - Instantiated during user logon
  - Cached in user session (UGA)
  - Session or Access

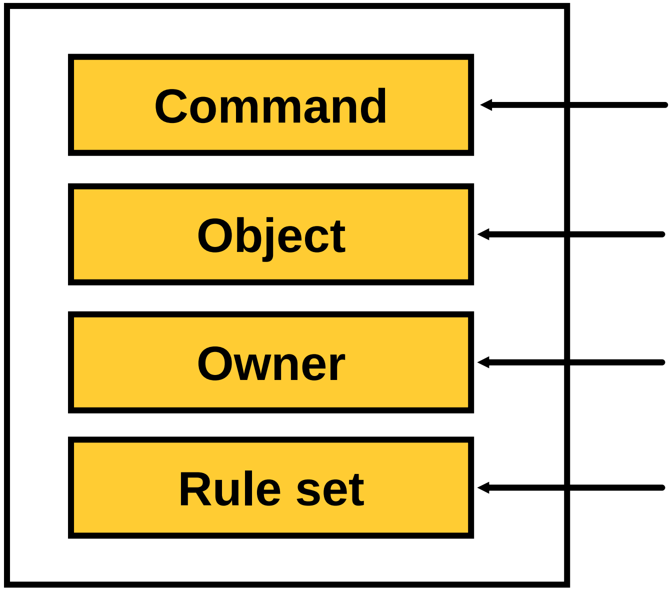
+
Customer-controlled variables

Additional Built-In Factors

- User Factors
  - Name
  - Authentication type
  - Session User
  - Proxy Enterprise Identity
- Network Factors
  - Machine name
  - Client IP
  - Network Protocols

- Database Factors
  - Database IP
  - Database Instance
  - Database Hostname
  - Database SID
- Runtime Factors
  - Language
  - Date
  - Time

SQL Command Rules



Command

Object

Owner

Rule set

In order to perform this SQL command . . .

On this object . . .

owned by this user . . .

this rule set must evaluate to `TRUE`.

SQL Command Rules Mechanics

- Works very similar to DDL event triggers
- Built into the SQL engine for optimization and security
- Can reference USERENV or Factors for authorization decisions
- Ultimate Veto power
- Cover all basic DDL and DML commands

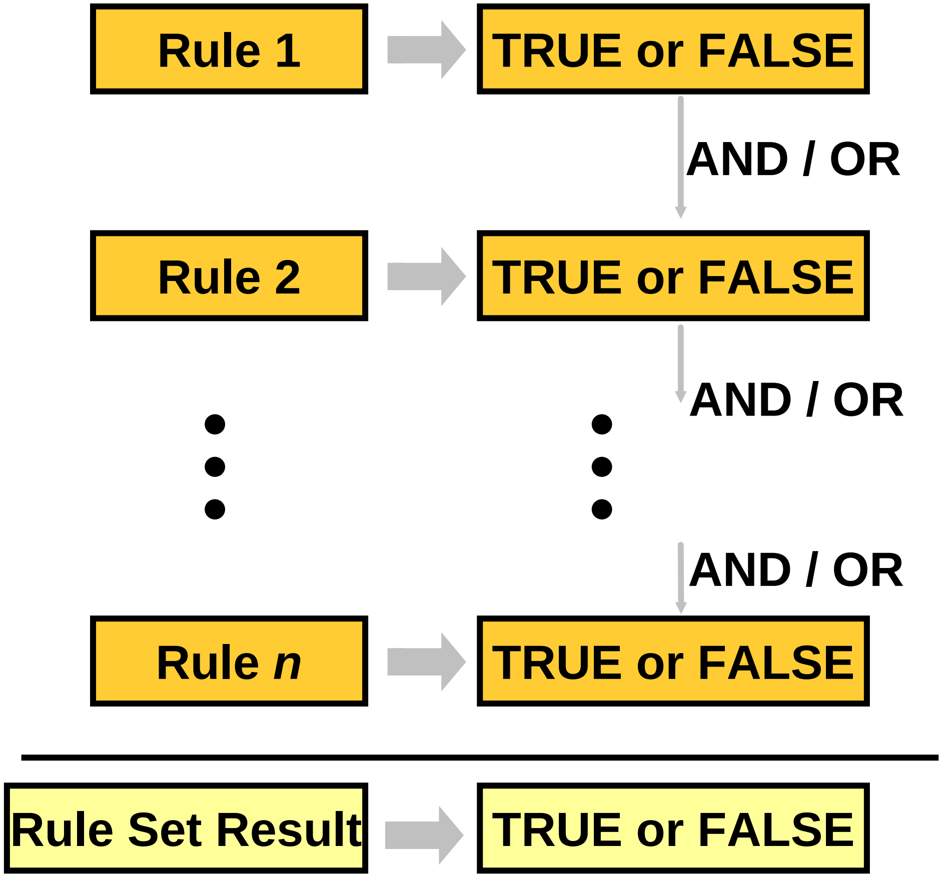
Alter Function
Alter Package Body
Alter System
Alter Trigger
Connect
Create Package
Create Role
Create View
Insert
Truncate Table
Execute

Audit/Noaudit
Alter Procedure
Alter Synonym
Alter User
Create Function
Create Database Link
Create Package Body
Create Table
Create Tablespace
Update
Select

Alter Tablespace
Alter Profile
Alter Table
Alter View
Create Index
Create Procedure
Create User
Grant
Create Trigger
Delete

Rules and Rule Set

Additional controls on Realms and SQL Commands



Rule 1 → TRUE or FALSE

AND / OR

Rule 2 → TRUE or FALSE

AND / OR

⋮ ⋮

AND / OR

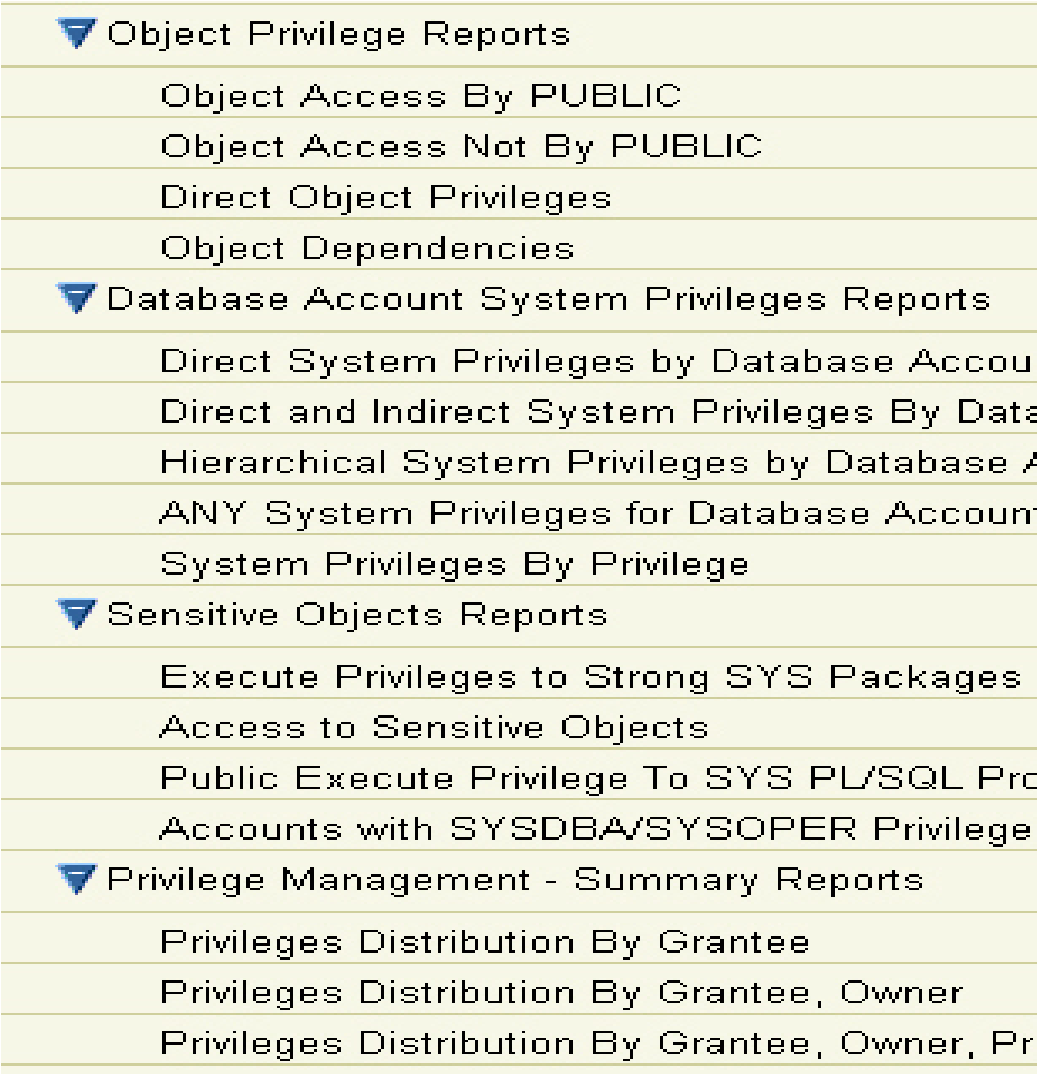
Rule *n* → TRUE or FALSE

Rule Set Result → TRUE or FALSE

Examples of Security Policies

- IP address based policy
  - Allow access from intranet IP addresses
  - Allow access only from application servers
  - Data loading from intranet, but transactions only from middle-tier
- DBA policies
  - Allow updates to the database structure only on the weekend
  - Allow DBA access only with PKI/Kerberos authentication
  - Allow DDL but only with strong authentication
  - Permit DDL (CREATE INDEX) but not SELECT
  - Implement a different set of policies for different types of DBAs
  - Two-key actions
- Time/date based policies
- Disallow access from adhoc tools (SQL*plus)

Database Vault Reports



- ▼ Object Privilege Reports
  - Object Access By PUBLIC
  - Object Access Not By PUBLIC
  - Direct Object Privileges
  - Object Dependencies
- ▼ Database Account System Privileges Reports
  - Direct System Privileges by Database Accou
  - Direct and Indirect System Privileges By Data
  - Hierarchical System Privileges by Database A
  - ANY System Privileges for Database Accoun
  - System Privileges By Privilege
- ▼ Sensitive Objects Reports
  - Execute Privileges to Strong SYS Packages
  - Access to Sensitive Objects
  - Public Execute Privilege To SYS PL/SQL Pro
  - Accounts with SYSDBA/SYSOPER Privilege
- ▼ Privilege Management - Summary Reports
  - Privileges Distribution By Grantee
  - Privileges Distribution By Grantee, Owner
  - Privileges Distribution By Grantee, Owner, Pr

- Over 3 dozen security reports
- Useful for initial priv. maps
- System and Public Privileges
- Audit violation/use attempts

Protecting Database Vault and Database

Protecting Database Vault Schema

Security configuration needs full protection

- Protected Schema: Special built-in schema that is not accessible to DBAs, including SYSDBA
- Stores Database Vault security relevant objects and meta-data
- Enforcement integrated into database security layer
  - Access only through DV roles
  - Database Vault schemas are protected schema
  - No creation or dropping of Database Vault schemas allowed
  - SYSDBA cannot modify/query Database Vault schemas
  - Protection not bypass-able by DBAs
- Stops privileged users from tampering DV meta-data

Oracle Database Vault Roles

Administration Model

- DV Administrative roles
  - DV_SECANALYST: Reporting only
  - DV_ACCTMGR: Maintain db accounts/profiles (but no roles)
  - DV_OWNER: Big boss but cannot grant any direct access rights
- DV Realm Roles
  - DV_REALM_OWNER: Manages realm and associated roles
- Security
  - Provide separation of duties with different admin roles
  - sys, system, sysdba and sysoper cannot grant DV_OWNER, DV_ADMIN roles

Please refer to the documentation for complete details.

DB Hardening

Initialization Parameter	Default Value in DB 10g R2	New Value specified by Database Vault
AUDIT_SYS_OPERATIONS	FALSE	TRUE
AUDIT_TRAIL	NONE	DB
LOCAL_LISTENER	Not configured	LISTENER_<SID>
OS_AUTHENT_PREFIX	ops$	(null string)
RESOURCE_LIMIT	FALSE	TRUE
SQL92_SECURITY	FALSE	TRUE
RECYCLEBIN	ON	OFF

After Installing Database Vault

- Re-links Oracle Kernel
  - Replaces objects in kernel library; New Oracle executable
- Hardens the database
- Creates new Database Vault security metadata repository in protected schema to prevent from DBA tampering
  - Defines protected schema DVSYS
  - Stores security tables, functions and views in DVSYS
  - Locks DVSYS account
- Creates realms for major area of admin. responsibilities
  - Account Management
  - Data Dictionary
  - Enterprise Manager
  - Database Vault

Account Management Default Realm

- Protects user accounts and profile
  - Create/Alter/Drop User command
  - Session Connect role
  - Create/Alter/Drop Profile command
- Protects Account Management role
- Granted Access: Only user account managers

Data Dictionary Default Realm

- Protects all DBMS meta-data
  - All objects owned by SYS
  - All objects owned by SYSTEM
  - All objects owned by seeded schemas like:
    - CTXSYS
    - MDSYS
    - OLAPSYS, …etc
  - All Seeded Administration Roles like:
    - DBA
    - SCHEDULER_ADMIN
    - HS_ADMIN_ROLE, …etc
- Granted Access: Only during DB maintenance and on exception

Enterprise Manager Default Realm

- Protects all objects required by Enterprise Manager
  - All objects owned by SYSMAN
  - All objects owned by DBSNMP
  - All Enterprise Manager related Roles:
    - OEM_MONITOR
    - MGMT_USER
    - MGMT_VIEW
- Granted Access: Operators of Enterprise Manager to monitor health of DBMS

Database Vault Default Realm

- Protects all Database Vault meta-data, including:
  - All object owned by Database Vault schemas
  - All objects owned by LBACSYS
  - DBMS_RLS package
  - All Security Administration Roles
    - DV_ADMIN
    - DV_OWNER
- Granted Access: Only the security officer

Operating with Database Vault

Post Installation Oracle Environment

Separation of Duty

Key roles	Roles	Description	Impact
Account Management	DV_ACCTMGR	User account management responsibility that can create, drop, or modify database users.	DBA can no longer manage users
Security Administrator	DV_OWNER DV_ADMIN	Setup Database Vault Realms, Command Rules, authorize others users to use them, and execute various Database Vault specific security reports.	DBA can not longer grant/revoke DBA roles nor access DVSYS schema
Resource Administrator	SYSDBA	Traditional DBA tasks	None

Other Impact On Operations

- Separation of Duties may require review of security operation procedures and responsibilities
  - Define data owner and system administrators
  - Identify sensitive data and access policies
- Administration affected
  - User and application administration
  - Privilege administration
  - Ad-hoc program in place that rely on DBA or SYSDBA being all powerful

Performance

- Tested
  - TPCC: ~1% with realm-protection
  - SQL Command Rules protection overhead depends on rule complexity
- Techniques used for improving performance
  - Caching of realm objects, realm membership, realm authorization result
  - Kernel row-cache for DV policies and meta-data
  - No PL/SQL VPD policy
  - No logon triggers for evaluation of factors

PL/SQL API to Database Vault

- PL/SQL interface for scriptable administration and tools
- API includes
  - Create, modify, and delete Database Vault components
  - Allow a session to define their security environment
  - Query the state and values of components
  - Administer and configure system-wide Database Vault parameters
- Supports for bulk policies loading

Database Vault Trust Profile

- Trusted Accounts
  - DV_ACCTMGR: Manages users/profiles, but cannot grant
  - DV_OWNER: Creates realms, Command Rules, Factors, etc.
- Trusted Roles: SYSDBA
  - But operations are audited
  - And they cannot modify DV schema, or grant DV roles
  - Can be blocked (if needed)
- Trusted Operating System users
  - Oracle software owner
  - OS Root
  - Members of DBA and OINSTALL OS groups with direct file access
- Data in backed up media can be accessed unless encrypted

Refer to the Protection Profile section of the Database Vault documentation for further details.

Deployment Flow

1 **Define Realms**
(Block Highly Privileged Users)

- 2 **Add Command Rules (Optional)**
- 3 **Add customized Factors, Rule Sets, or other security policies (Optional)**

4 **PL/SQL scripts to deploy security policies (Optional)**

5 **Test your application and measure performance**

6 **Consider application maintenance**

Case Studies

Case Study 1

Financial Services

Business Requirements	Database Vault Solution
Prevent DBAs from accessing sensitive data	Put sensitive data/schema in a Realm
Control DBA’s use of ad-hoc query tools	Restrict connections by ad-hoc query tools to maintenance times
Enforce maintenance periods	Use DV to enforce another monitoring user to be logged in while patching
Restrict hostnames authorized to access the DB	Add rules to specify trusted middle tier systems
Control access based on geography	Restrict system access by geography using subnet Factor

Case Study 2

Hosting Services

Business Requirements	Database Vault Solution
Provide assurance to customers their data is protected	Define Realms for customer-specific sensitive data
Reduce liability for data breach by limiting access to customer data by hosting services staff	Define realms around each hosting data to enforce separation of duty
Provide backend operations to customers, among other services	Define command rules to allow multiple level of DBAs in order to protect data from backend operations
Comply with regulations such as SOX and PCI	Use DV role to enforce operations. DBAs are not allowed to see business data

Summary

Oracle Database Vault Summary

Defense in Depth

- Integrated security framework to provide full control
  - Control access based upon Network, users, DBA, data, roles, SQL access
  - Multi-factor Authorization and Policies across various checks
  - Baked-in Security controls
- Compliance requirements
  - Built-in Separation of Duty (Users mgmt, data mgmt, apps mgmt)
  - Prevent misuse of powerful privileges
- Operational requirements
  - No application changes required
  - Minimal Performance impact
  - Easy-to-use PLUS customization flexibility
  - Support Database consolidation

Learn More

Learn the Technology

- Visit: oracle.com/goto/DatabaseVault

  View whitepapers, buyer's guides, and webinars

Try the Software

- Visit OTN: otn.oracle.com (9.2 and 10gR2) OR
- www.oracle.com/technology/deploy/security/database-security/database-vault/index.html

  Download software, get technical information

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Q&A