RAA5
Introduction to DB2 for z/OS Security

Gayathiri Chandran

IBM Silicon Valley Laboratory

gchandran@us.ibm.com

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Agenda

DB2 security overview

Controlling access to a DB2 subsystem

Controlling access to DB2 objects

- Native DB2 authorization
- Access Control Authorization Exit authorization

Security objects overview

Audit

Summary

DB2 Security Overview

Security controls access to the DB2 subsystem, its data, and its resources

- A security plan sets objectives for a security system
- Describes how to meet the objectives by using functions of DB2, functions of other programs, and administrative procedures

Auditing is how you determine whether the security plan is working and who has accessed data

- Auditing includes questions, such as:
  - Have attempts been made to gain unauthorized access?
  - Is the data in the subsystem accurate and consistent?
  - Are system resources used efficiently?

Controlling access to DB2 – Authenticate user

All users accessing DB2 must be authenticated.

For local connections user authentication is generally performed by local attachments, such as TSO, IMS, or CICS.

For remote connections or for local connections where the user is not authenticated, DB2 invokes RACF to authenticate the user.

Controlling access to DB2 – Authorize access

RACF is used to protect access to a DB2 subsystem

The RACF resource class used by DB2 is DSNR

DSNR profiles are created of the form "*subsystem.environment*", where:

- *subsystem* is the name of a DB2 subsystem
- *environment* denotes the environment

- DIST for DDF
- MASS for IMS (including MPP, BMP, Fast Path, and DL/I batch).
- SASS for CICS
- RRSAF
- BATCH for all others, including TSO, CAF, batch, and all utility jobs

Security Administrator needs to enable RACF checking for the DSNR class and PERMIT users to access DB2 for a specific environment

Controlling access to DB2

When the user ID is successfully authenticated and authorized, to associate authorization IDs of the process, DB2 invokes:

- Connection exit routine or
- Sign-on exit routine

After association of authorization IDs, DB2 checks for a trusted context that matches the primary authorization ID.

- If a matching trusted context is found, DB2 validates the connection attributes based on the connection type, local or remote.
- Based on successful validation, DB2 establishes the connection as trusted.
- Otherwise, DB2 establishes a normal connection.

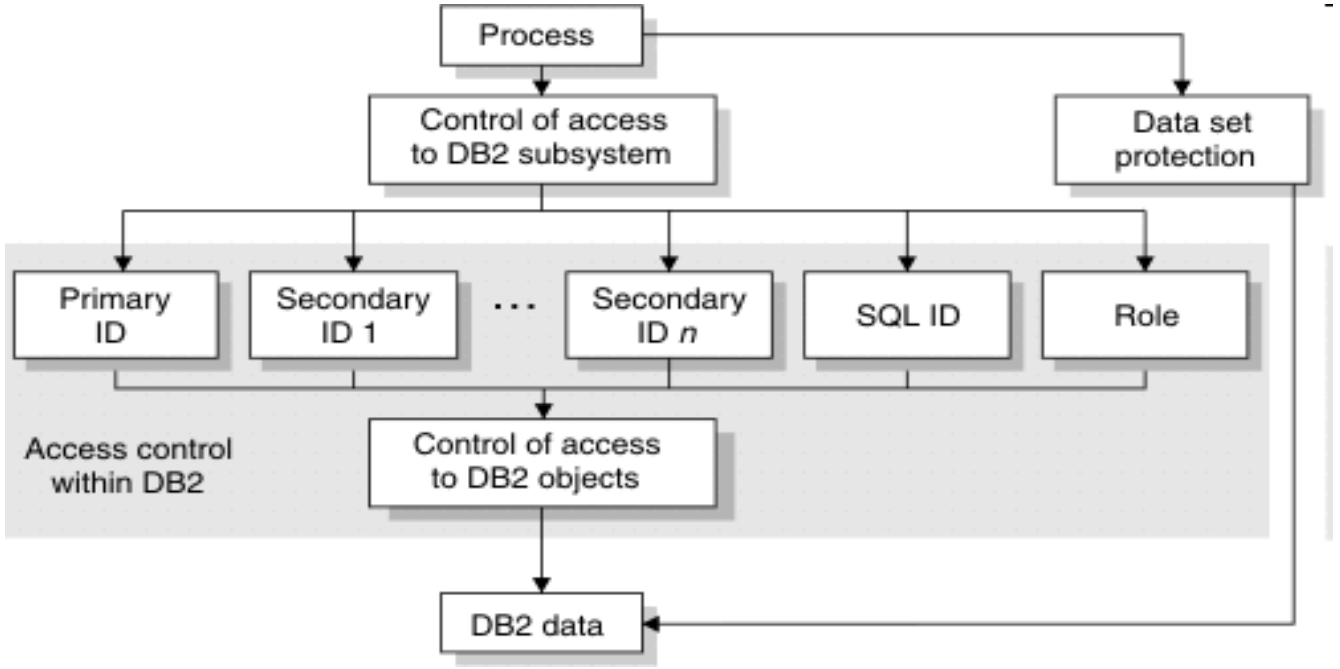
- The process now creates a thread to access DB2

DB2 Process – Access to data

DB2 Process represents all access to data

Every process that connects to or signs on to DB2 is represented by one or more DB2 authorization identifiers (IDs)

- Primary Authorization ID
- Secondary Authorization IDs (RACF Groups)
- DB2 role
- SQL ID



DB2 Process – Authorization IDs

RACF User ID

- Used by connection and signon exit to generate set of authorization IDs for the thread

Primary authorization ID

- Generally, identifies a thread. For example, statistics and performance trace records use a primary authorization ID to identify a process

Secondary authorization ID

- Optional, can hold additional privileges that are available to the process. For example, a secondary authorization ID can be a RACF group ID

SQL ID

- An SQL ID holds the privileges that are exercised when certain dynamic SQL statements are issued. The SQL ID can be set equal to the primary ID or any of the secondary IDs

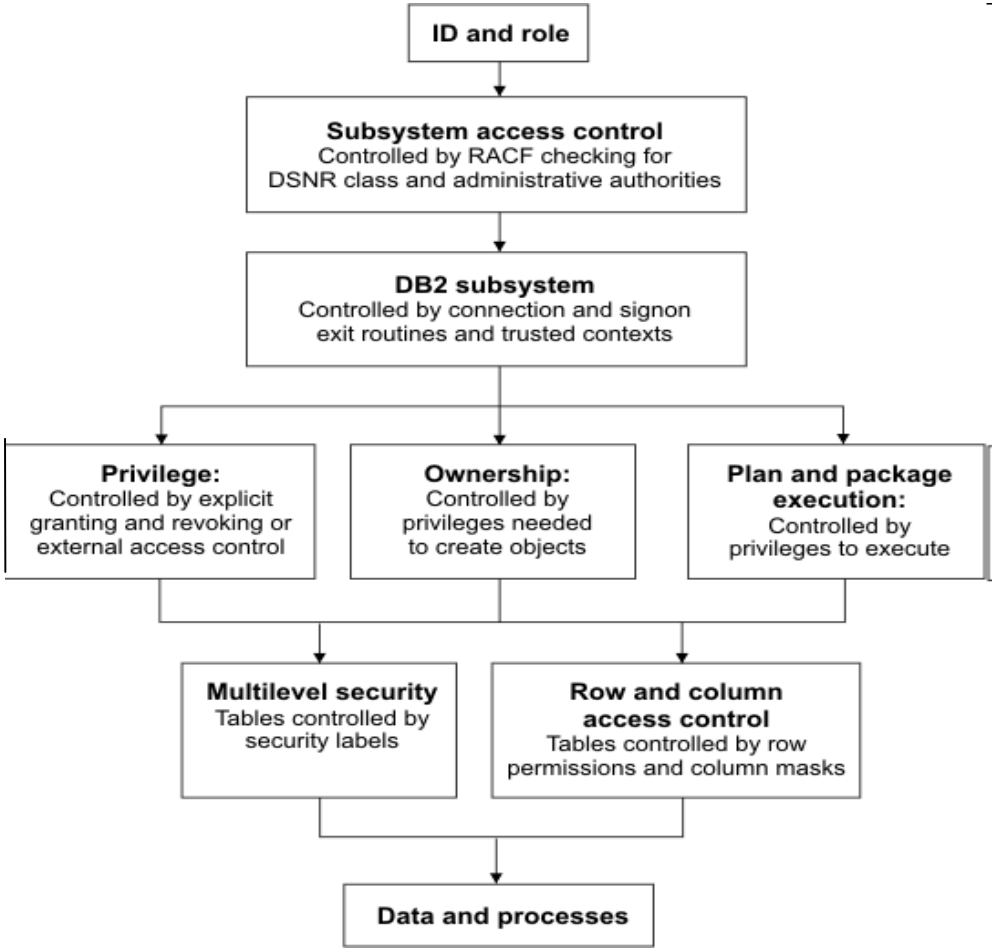
ROLE

- A ROLE is a database entity that groups one or more privileges together and is available only in a trusted connection

Controlling access to DB2 objects

DB2 controls access to its objects and data by a set of **privileges** through **authorization identifiers (IDs) and roles**

Each privilege allows a specific action to be taken on an object

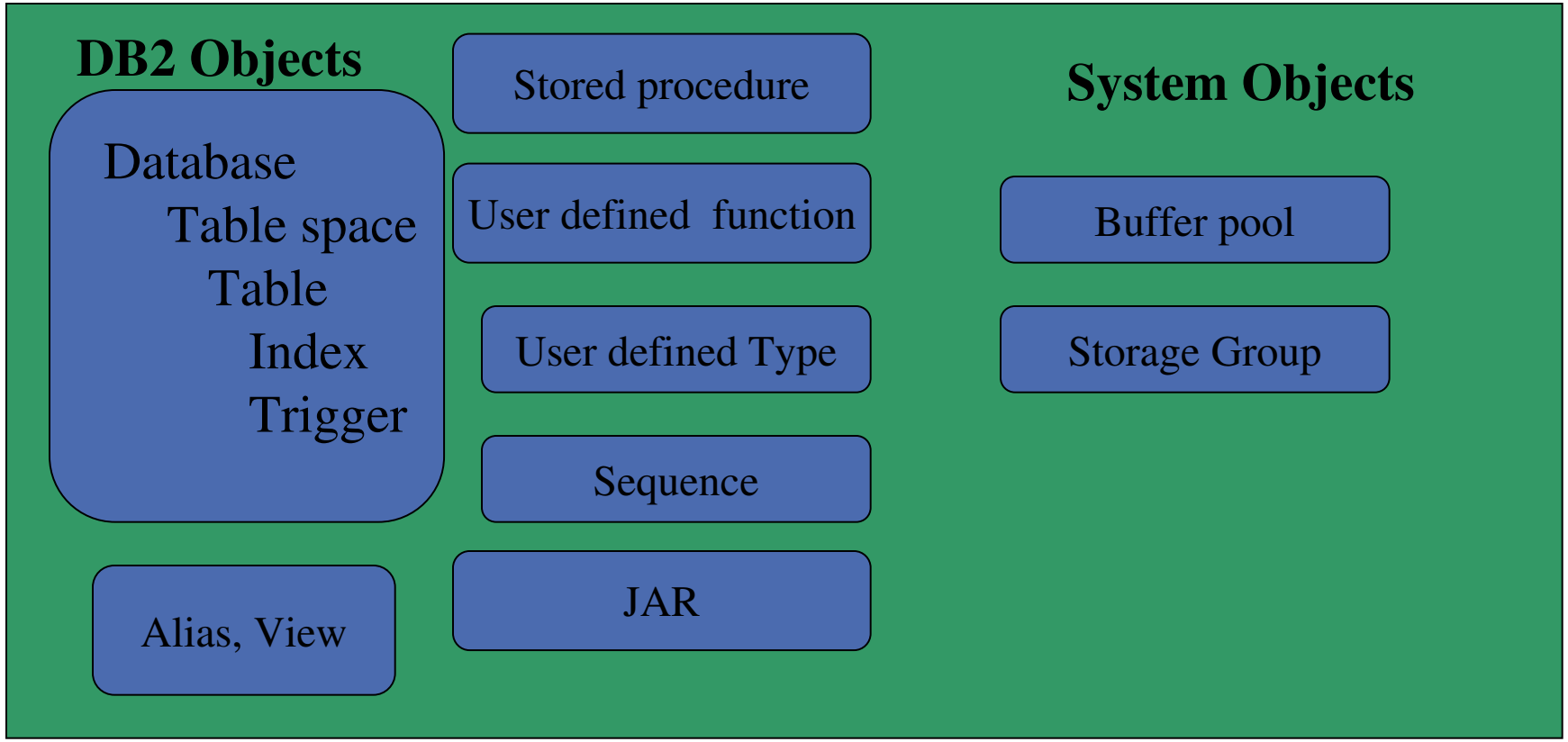


Primary ways within DB2 to a thread access to data

DB2 Data Structures

DB2 catalog is a set of tables which contain information about the data that DB2 is managing

- All DB2 objects and DB2 managed authorization information



DB2 Data Structures – DB2 Objects

Database

- Includes a collection of tables, their associated indexes and the table spaces

Table space

- Set of volumes on disks that hold the data sets in which the tables are actually stored. Can have one or more tables

Table

- Logical structure that is made up of columns and rows

Index

- Ordered set of pointers to rows of a table.

View

- An alternative way of representing data that exists in one or more tables.

Trigger

- Defines a set of actions that are executed when a delete, insert, or update operation occurs on a specified table or view.

DB2 Data Structures – DB2 Objects

Alias

- Alternate name for an object such as a table, view, sequence or another alias

Function

- An executable SQL object that returns a value or a table.

Stored Procedure

- An executable SQL object that you can call to perform operations that can include SQL statements.

Sequences

- Stored object that generates a sequence of numbers in an ascending or descending order.

User-defined types

- Data type that can be a distinct type or an array type

DB2 Data Structures - System Objects

Storage groups

- Set of volumes on disks that hold the data sets in which tables and indexes are stored.

Buffer pools

- Areas of virtual storage that temporarily store pages of table spaces or indexes

DB2 Application Structures

Access to DB2 requires an application plan or package

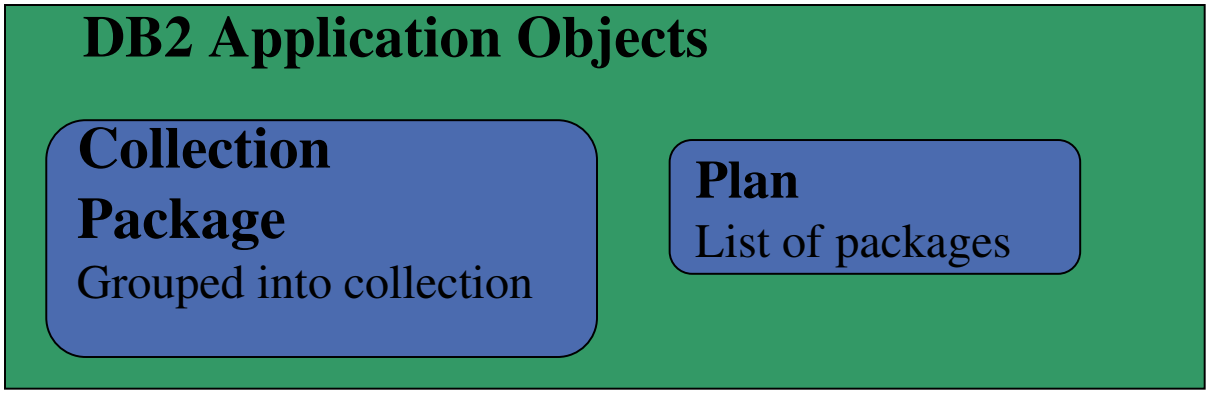
- Relates an application to an instance of DB2 and processing options
- Created using DB2 BIND command

Plan

- Relates an application process to a local instance of DB2
- Contains list of packages and specifies processing options

Package

- Contains control structures that DB2 uses when it runs SQL statements
- All control structures in the package are derived from the SQL statements embedded in a single source program



DB2 Privileges and Authorities

Privilege

- Allows a specific function, sometimes on a specific object
- Explicit privilege
- Implicit owner privileges
  - Cannot be revoked

Administrative Authority

- Set of privileges, often covering a related set of objects.
  - Example: DBADM, PACKADM
- Includes privileges that are not explicitly granted
  - Example: Ability to execute BACKUP SYSTEM utility is included in the SYSCTRL authority

DB2 Privileges

Database Privileges
CREATETAB
CREATETS
DISPLAYDB
DROP
IMAGCOPY
RECOVERDB
REORG
REPAIR
STARTDB
STATS
STOPDB
LOAD

Collection Privileges
CREATEIN

Table Privileges
ALTER
DELETE
INDEX
INSERT
SELECT
REFERENCES
TRIGGER
UPDATE

Table Space Buffer Pool Storage Group Privileges
USE

System Privileges
ARCHIVE
BINDADD
BINDAGENT
BSDS
CREATEALIAS
CREATEDBA
CREATEDBC
CREATESG
DISPLAY
MONITOR1
MONITOR2
STOPALL
STOSPACE
TRACE
RECOVER
CREATETMTAB
EXPLAIN (V10)
CREATE_SECURE_OBJECT (V10)

Plan Privileges
BIND
EXECUTE

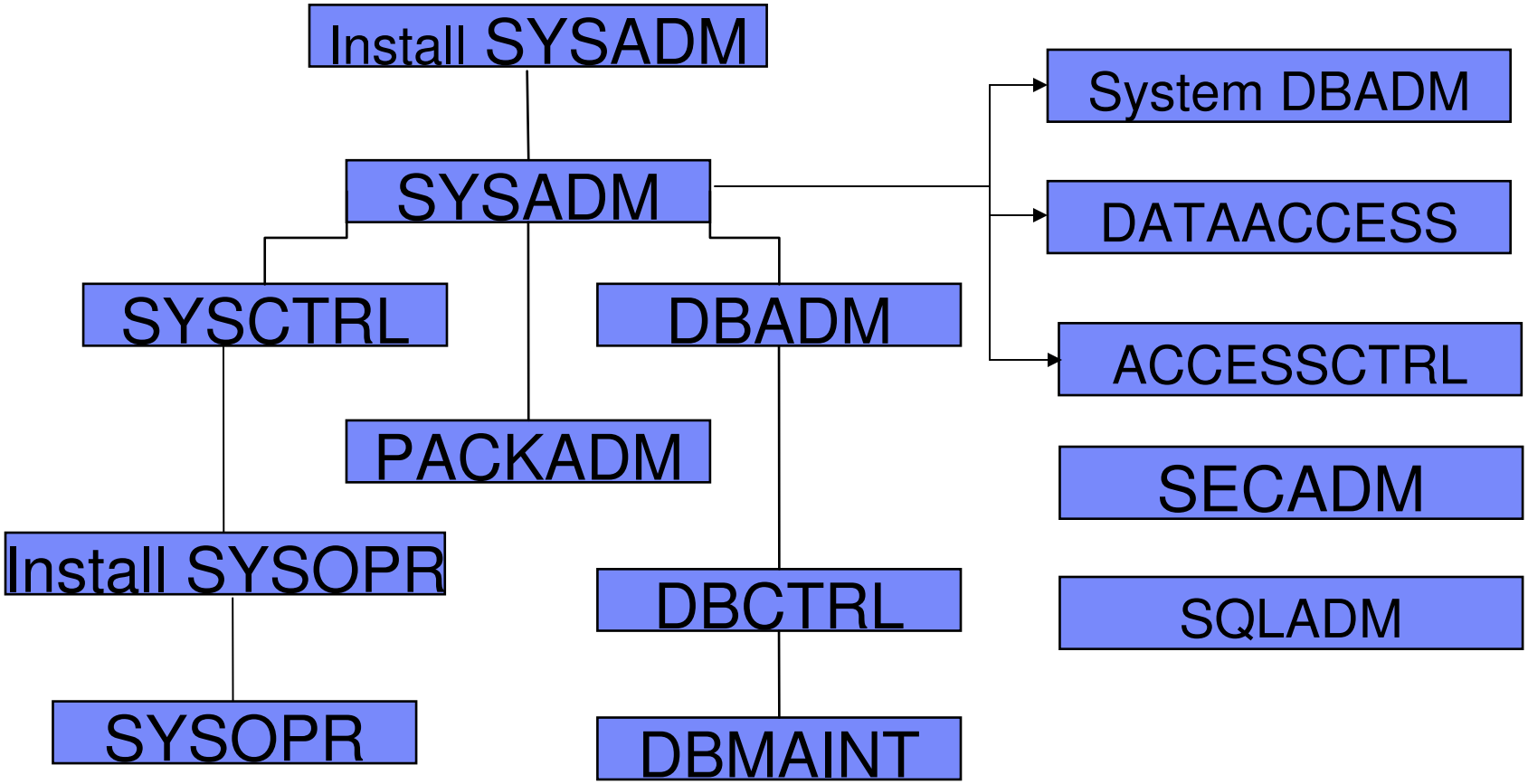
Package Privileges
BIND
COPY
EXECUTE

Schema Privileges
CREATEIN
ALTERIN
DROPIN

Stored Procedure User defined Function Privileges
EXECUTE

JAR User defined Type Privileges
USAGE

DB2 Administrative Authorities



System Administrative Authorities

System authorities specified by installation parameters

- **Install SYSADM**: Installation authority same as SYSADM
- **Install SYSOPR**: Installation authority same as SYSOPR
- Available when DB2 is started in maintenance mode

System authorities

- **SYSADM**: Includes all DB2 privileges, including system privileges, for creating objects and accessing all data.
- **SYSCTRL**: Includes all DB2 privileges, except to read or modify user data
- **SYSOPR**: Allows to issue most commands and execute utilities

Database Administrative Authorities

System level authorities

- **SECADM**
  - Performs security tasks such as control access and manage security objects
  - No inherent privilege to access data
- **System DBADM**
  - Allows management of all the objects in the DB2 subsystem
  - Separates object management from data access and access control
- **DATAACCESS**
  - Access to data in all user tables
  - Execute all plans, packages, functions and procedures
- **ACCESSCTRL**
  - Controls access to all objects and data
- **SQLADM**
  - Allows monitoring and tuning without access to data

Database Administrative Authorities

Database level authorities

- **DBADM**: Allows to control and manipulate any table within the database
- **DBCTRL**: Allows to control the database
- **DBMAINT**: Allows to create objects and run certain utilities on the database

Application authority

- **PACKADM**: Includes package privileges on all packages in the specified collection

DB2 10: Install Parameter - Separate Security

SEPARATE_SECURITY: Prevents SYSADM and SYSCTRL authority from granting or revoking privileges

- Install SECADM authority manages subsystem security
- SYSADM and SYSCTRL can no longer implicitly grant or revoke privileges
- SYSADM can no longer set current SQLID to any value
- Install SYSADM authority is not impacted

Implicit privileges through ownership

DB2 object created by issuing an SQL statement establishes an owner

The owner of an object implicitly holds all the privileges over that object

- For example: Tables
  - Alter/drop the table or any index, create index or view, select or update any row or column, insert or delete any row

Privileges exercised through a plan or a package

DB2 provides a unique access control method for plans and packages to simplify and provide better access control from processes

The owner of a plan or a package can grant the privilege to execute a plan or a package to any ID.

When the EXECUTE privilege on a plan or a package is granted to an ID or ROLE, that ID or ROLE can execute a plan or a package without holding the privileges for every action that the plan or package performs

- Owner of the plan or package is checked for access

Type of SQL decides when the authorization check is done

- Static SQL: Authorization checked at BIND or compile time
- Dynamic SQL: Authorization checked at run time

Example of granting select and execute privileges

A program might contain the following statement:

```
SELECT * INTO :EMPREC FROM EMPTBL WHERE EMPNO='000010';
```

A DBA grants select privilege to the role EMPROLE

```
GRANT SELECT ON TABLE EMPTBL TO ROLE EMPROLE;
```

A program with the statement is bound into a package using role EMPROLE as the owner of the package.

```
BIND PACKAGE EMPPKG OWNER(EMPROLE);
```

A DBA using role EMPROLE grants execute privilege to EMPUSER

```
GRANT EXECUTE ON PACKAGE EMPPKG TO EMPUSER;
```

Any process that executes the packages must have EMPUSER as one of its primary or secondary IDs

Any process that executes the package is not required to have select privilege on the EMPTBL table

Control of access to DB2 objects

DB2 native authorization

- Access is controlled by the SQL GRANT and REVOKE statements
- Security definitions in DB2 catalog tables
- Security definitions are tied to object existence

Access Control Authorization Exit (DSNX@XAC)

- Exit point provided by DB2 which can control access to DB2 resources
- The programming interface is RACROUTE, which is part of the System Authorization Facility (SAF)
- Other vendors support the SAF interface
- Security definitions and data are separate
- Security definitions can exist before the object is created

DB2 Native Authorization – SQL GRANT

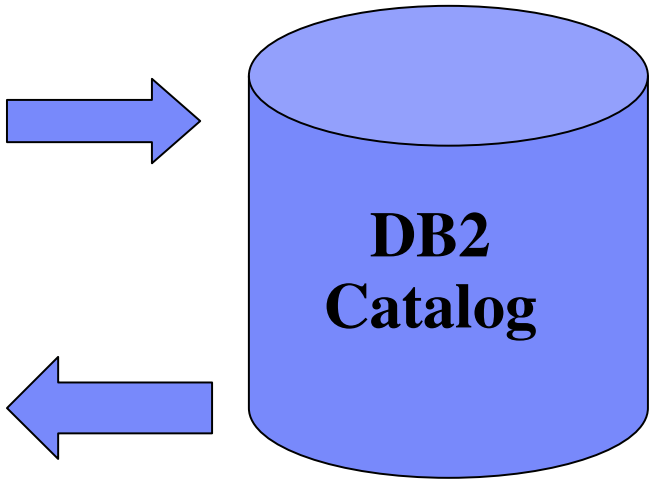
SQL GRANT statement grants privileges to authorization IDs, roles

Delegation via GRANT… WITH GRANT OPTION

```
GRANT ALL ON SALES.CUSTOMER
TO MARY WITH GRANT OPTION

GRANT SELECT ON  SW_CUSTOMER TO
SW_SALES

GRANT CREATEDBA TO ROLE DBAROLE
```



Access controls check for granted authority.

DB2 Native Authorization – SQL REVOKE

SQL REVOKE statement revokes privileges from authorization IDs and roles.

REVOKE …BY clause allows administrators to revoke privileges granted by others

Cascading revoke

- In DB2 10, NOT INCLUDING DEPENDENT PRIVILEGES clause can be specified on the SQL REVOKE statement to avoid cascade revoke of privileges
  - System parameter, REVOKE_DEP_PRIVILEGES can be set to control the cascading effect of revoke

```
REVOKE SELECT ON  SALES.SW_CUSTOMER FROM TED NOT
INCLUDING DEPENDENT PRIVILEGES;
```

DB2 - Access Control Authorization Exit

Exit point is driven

- Once at DB2 subsystem start up
- If exit authorization is used:
  - For each DB2 authorization request
  - Once at DB2 subsystem termination

Exit CSECT name: DSNX@XAC

Exit parameter list: DSNDXAPL

DB2 provides dummy DSNX@XAC routine

DB2 provides sample LKED JCL for DSNX@XAC

- Install job DSNTIJEX in SDSNSAMP

RACF/DB2 External Security Module

- Fully supported exit module designed to receive control from the DB2 access control authorization exit point
- From DB2 V8, the exit module ships in 'SYS1.SDSNSAMP(DSNXRXAC)'
- New classes defined in RACF CDT (Class Descriptor Table)
- RACF stores all of its information in the RACF database
- Access to a resource is given using the RACF PERMIT command
- Access to a resource is removed using the RACF PERMIT command with the DELETE keyword

RACF/DB2 External Security Module

Initialization

- Loads profiles for RACF/DB2 authorization checking
  - Classes targeted for use must be active
- If unsuccessful or no classes are active, DB2 will not drive the exit point again

Authorization Checking

- Checks user's authority to specified DB2 resource
  - Return code 0 – Access allowed
  - Return code 8 – Access not allowed
  - Return code 4 – Don't know. Defers to DB2 authorization check

Termination

- Clean up profiles loaded into data spaces

DB2 Objects and their RACF classes

DB2 Object Type	RACF Class Name
Bufferpool	MDSNBP
Collection	MDSNCL
Database	MDSNDB
Global Variable	MDSNGV
JAR	MDSNJR
Package	MDSNPK
Plan	MDSNPN
Schema	MDSNSC
Sequence	MDSNSQ

DB2 Object Type	RACF Class Name
Storage group	MDSNSG
Stored procedure	MDSNSP
System	MDSNSM
Table/Index/View	MDSNTB
Table space	MDSNTS
User defined type	MDSNUT
User defined function	MDSNUF

Exploiting RACF multilevel security with DB2

Row-level security checks allow you to control which users have authorization to view, modify, or perform other actions on specific rows

Used when mandatory row-level security checks are required

Multilevel security can be implemented with the following combinations:

- DB2 authorization and RACF multilevel security
  - DB2 grants are used for authorization at the DB2 object level
  - RACF performs mandatory access checking on DB2 tables using security labels
- RACF access control and RACF multilevel security
  - RACF is used to control authorization at the DB2 object level and perform mandatory access checking on DB2 tables using security labels

Security Objects Overview

DB2 9: Trusted context and Role

Trusted context

- Establishes trust between DB2 and an external entity such as an application server, DSN command processor or RRS Attachment Facility
- Can be established for local or remote connection
- Manage trusted context using SQL CREATE / ALTER / DROP TRUSTED CONTEXT

Once established, a **trusted connection** provides the ability to

- Efficiently switch user with optional authentication
- Acquire special set of privileges using a Role
- Acquire special RACF Security Label authority

Database Role

Database entity with one or more privileges

Established only through a trusted connection

User assigned only one role in a trusted connection

Can optionally be the OWNER of DB2 objects

Manage role using SQL CREATE / DROP ROLE

DB2 10: Row and Column Access Controls

New data controls at the table level to protect against unplanned and dynamic SQL access

- Can be defined with DB2 native authorization

Row Access control

- Establishes a row policy for the table to protect SQL access to individual rows
- Defined as a row permission using SQL CREATE PERMISSION statement

Column Access control

- Establishes column policy for a table to mask column values in answer set
- Defined as a column mask using SQL CREATE MASK statement

Audit

Auditing in DB2

Who is privileged to access what data?

- Most of the catalog tables describe the DB2 objects, such as tables, views, table spaces, packages, and plans
- If using DB2 native authorization, several other tables (every table with the character string "AUTH" in its name) hold records of every granted privilege or authority.

Who accessed what data?

- You can find answers by using the audit trace, another important audit trail for DB2

DB2 Instrumentation Facility

DB2 uses SMF and/or GTF and/or monitor program for trday

Audit Trace Records

Selective tracing with 11 classes of information

- Access denials
- Authorization changes
- Changes to the structure of data (such as dropping a table)
- Changes to data values (such as updating or inserting records)
- Reading of data values (such as select)
- Changes in authorization IDs
- Utilities changes
- Trusted context information
- Audit Administrative Authorities

-START TRACE (AUDIT) CLASS (4,6) DEST (GTF) LOCATION (*)

DB2 10: Audit Policies

Provide needed flexibility to audit any access to specific tables for specific programs during day

- Does not require AUDIT clause to be specified using DDL
- Generates records for all read and update access for statements with unique statement identifier

Identify any unusual use of privileged authority

Up to 8 audit policies can be specified to auto start or auto start as secure during DB2 start up

Audit policy supports eight categories that maps to AUDIT classes.

```
INSERT INTO SYSIBM.SYSAUDITPOLICIES (AUDITPOLICYNAME,
OBJECTSCHEMA, OBJECTNAME, OBJECTTYPE, EXECUTE)
  VALUES ('TABADT1',‘EMPLOYEE','’’PAY%’’','T','A');

-STA TRACE (AUDIT) DEST (GTF) AUDTPLCY(TABADT1);
```

Auditing with RACF exit authorization

Failure SMF records written after entire list of profiles is exhausted

SMF records have correlation information

DB2 trace record IFCID 314

- Traces all calls to the exit

DB2 Security provides

Access control to DB2 objects using

- DB2 Security
- Access Control Authorization exit security

Trusted context for better manageability and user accountability

Row and column access control to safeguard data

Enhanced auditing capability

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