Session RAA6
DB2 for z/OS Security Features and Audit

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Agenda

- Trusted context and roles
- Row and column level access controls
- Access Control Authorization Exit enhancements
- Program Authorization
- Audit policies
- Temporal tables for audit
- Summary

Trusted Contexts and Roles

DB2 9: Trusted context and Role

- Better access control from application servers.
- llows connections to be established as today. pplication attributes are verified before associating it with a trusted conte#t such as the application id and where the re2uest originated
- !upports identity propagation allowing authenticated non 301! distributed I%s to flow to %B& to be included in audit logs
- llows a uni2ue set of privileges by use of a Role to be associated with an application preventing the misuse of privileges when not accessing through the application
- 4rovides fle#ibility by removing ob5ect dependency from users
- ddresses administrator challenges

Trusted Context

- **Trusted context** establishes trust between %B& and an e#ternal entity such as
  - RR! (*Resource Recovery !ervices ttachment (acility-
  - ' (*'all ttachment (acility-
  - %!$ 'ommand 4rocessor
  - pplication !erver
- 1nce established, a **trusted connection** provides the ability to
  - 6fficiently switch user with optional authentication
  - c2uire special set of privileges using a Role
  - c2uire special R '(!ecurity 7abel authority
- Manage trusted conte#t using !87 'R6 T60 7T6R0%R14 TR)!T6% '1$T69T

Database Role

- %atabase entity with one or more privileges
- 6stablished only through a trusted connection
-)ser assigned only one role in a trusted connection
- 'an optionally be the 1W$6R of %B& ob5ects
- Manage role using !87 'R6 T60%R14R176

```
CREATE ROLE ADMINROLE;

DB2 native authorization – new ROLE keyword  or !RANTEE"
!RANT #$#ADM TO ROLE ADMINROLE;

RAC% e&it authorization – new CRITERIA keyword"
'ERMIT D#NADM #(B#$#)#$#ADM ID*ADMINA+
       ,-EN*CRITERIA*#.LROLE*ADMINROLE+++
```

Trusted context - Local

- Trusted conte#t can be local or remote
- 7ocal trusted conte#t is based upon
  - !ystem uthid
    -) ser I% associated with the connection
  - :1B$ M6
    - :ob or started task name associated with the connection

```
E&a/01e" A22i3n a ro1e DBAROLE to any 4o5 na/ed ADMIN6OB that
7onne7t2 u2in3 auth ID #ALL$

CREATE ROLE DBAROLE;

CREATE TR(#TED CONTE8T DBACONTE8T
   BA#ED ('ON CONNECTION (#IN! #$#TEM A(T-ID #ALL$
   ATTRIB(TE# 6OBNAME*9ADMIN6OB:+
   DE%A(LT ROLE DBAROLE
   ENABLE;
```

Trusted Context - Remote

- Remote trusted conte#t is based upon
  - !ystem uthid
    -) ser I% associated with the connection
  - %%R6 ! ! or ! 6R ;) T<
    - ' lient=s I4 address, domain name or ! 6R ;) T< security 3one name of the connection
  - 6 $ ' R>4TI 1 $
    - ' onnection encryption level * $ 1 $ 6 ? 7 1 W ? < I@<-

```
E&a/01e" A22i3n a ro1e TELLER to a 7onne7tion e2ta51i2hed  ro/
I' addre22 ;)<=)<=)<2= and the auth ID #R>RID=<)

CREATE ROLE TELLER;

CREATE TR(#TED CONTE8T TELLERCONTE8T
   BA#ED ('ON CONNECTION (#IN! #$#TEM A(T-ID #R>RID=<
   ATTRIB(TE# ADDRE##*9;)<=)<=)<2=:+
   DE%A(LT ROLE TELLER
   ENABLE;
```

Trusted Context Auth ID Switching

- llows trusted connection to be used by different users
- 1ptional authentication re2uirement
- !pecific R176 and R '(!ecurity 7abel can be assigned to the user

```
E&a/01e" A22i3n a ro1e TELLER to a 7onne7tion e2ta51i2hed  ro/
l'L‰e3R;)<=)<=)<2=' edi2h'2i2elD@#aÂta1@AA' ed
```

Trusted Context Auth ID Switching

- !witch user optionsA
  - B uthori3ation name
  - B 69T6R$ 7 !6')RIT> 4R1(I76 4rofile"name
    - C %B& primary authori3ation id or one of their groups has to be permitted to use the specified profile.
  - B 4)B7I'
- %istributed Identity
  - B R '(R 'M 4 command is used to map a distributed I% to a %B& R '(I%.

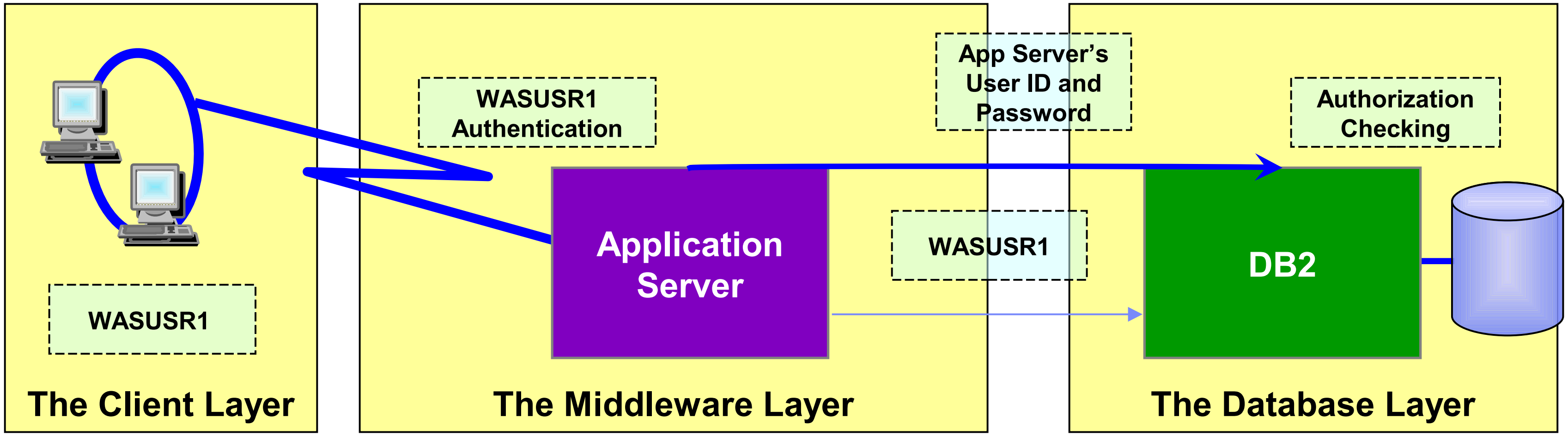
Use case: Separate owner privileges from DBA

- <elps address concerns with implicit owner privileges and %B access to sensitive data

- n auditable %B process can be done with trusted conte#t and roleA
  - @rant %B %M to role, %B R176
  - When a %B needs to perform a system changeA
    - C 6$ B76 trusted conte#t to allow access
    - C %I! B76 trusted conte#t after the change is done
  - n auditor can review the audit trace

```
CREATE ROLE DBAROLE;
!RANT DBADM ON DATABA#E 'RODDB TO ROLE
DBAROLE;
CREATE TR(#TED CONTE8T DBACT8<
BA#ED ('ON CONNECTION (#IN! #$#TEM A(T-ID ADMIN<
DE%A(LT ROLE DBAROLE ,IT- ROLE A# OB6ECT O,NER AND .(ALI%IER
ATTRIB(TE# *6OBNAME 96M@A+
ENABLE;
```

Trusted connections provide more effective controls and accurate audit trail for remote access



- The application serverDs user I% and password are used to establish the trusted connection
- The user is switched in the trusted connection and client user I% is propagated to the server and checked for database access
- %B& EF support for distributed identities introduced in 301 !   ; EREE allows to map client user I% to R   ' (user I%
  - distributed identity is a mapping between a R   ' (user I% and one or more distributed user identities, as they are known to application servers
  - %istributed identities are part of the %B& audit log.

$ew improved security features provide more effective controls and accurate audit trail for remote access

- !upport client certificate authentication in 301 ! ;EREF
  - T"T7! secure handshake accomplishes identification and authentication for client certificates
  - %B& client driver presents its certificate as identification and its *proof-of-possession* as authentication
  - %B& server can retrieve the user I% associated with the client certificate in ! (for the T"T7! policy rule configurationA
    <andshakeRole G !erverWith ' lient uth, ' lient uthType G ! (' heck
  - R ' (certificate name filtering *R ' % ' 6RT M 4 command- can map many certificates with one R ' (userid
- !upport password phrases in 301 ! ;EREF
  - C R ' (password phrase is a character string made up of mi#ed"case letters, numbers, special characters, and is between H to EFF characters long
  - C ' an be used instead of a traditional I"character password

Row and Column Access Controls

!atisfy >our uditorA

$ew table controls to protect against unplanned !87 access

- J %efine additional data controls at the row and column level
  - !ecurity policies are defined using !87
  - !eparate security logic from application logic
- J !ecurity policies based on real time session attributes
  - 4rotects against !87 in5ection attacks
  - %etermines how column values are returned
  - %etermines which rows are returned
- J ll access via !87 including privileged users, adhoc 2uery tools, report generation tools is protected
- J 4olicies can be added, modified, or removed to meet current company rules without change to applications

Table controls to protect !87 access to individual row level

- 6stablish a row policy for a table
  - (ilter rows out of answer set
  - 4olicy can use session information, e.g. the !87 I% is in what group or user is using what role, to control which row is returned in result set
  - pplicable to !676'T, I$!6RT,)4% T6, %676T6, K M6R@6
  - %efined as a row permissionA

CREATE PERMISSION policy-name ON table-name
FOR ROWS WHERE search-condition
ENFORCED FOR ALL ACCESS ENABLE;

Table controls to protect ! 8 7 access to individual column level

- 6stablish a column policy for a table
  - Mask column values in answer set
  - 4olicy can use session information, e.g. the ! 8 7 I% is in what group or user is using what role, to control what masked value is returned in result set
  - pplicable to the output of outermost subselect
  - %efined as column masks A

```
CREATE MASK  mask-name ON table-name
   FOR  COLUMN  column-name RETURN CASE-expression
ENABLE;
```

%efine table policies based on who or how the table is being accessed

- !6!!I1$L)!6R " 4rimary authori3ation I% of the process
- ')RR6$T !87I% " !87 authori3ation I% of the process
- ;6RI(>L@R1)4L(1RL)!6R function
  - @et the authori3ation I%s for the value in !6!!I1$L)!6R
  - Returns E if any of those authori3ation I%s is in the argument list

```
W<6R6
   ;6RI(>L@R1)4L(1RL)!6R*!6!!I1$L)!6R,MM@R=,M4  >R177=-GE
```

- ;6RI(>LR176L(1RL)!6R function
  - @et the role for the value in !6!!I1$L)!6R
  - Return E if the role is in the argument list

```
W<6R6
    ;6RI(>LR176L(1RL)!6R*!6!!I1$L)!6R, =M@R=,M4  >R177=-GE
```

Managing row and column access controls

- When activated row and column access controlsA
  - ll row permissions and column masks become effective in all %M7
  - ll row permissions are connected with M1R= to filter out rows
  - ll column masks are applied to mask output
  - ll access to the table is prevented if no user"defined row permissions

```
7T6R T  B76  table"name
   'TI;  T6R1W        ''6!! '1$TR17
   'TI;  T6'17)M$    ''6!! '1$TR17N
```

Managing row and column access controls

- When deactivated row and column access controlsA
  - Make row permissions and column masks become ineffective in %M7
  - 1pens all access to the table

```
7T6R T B76 table"name
 %6 'TI; T6R1W       ''6!! '1$TR17
 %6 'TI; T6'17)M$  ''6!!'1$TR17N
```

6#ample B simple banking scenario

- 1nly allow customer service representatives to see customer data but always with masked income
- TableA ') !T1M6R

Account	Name	Phone	Income	Branch
1111-2222-3333-4444	Alice	111-1111	22,000	A
2222-3333-4444-5555	Bob	222-2222	71,000	B
3333-4444-5555-6666	Louis	333-3333	123,000	B
4444-5555-6666-7777	David	444-4444	172,000	C

%efine row and column access control on customer table

- %efine row and column policies for customer service representatives
  - C llow access to all customer service representatives of the bank *a row permission-
  - C Mask all I$'1M6 values *a column mask-
    - – Return value F for incomes of &OFFF and below
    - – Return value E for incomes between &OFFF and POFFF
    - – Return value & for incomes between POFFF and EOFFFF
    - – Return value Q for incomes above EOFFFF
  - C 'ustomer service representatives are in the '!R group *who-

' reate Row 4ermission

- ' reate a row permission for customer service representatives

```
'R6  T6  46RMI!!I1$  '!RLR1WL   ''6!!  1$  ')!T1M6R
   (1R  R1W!  W<6R6
       ;6RI(>L@R1)4L(1RL)!6R*!6!!I1$L)!6R,='!R=-GE
6$(1R'6%(1R   77    ''6!!6$  B76N
```

' reate ' olumn Mask

- ' reate a column mask on I$ ' 1M6 column for customer service representatives

```
'R6  T6  M   !R  I$'1M6L'17)M$LM   !R  1$   ')!T1M6R

  (1R  '17)M$  I$'1M6  R6T)R$

      '   !6 W<6$ *; 6RI(>L@R1 )4L(1RL)!6R*!6!!I1$L)!6R,M'!R=-G E-

             T<6$  '   !6  W<6$ *I$'1M6 S EOFFFF- T<6$  Q
                           W<6$ *I$'1M6 S POFFF-   T<6$  &
                           W<6$ *I$'1M6 S &OFFF-   T<6$  E
                           67!6  F
                   6$%

          67!6 $)77
      6$%
6$  B76N
```

! tart enforcing row and column access contp rBf! P[illegible]

!electing from customer table
U after row and column access control activated

- !676'T ''1)$T,$ M6,I$'1M6,4<1$6 (R1M ')!T1M6RN

ACCOUNT	NAME	INCOME	PHONE
1111-2222-3333-4444	Alice	0	111-1111
2222-3333-4444-5555	Bob	1	222-2222
3333-4444-5555-6666	Louis	2	333-3333
4444-5555-6666-7777	David	3	444-4444

I$'1M6 automatically masked by %B&V

%B& effectively evaluates the following revised 2uery

```
!676'T   ''1)$T,
       $  M6,

       '  !6 W<6$ *;6RI(>L@R1)4L(1RL)!6R *!6!!I1$L)!6R,M'!R=-GE-
              T<6$ '  !6  W<6$ *I$'1M6 S EOFFFF- T<6$ Q
                         W<6$ *I$'1M6 S POFFF-   T<6$ &
                         W<6$ *I$'1M6 S &OFFF-   T<6$ E
                         67!6 F
                    6$%
          67!6 $)77
      6$% I$'1M6,

      4<1$6
(R1M  ')!T1M6R

W<6R6  ;6RI(>L@R1)4L(1RL)!6R *!6!!I1$L)!6R,M'!R=-GE  1R  EGFN
```

External Security (DSNX@XAC) Enhancements

%B& EEA 6#ternal !ecurity *%!$9W9 '- enhancements

Owner Authorization

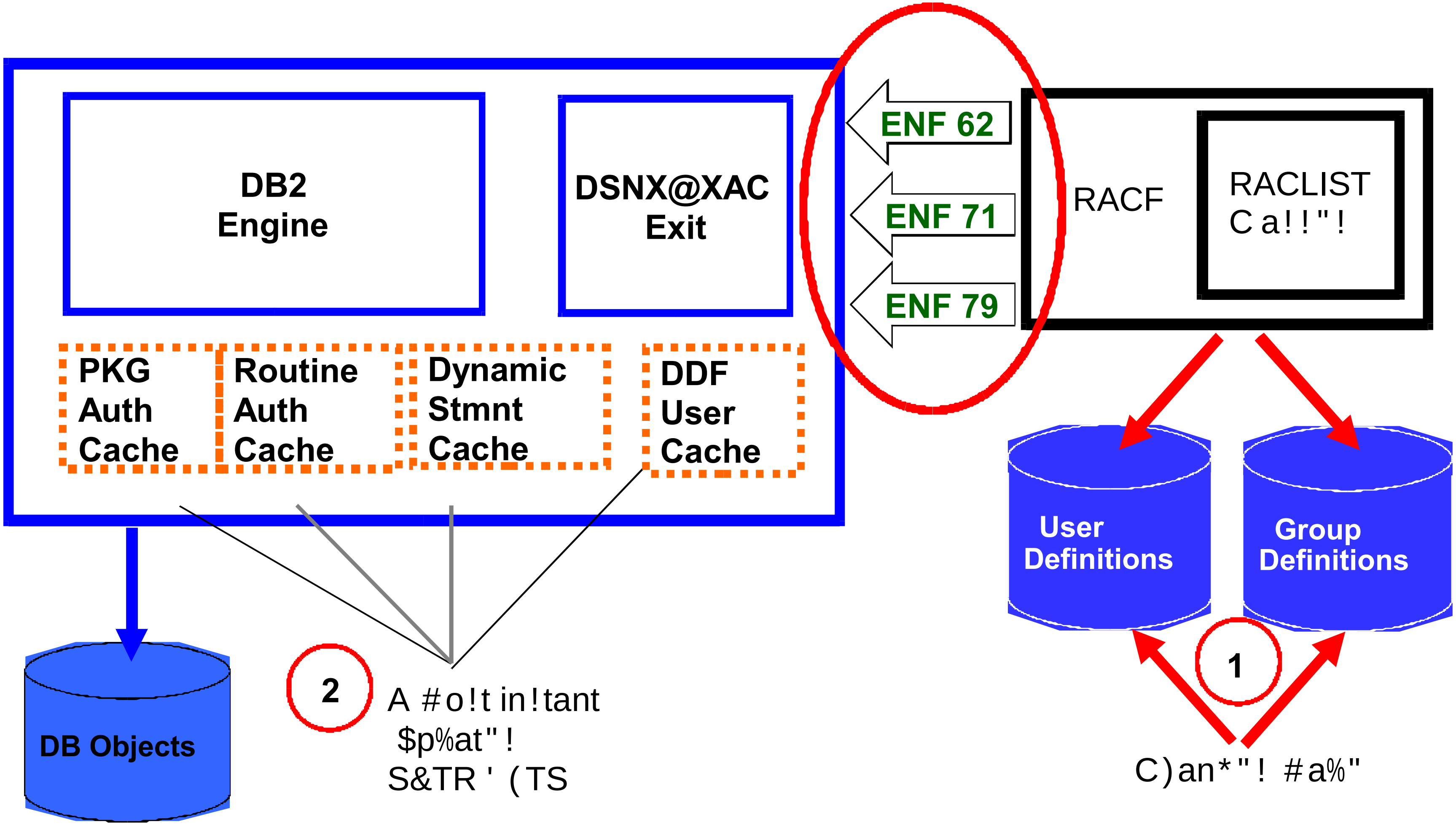
- !upport 1W$6R privileges for authori3ation
  - C llows owner to be checked for authori3ation on BI$% and R6BI$% commands
  - C !upports dynamic !87 authori3ation using %>$ MI'R)76! behavior
    - C 4ackage owner
    - C I% that e#ecutes the package
    - C I% that defined the routine
    - C I% that invokes the routine
  - C llows automatic rebind *)T1BI$%-
  - C 1wner can be a R '(I%, @R1)4 or R176. %B& provides owner '66 to R '(
  - C !imilar behavior between %B& native authori3ation and R '(e#it authori3ation

<ow to e#ploit owner authori3ation

- $ew installation parameter,)T<69ITL'<6'R to govern owner authori3ation
  - ; alueA %B&
    - 4rovides '66 of the owner for)T1BI$%0BI$%0R6BI$%
    - 4rovides '66 of the authori3ation I% as specified by the %>$ MI'R)76! value for dynamic !87 authori3ation
    - When owner is a group in R '(, 46RMIT the group access to the resource associated with the connection in R '(%!$R class
      - 6#A 46RMIT %!$ .B T'< '7 !!*%!$R- I%*%B @R1)4- ''6!!*R6 %-
  - ; alueA 4RIM R> *default B old behavior-
    - 4rovides '66 fo the primary authori3ation I% for all authori3ation checks
  - $o online update of this parameter

%B& EEA 6#ternal !ecurity *%!$9W9 '- 6nhancements

Sync RACF Permission Changes to DB2 Cache



RACF ENF Signals Heard by DB2 11

- R ' (6vent $otifications *6$(-
  - $otifications generated by R ' (when a profile is changed
- %B& EE listens forA
  - 6$(X&A R ' (options refreshed
    - !6TR14T! R '7I!T R6(R6!<
  - 6$(PEA) ser permissions changed
    - 7T)!6R R6; 1R6, '1$$6'T R6; 1R6, %67)!6R, %67@R1)4, R6M1; 6
  - 6$(PHA) ser permissions to access resource changed
    - 46RMIT..%676T6, ''6!!*$1$6-, R6!6T, W<6$*'RIT6RI *!87R176...--
    - R 7T6R..) ''*$1$6-, %67M6MN R%676T6
    - 1n receipt of 6$(PH, %B& stores the changes and refreshes cache entries only when 6$(X& is heard
    - Re2uirementA R ' (class descriptor table must have !I@$ 7 G >6!
      - 6nabled for IBM supplied R ' (resource classes for %B&

How to exploit cache refresh enhancement

- $ew installation parameter,)T<69ITL' '<6R6(R6!< to govern cache refresh
  - ; alueA 77
    - %B& listens for 6$(X&, 6$(PE and 6$(PH signals
    - 4ackage authori3ation cache, Routine authori3ation cache and dynamic statement cache entries are refreshed and dependent packages are invalidated
  - ; alueA $1$6 *default B old behavior-
    - The cache entries are not refreshed and dependent packages are not invalidated.
  - $o online update of this parameter

Cache Refresh Considerations

- The cache entries may not be refreshed or packages invalidated if user inherited authori3ation from a group and privilege is revoked from the group
- 6$(notification ignored for some generic resource names or more entries cleared from the cache
- !tatic package invalidation
  - %B& listens for 6$(X& and 6$(PH signals for static package invalidation
  - 1nly profile names with discrete characters are supported
  - 6$(notification ignored for profiles in %!$ %M class
  - %B& has to be started
- 'ache refresh considerations linkA

httpA00publib.boulder.ibm.com0infocenter0d3ichelp0v&r&0topic0com.ibm.db&3EE.doc.seca0src0tpc0db&3Lengsignalprocessing.htm

Program Authorization

DB2 11: Program Authorization

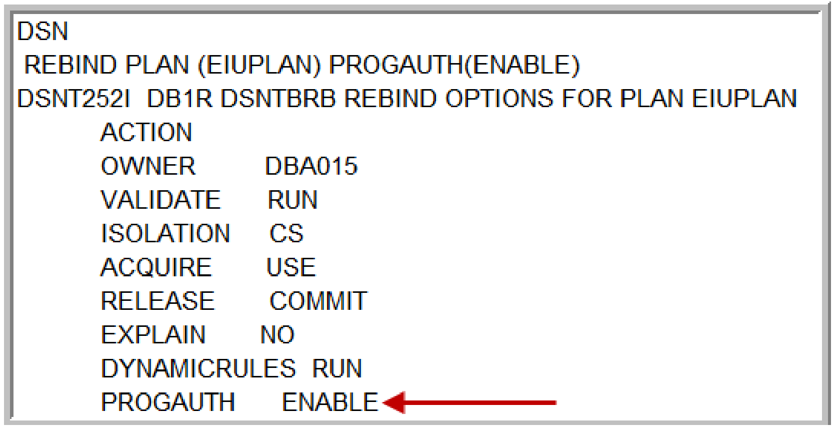
- llows a plan owner to authori3e a %B& production application program
  - 1wner controls the packages an application can use by defining a package list
  - 4ackage lists are difficult to manage causing the use of wild cards
- 4erformed in addition to package authori3ation
-)seful when all of the programs and packages that might use a plan are unknown

How to exploit Program Authorization

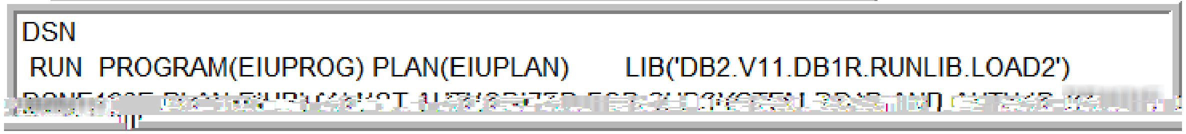
- Re2uires table, !>!IBM.%!$4R1@)T< and inde#, !>!IBM.%!$4R1@)T<LI%9E to e#ist
  - ' reated by installation 5ob, %!$TI:!@
- BI$% or R6BI$% 47 $ with 4R1@)T<*6$ B76- option
- dd a row in the !>!IBM.%!$4R1@)T< table for each program and plan combination for the 4R1@)T< enabled plan
- %B& ensures the program is authori3ed for the plan
- $ot supported forA
  - RR! (applications that use the default plan name, TRR! (
  - Multi"conte#t 1%B' applications with the plan name, %!$ '7I.
  - 4rograms that run in stored procedure address spaces

Program Authorization

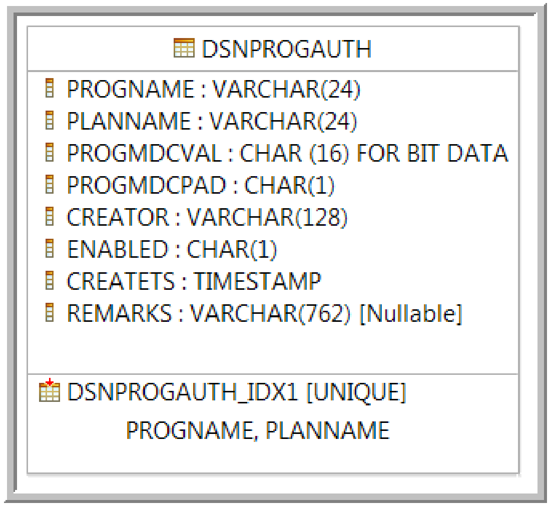
- R6BI$% and run with no %!$4R1@)T< entry



```
DSN
 REBIND PLAN (EIUPLAN) PROGAUTH(ENABLE)
DSNT252I  DB1R DSNTBRB REBIND OPTIONS FOR PLAN EIUPLAN
        ACTION
        OWNER        DBA015
        VALIDATE     RUN
        ISOLATION    CS
        ACQUIRE      USE
        RELEASE      COMMIT
        EXPLAIN      NO
        DYNAMICRULES  RUN
        PROGAUTH     ENABLE
```



```
DSN
 RUN  PROGRAM(EIUPROG) PLAN(EIUPLAN)      LIB('DB2.V11.DB1R.RUNLIB.LOAD2')
[illegible]
```



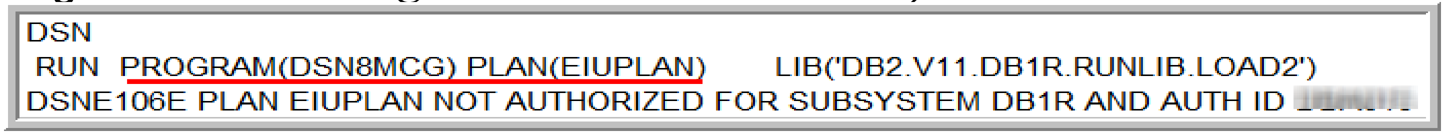
DSNPROGAUTH

- PROGNAME : VARCHAR(24)
- PLANNAME : VARCHAR(24)
- PROGMDCVAL : CHAR (16) FOR BIT DATA
- PROGMDCPAD : CHAR(1)
- CREATOR : VARCHAR(128)
- ENABLED : CHAR(1)
- CREATETS : TIMESTAMP
- REMARKS : VARCHAR(762) [Nullable]

DSNPROGAUTH_IDX1 [UNIQUE]

PROGNAME, PLANNAME

- I$!6RT %!$4R1@)T< entry for 6I)4R1@
  - $oteA %efaults to 6$ B76%G$
- 4rogram 6I)4R1@ now e#ecutes the plan
- 4rogram %!$IM'@ not allowed to use 6I)47 $



```
DSN
 RUN  PROGRAM(DSN8MCG) PLAN(EIUPLAN)      LIB('DB2.V11.DB1R.RUNLIB.LOAD2')
DSNE106E PLAN EIUPLAN NOT AUTHORIZED FOR SUBSYSTEM DB1R AND AUTH ID [redacted]
```

Audit

%B& EFA udit 4olicies

- $ew udit policy allows you to comply without the need of e#ternal collectors. Managed in the %B& catalog.
- uditor can define an audit policy to audit any access to specific tables for specific programs during day
  - udit policy does not re2uire)%IT clause to be specified using %%7
  - udit policy generate records for all !87 read and update access
  - udit policy includes additional records identifying the specific !87 statements
  - udit policy provides wildcarding of based on table names
- uditor can define an audit policy to identify any unusual use of a privileged authority
  - Records each use of an administrative authority
  - udit records written only when authority is used for access
  - 6#ternal collectors only report users with a system authority

<ow to e#ploit udit policies

- !ecurity administrator using the new !6' %M authority maintains %B& audit policies in a new catalog table
  - !>!IBM.!>!)%IT417I'I6!
- udit policies enabled using B!T TR '6 command
- udit policies disabled using B!T1 TR '6 command
-)p to I audit policies can be specified to auto start or auto start as secure during %B& start up
- 1nly user with !6' %M authority can stop a secure audit policy trace

udit policy categories

' ategories	Mapping I(' I%s
' <6 ' RI$@	I(' I% IQ *only authentication failures-, I(' I% EYF
; 7I% T6	I(' I%s OO, IQ, IP, EXH, &XH, QEH
1B:M I$T	I(' I% EY&
696 ')T6	I(' I%s EYQ, EYY, EYO
' 1$T69T	I(' I%s &Q, &Y, &O
!6 ' M I$T	I(' I%s EYE, &PF, &PE
!>! %MI$	I(' I% QXE * udits installation !>! %M, installation !>!14R, !>!14R, !>! ' TR7, !>! %M-
%B %MI$	I(' I% QXE * udits %BM I$T, %B ' TR7, %B %M, 4 ' R %M, !87 %M, system %B %M, % T ' ' 6!!, ' ' 6!! ' TR7, !6 ' %M-

6#ampleA %ynamic auditing of tables

- udit all the tables that start with M4 >= in 6M471>66 schema
  - %oes not re2uire)%IT clause to be specified during table definition

```
I$!6RT I$T1 !>!IBM.!>!  )%IT417I'I6!*  )%IT417I'>$  M6,
1B:6'T!'<6M  , 1B:6'T$  M6, 1B:6'TT>46, 696')T6-
  ;  7)6!*DT  B  %TED,M6M471>66D,D==4  >Z==D,DTD,D  D-N

"!T  TR  '6*  )%IT-%6!T*@T(-  )%T47'>*T  B  %TE-N
```

6#ample B udit privileged authority

- udit successful e#ecution of all actions using installation ! > ! %M authority and system %B %M authority

```
I$!6RT I$T1 !>!IBM.!>!  )%IT417I'I6!
  *  )%IT417I'>$  M6, !>!  %MI$, %B  %MI$-
  ;  7)6! *M  )%IT  %MI$D,MID,MBD-N

"!T  TR  '6*  )%IT- %6!T *@T(-  )%T47'>*  )%IT  %MI$-N
```

%B& EFA Temporal table

%B& can now manage different versions of your data

- Temporal table allows %B& to automatically maintain different versions of your data
- Two types of time se2uences of table rows are supported through the introduction of database defined time periods
  - !>!T6MLTIM6 is used to support data .versioning/ which archives old rows into a history table
  - B)!I$6!!LTIM6 is a period that represents when a row is valid to the user or application
  - BIT6M41R 7 table combines !>!T6MLTIM6 period and B)!I$6!!LTIM6 period

%efining system period on an e#isting table

- !ystem versioning is implemented by altering an e#isting or creating a table with two timestamps, a history table, and defining the versioning relationship between tables
- fter the base and history tables are appropriately definedA
  - 7T6R T B76 table"name %% ; 6R!I1 I@ is specified on the base table that is to be versioned
- uditor can 2uery historical data through ! 8 7
  - %B& rewrites the user=s 2uery to include data from the history table

Summary

- ✓ Trusted connections provide better user accountability and improved compliance.
- ✓ Row and column access table controls to safe guard your data
- ✓ 4rogram uthori3ation provides additional control on plan management
- ✓ ccess ' ontrol uthori3ation 6#it enhancements provide consistent security model and improved R ' (integration
- ✓ uditing features using audit policies provide better auditing capabilities
- ✓ Temporal data to comply with regulations to maintain historical data

R"+"r"n,"!

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Thank
You