Best practices in Firebird database security - from 2.5 to 4.0

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Agenda

1) Authentication and Privileges
2) Best practices and demos
3) Mappings

1. Authentication and Privileges

Authentication and Privileges

- Authentication – “Confirm you are UserX”
- Privileges - “UserX is [not] allowed to do this”

- Firebird performs authentication on the server level, and grants privileges on server and database levels
  - By default any user with valid password to the server can establish connection to the database
  - To do something user requires privilege

Example: any user can connect!

```
isql -user SYSDBA -pass masterkey /:d:\o30-etalon.fdb
Database: /:d:\o30-etalon.fdb, User: SYSDBA
SQL> create user NEWUSER1 password '12345';
SQL> exit;

isql -user NEWUSER1 -pass 12345 /:d:\o30-etalon.fdb
Database: /:d:\o30-etalon.fdb, User: NEWUSER1
SQL> show database;
Database: /:d:\o30-etalon.fdb
        Owner: SYSDBA
PAGE_SIZE 8192
```

Example: ...any user can view basic metadata

```
SQL> show table AGENTS;
ID          (DM_IDB) BIGINT Not Null Identity (by default)
NAME   (DM_NAME) VARCHAR(80) CHARACTER SET
UTF8 Nullable                  COLLATE NAME_COLL
IS_CUSTOMER       (DM_SIGN) SMALLINT Nullable default 1
                  check(value in(-1, 1, 0))
IS_SUPPLIER       (DM_SIGN) SMALLINT Nullable default 0
                  check(value in(-1, 1, 0))
IS_OUR_FIRM       (DM_SIGN) SMALLINT Nullable default 0
                  check(value in(-1, 1, 0))
```

Example: ...but cannot access users data

```
SQL> select * from AGENTS;
Statement failed, SQLSTATE = 28000
no permission for SELECT access to TABLE AGENTS
```

Owner

- Owner of the database objects
  - Who created the object
- Owner of the database
  - Who created (= restored) database
- Owner has FULL access to the created objects

SYSDBA

- The ultimate ruler of the server
- SYSDBA has ALL privileges

- The popularity of SYSDBA based access is understandable, but not secure

Users

- Users are stored in security database
  - User names and hashes of passwords
  - Since Firebird 3 can be many security databases
- Authentication plugins (since Firebird 3)
  - Each plugin has own set of users
    - Yes, 2 SYSDBA with different passwords can co-exist!

Authentication plugins

- Auth plugins are dll/so libraries in folder plugins, and specified in firebird.conf:

  ```
  AuthServer = Srp, Legacy_Auth
  ```

- Each plugin can have own list of users and, optionally, UserManager

  ```
  UserManager=Srp, Legacy_UserManager
  ```

Authentication plugins and User Manager plugins

Authentication Plugin	UserManager Plugin
Srp	Srp
Srp256	
Legacy_Auth	Legacy_UserManager
WinSSPI	-- gets data from Windows
Cluster (example in FB4 or HQbird)	– gets data from remote host

Example: identical users with different passwords

- CREATE USER newuser1 PASSWORD ‘12345’ USING PLUGIN SRP;
- CREATE USER newuser1 PASSWORD ‘54321’ USING PLUGIN Legacy_UserManager;

Example: identical users with different passwords

- isql -user NEWUSER2 -pass 54321
- Database: localhost:d:\o30-etalon.fdb, User: NEWUSER2
- SQL> exit;

- isql -user NEWUSER2 -pass 12345
- Database: localhost:d:\o30-etalon.fdb, User: NEWUSER2
- SQL> exit;

Order of plugins

- AuthServer = Srp, Legacy_Auth
  - AuthClient = Srp – changes the order

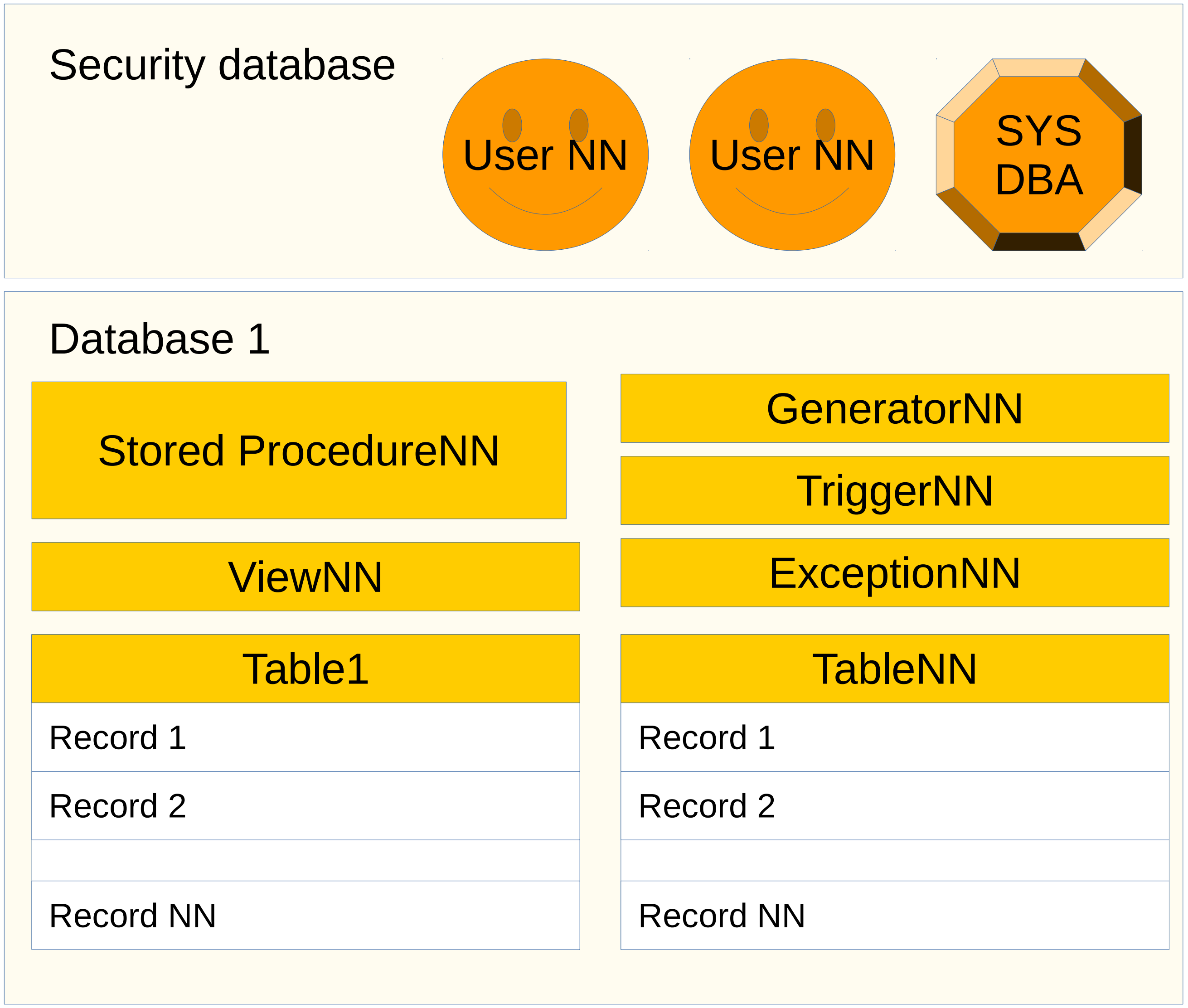
- By default, without specification, Firebird creates users using the first plugin defined in UserManager parameter:

  UserManager=Srp, Legacy_UserManager
  - CREATE USER usr PASSWORD ‘12345’;
  - Will be created with Srp

Authentication complete

- Let’s talk about privileges of authenticated user

What objects to be secured?



- Security DB
  - Users
    - Password hashes
  - Roles
- Database
  - Tables
    - records
  - Views
  - Stored Procs
  - Roles
- Global actions
  - Create DB
  - Drop DB
  - Backup
  - ....

Privileges

- Access to the objects
  - SELECT
  - INSERT, UPDATE, DELETE
  - EXECUTE
  - REFERENCES
- Managing privileges
  - GRANT
  - REVOKE
- Object management (DDL privileges)
  - CREATE
  - ALTER ANY
  - DROP ANY (ANY means access to non-owned objects)

GRANT/REVOKE

- GRANT <privileges>
  TO <user>| <role>| <object>
- REVOKE <privileges> FROM ...
  - Details are in Firebird Language Reference and Release Notes

2. Best practices for Firebird security

Out of the scope of Firebird security

- Protection of server and database
  - From the direct and embedded access
  - From stealing
- Consider encryption
  - Visit our “Firebird Database Encryption workshop” tomorrow!

Firebird security tuning can protect:

1) From non-authorized access from valid users
2) Brute force password attack
3) Access from unknown users

Don’t do, or useless SYSDBA role

- In Firebird 2.5, it is possible to create SYSDBA role (the same as SYSDBA), to protect from SYSDBA access
- Requires direct access to system tables
  - Does not work on Firebird 3!
- Weak protection
  - If attacker has physical access to database

Best practices: server level-1

1) Enable “Over the wire” encryption to prevent sniffing of users and password hashes
2) Use Srp256 and passwords 20+ symbols for users (SHA-256)
3) Use option to fetch passwords from files (isql, gbak, gfix):
    1) Parameter -FE(TCH)
    2) Easy change of passwords in all SQL scripts

Best practices: server level-2

1) Use separate security database for the database (can be set in databases.conf)
2) Create users with privileges to create new objects in database
    1) Use SQL scripts to [re-]create users
    2) Pseudo-Tables with List of Users to see the whole picture

Best practices: database level-1

- CREATE database with OWNER <> SYSDBA
- Define necessary ROLEs to manage all types of access
  - DDL privileges (GRANT CREATE/ALTER_ANY/DROP_ANY <object>)

Best practices with ROLES-1

- Roles can be granted to other Roles!

  GRANT ROLE1 to BIGROLE

- Easy to define more granular access
  - ROLE1 covers operations with T1, T2, etc
  - ROLE2 covers operations with StoredProcedure1, SP2, etc
  - BIGROLE = ROLE1 AND ROLE

Best practices with ROLES-2

- GRANT DEFAULT ROLE
  - Once user is created, it immediately receives some default role:
    - Regular user
    - very restricted user

Record-level security

- At the moment the only method in community Firebird to implement record-level security is to use stored procedures
  - Access is granted inside the logic of the stored procedures
- Views
  - For simple cases

Stored procedures privileges

- Grant/revoke stored procedure to user
- Grant revoke/stored procedure to other stored procedure
- In Firebird 4, new feature
  - SQL SECURITY DEFINER
  - to grant all privileges to stored procedure
- Demo!

Why UDF are deprecated in 4.0?

- Potential attack with UDF code
- UDRs as replacement
  - UDR better protects from wrong parameters and other mistakes
  - demo

3. Mappings: solution for external users

External users

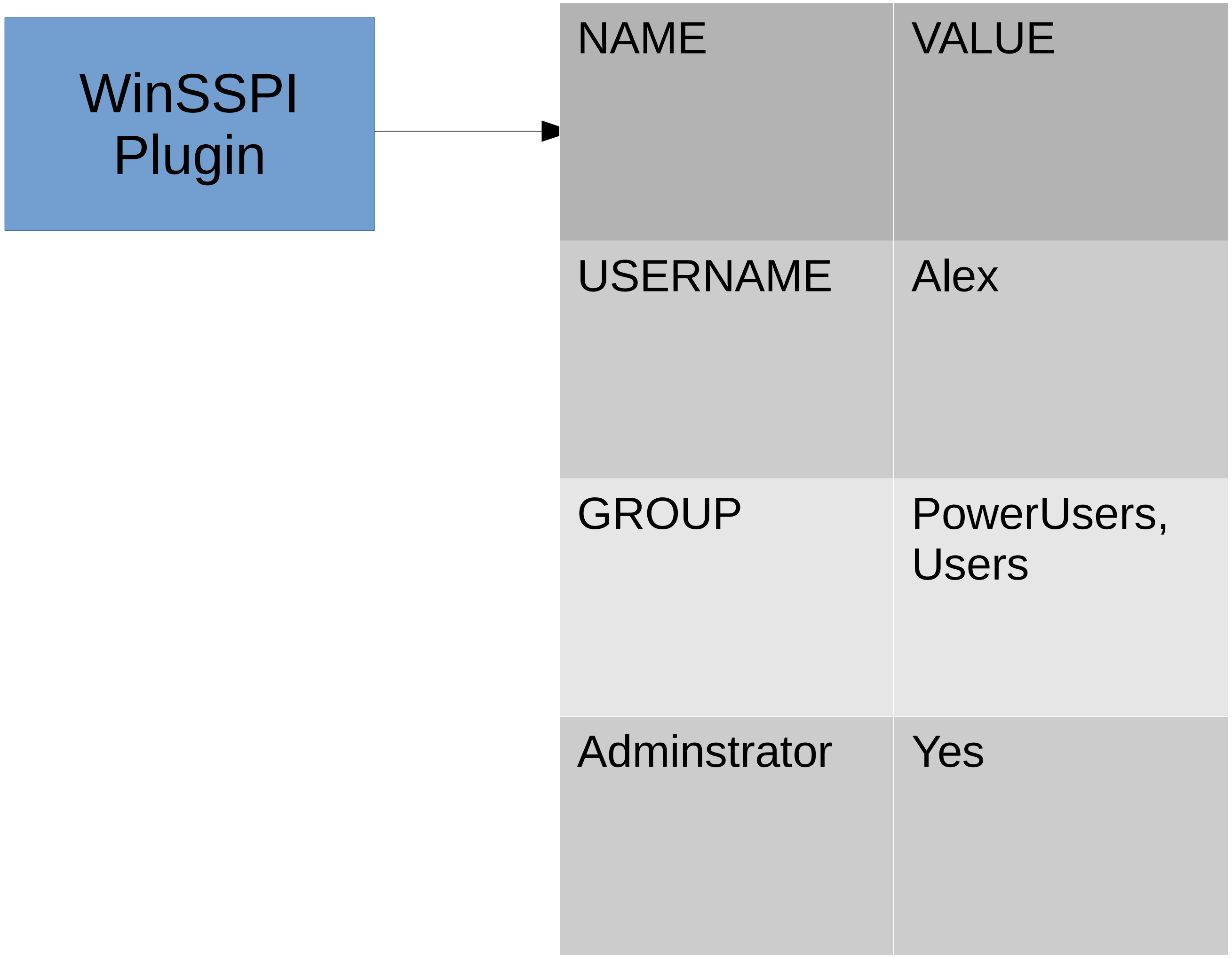
- Some authentication plugins allow authentication of external users
  - External user = not stored in Firebird security database
- Execute statement on external (plugin Cluster)
- Server-wide plugins – WinSSPI
- Special plugins (for example, LDAP authentication)

Mappings

- Mappings create relationships between users of plugin and internal Firebird users and objects
- Can be global mappings and database-level mappings

- Plugin can send to the mapping any specific security object
  - E.g., WINSSPI transfers Windows groups and domain administrator attribute

Authentication block (simplified)



NAME	VALUE
USERNAME	Alex
GROUP	PowerUsers, Users
Adminstrator	Yes

Example of mapping for auth block

NAME	VALUE
USERNAME	Alex
GROUP	PowerUsers, Users
Adminstrator	Yes

```
CREATE MAPPING map1
USING PLUGIN WinSSPI
FROM USERNAME Alex to
USER Donald
```

```
CREATE MAPPING map2
USING PLUGIN WinSSPI
FROM GROUP PowerUsers TO
ROLE President;
```

Global Mapping

CREATE GLOBAL MAPPING
 - adding GLOBAL makes it work for all databases which work with current security database

Example: Mapping between User and Role, Any user to User

```
CREATE MAPPING USR_CLUSTER9 USING
PLUGIN CLUSTER FROM USER MUSER TO
ROLE RDB$ADMIN;

CREATE MAPPING  USR_CLUSTER_X USING
PLUGIN CLUSTER FROM ANY USER TO USER
MYUSER;
```

More security features in Firebird 4

- Built-in Cryptography functions (FB4)
- SET ROLE - change role without reconnect to the server
- DELETE USER
- System Privileges – to delegate several capabilities of SYSDBA/Owner to other users
    - CREATE(ALTER) ROLE SET SYSTEM PRIVILEGES TO USER_MANAGEMENT;

Example we promised: Disable connect from unwanted user

```
CREATE MAPPING deny_1 USING ANY PLUGIN  FROM
USER baduser TO ROLE BADROLE1;

CREATE MAPPING deny_2 USING ANY PLUGIN  FROM
USER baduser TO ROLE BADROLE2;
```

Summary

- Don’t use SYSDBA-only access
  - Try to avoid SYSDBA usage at all
- Use modern plugins (Srp256)
- Define privileges with ROLEs
- Use DEFAULT ROLE, etc
- Use stored procedures for fine tuning of the access

Thank you

- Questions?
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