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# Security Considerations for IBM i Application Development

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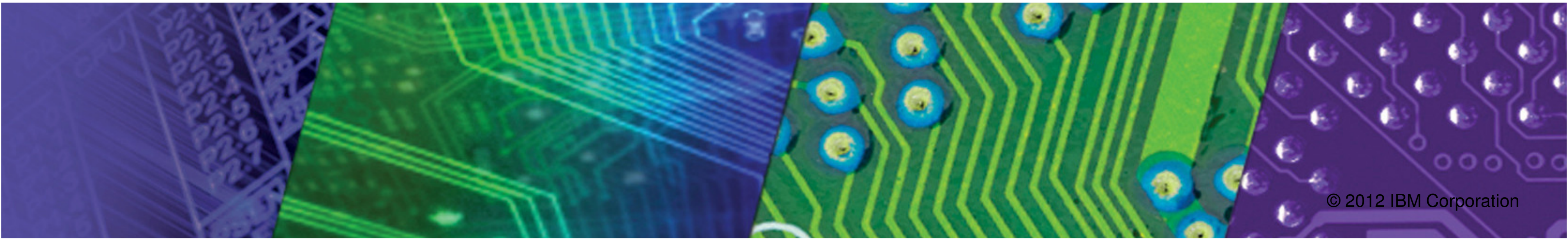


# Security for Application Development - Outline

- **Security Documentation**
  - Security related suggestions for application development documentation
- **Security Considerations**
  - Object ownership and public authority
  - Private authority and Authorization lists
- **System integrity Considerations**
  - Object domain, program state and security levels
  - Trojan horse considerations
  - Parameter validation, User Domain Objects
- **Application Security Techniques**
  - Adopted authority
  - Profile Swap

# Application Documentation

- When designing a new application, design documentation is a requirement in order to provide the necessary security information to a system administrator
  - What objects in the application contain “sensitive” data (these objects may need extra attention in order to **secure the data**)
  - What objects in the application contain “sensitive” data (the system admin may want to **“AUDIT”** access to the objects
  - What user profiles are used to **own** the application (this may be needed for audit purposes)
  - Are there authorization lists used to provide security for the data objects. The system admin will need this information in order to add/remove users for application access

# Application Documentation continued…

- Application documentation is necessary if, prior to application install/restore, objects need to be created by the system administrator
  - Does an “application” user profile(s) need to be created in order to establish correct ownership of objects?
  - Does an “application” authorization list(s) need to be created in order to secure application objects?

- An entry point into the application should be defined and documented. This entry point could be a CL Command or a Program that is called to “start” the application
  - This entry point can then be used to provide access to the application by granting users authority to “run” the application.  An authorization list would be a good mechanism to secure the entry point into the application.

# Security Overview & Considerations

# Security Overview

- In this section of the presentation, we will discuss:
  1. Object Ownership
  2. Public Authority
  3. Private Authority
  4. Authorization lists

# Object Ownership Overview

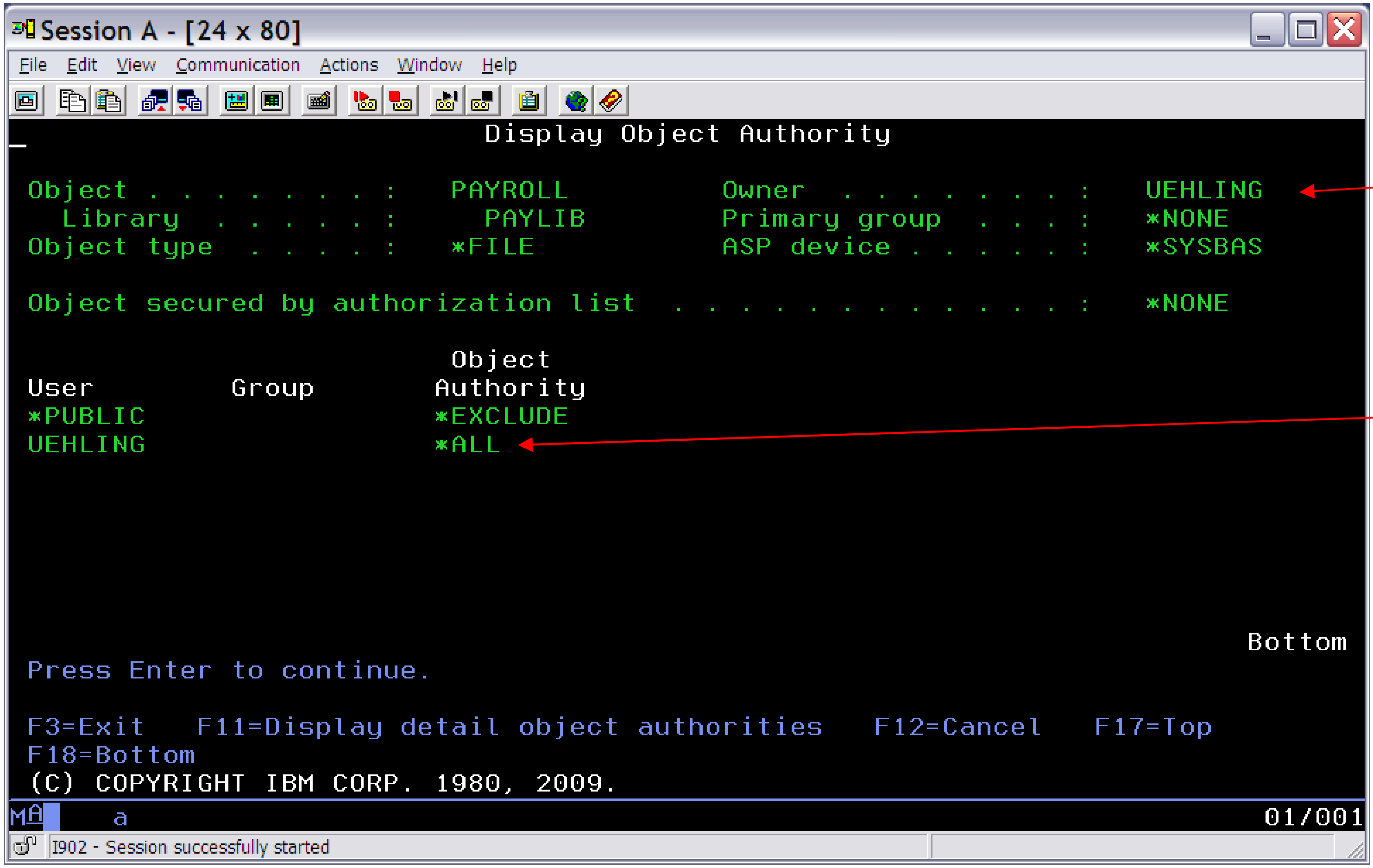
## *Object Ownership*

- Every object (*FILE, *PGM, *DIR, *STMF, etc) on the system has an owner

- Ownership assigned when the object is initially created
  - By default, the process user profile owns the object
  - The owner is granted ***ALL** authority to the created object
  - Options exist to assign ownership to the primary group profile of the process user profile (not discussed in this presentation)
  - Ownership can be changed via CHGOBJOWN or CHGOWN

# Object ownership continued…

- Signon and create an object. Process user owns the object.
- CRTPF FILE(PAYLIB/PAYROLL) RCDLEN(80) AUT(*EXCLUDE)
- DSPOBJAUT OBJ(PAYLIB/PAYROLL) OBJTYPE(*FILE)



```
                            Display Object Authority

 Object . . . . . . . . :   PAYROLL         Owner . . . . . . . :   UEHLING
   Library  . . . . . . :     PAYLIB        Primary group . . . :   *NONE
 Object type  . . . . . :   *FILE           ASP device  . . . . :   *SYSBAS

 Object secured by authorization list  . . . . . . . . . . . . :   *NONE

                          Object
 User        Group       Authority
 *PUBLIC                 *EXCLUDE
 UEHLING                 *ALL









                                                                        Bottom
 Press Enter to continue.

 F3=Exit   F11=Display detail object authorities   F12=Cancel   F17=Top
 F18=Bottom
 (C) COPYRIGHT IBM CORP. 1980, 2009.
MA      a                                                            01/001
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```

Object owner

Owner authority

# Object Ownership Considerations

- What user profile will own the application objects?
  - Creating an “application” user profile is recommended to own all application objects
  - A product “build” procedure should exist to set object ownership during application development & build
  - The “application” user profile should be created during application install via the pre-install exit program of RSTLICPGM (or created by the system administrator prior to restore of the application on the system)
    - CRTUSRPRF USRPRF(PAYROLL) PWD(*NONE) SPCAUT(*NONE)
    - This provides support to “assign ownership” during the application restore process

# Object Ownership Considerations continued…

- What user profile should own objects created (by the application) when the application is run by an end user?
  - Most likely **NOT** the user running the application…
    - If the process user owns the objects, they will, by default, have ***ALL** authority to the object which is a security exposure as they can change all data or delete the object
  - Use the CHGOBJOWN or CHGOWN interface, within your application, to change object ownership at run-time to the application user profile

# Public Authority Overview

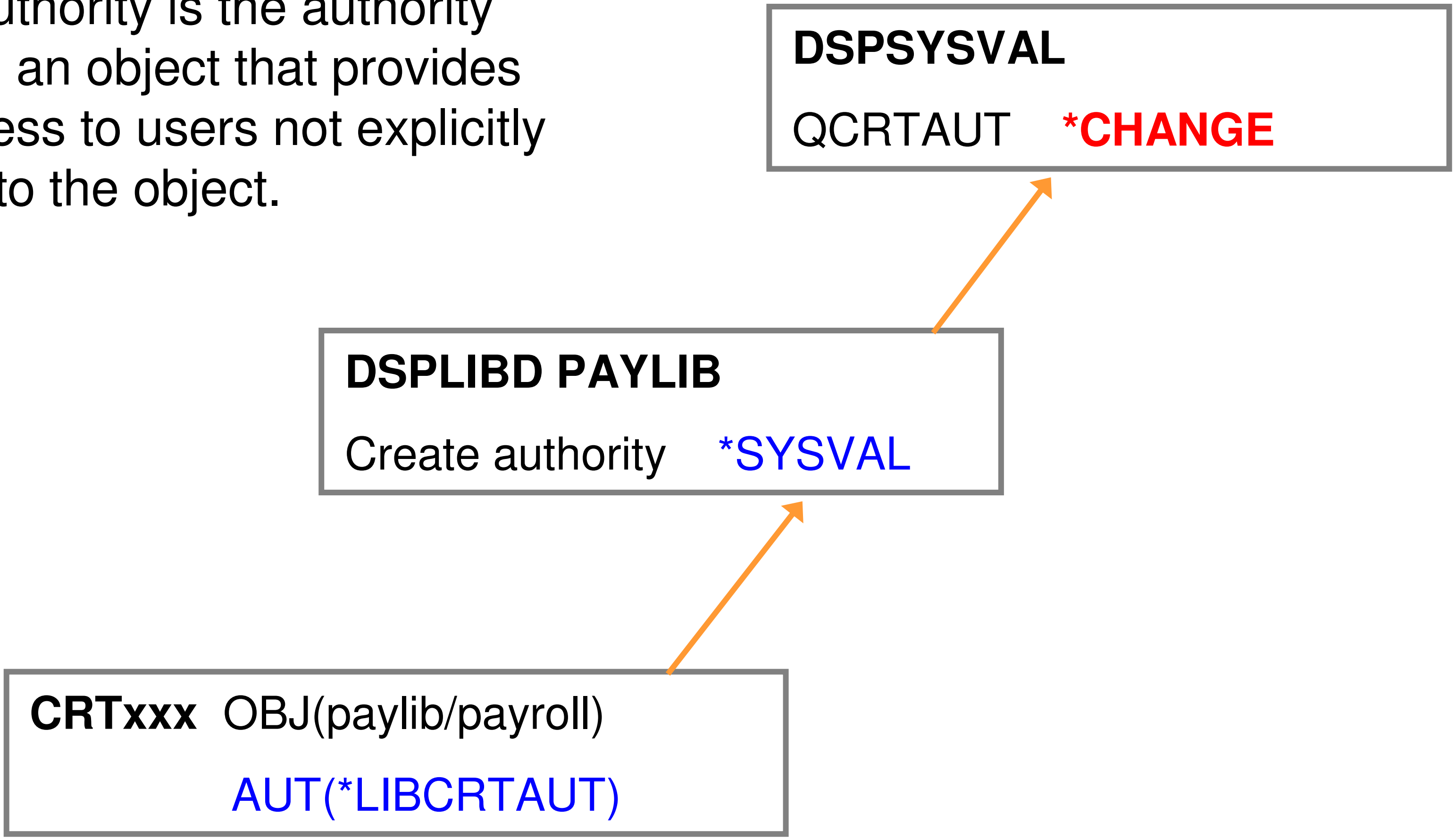
## *Object Public Authority*

- Every object (*FILE, *PGM, *DIR, *STMF, etc) on the system has a Public Authority Value

- Public Authority is assigned when the object is initially created
  - Public authority is set to the value specified on the AUT parm of the create interface (CL Command or API, e.g. CRTPF)
  - For IFS, inherited from the directory (default)
  - Public Authority can be changed via GRTOBJAUT or CHGAUT

# Where does *PUBLIC authority come from?

*PUBLIC authority is the authority assigned to an object that provides default access to users not explicitly authorized to the object.



**DSPSYSVAL**

QCRTAUT *CHANGE

**DSPLIBD PAYLIB**

Create authority *SYSVAL

**CRTxxx** OBJ(paylib/payroll)

AUT(*LIBCRTAUT)

**NOTE: The system default, because of history, is *CHANGE**

# “Short-cut” Authorities

## Authority is required to access every object on the system

| | *OBJOPR | *OBJMGT | *OBJEXIST | *OBJALTER | *OBJREF | *READ | *ADD | *UPD | *DLT | *EXECUTE |
|---|---|---|---|---|---|---|---|---|---|---|
| *ALL | X | X | X | X | X | X | X | X | X | X |
| *CHANGE | X | | | | | X | X | X | X | X |
| *USE | X | | | | | X | | | | X |
| *EXCLUDE | | | | | | | | | | |

# Object Authorities

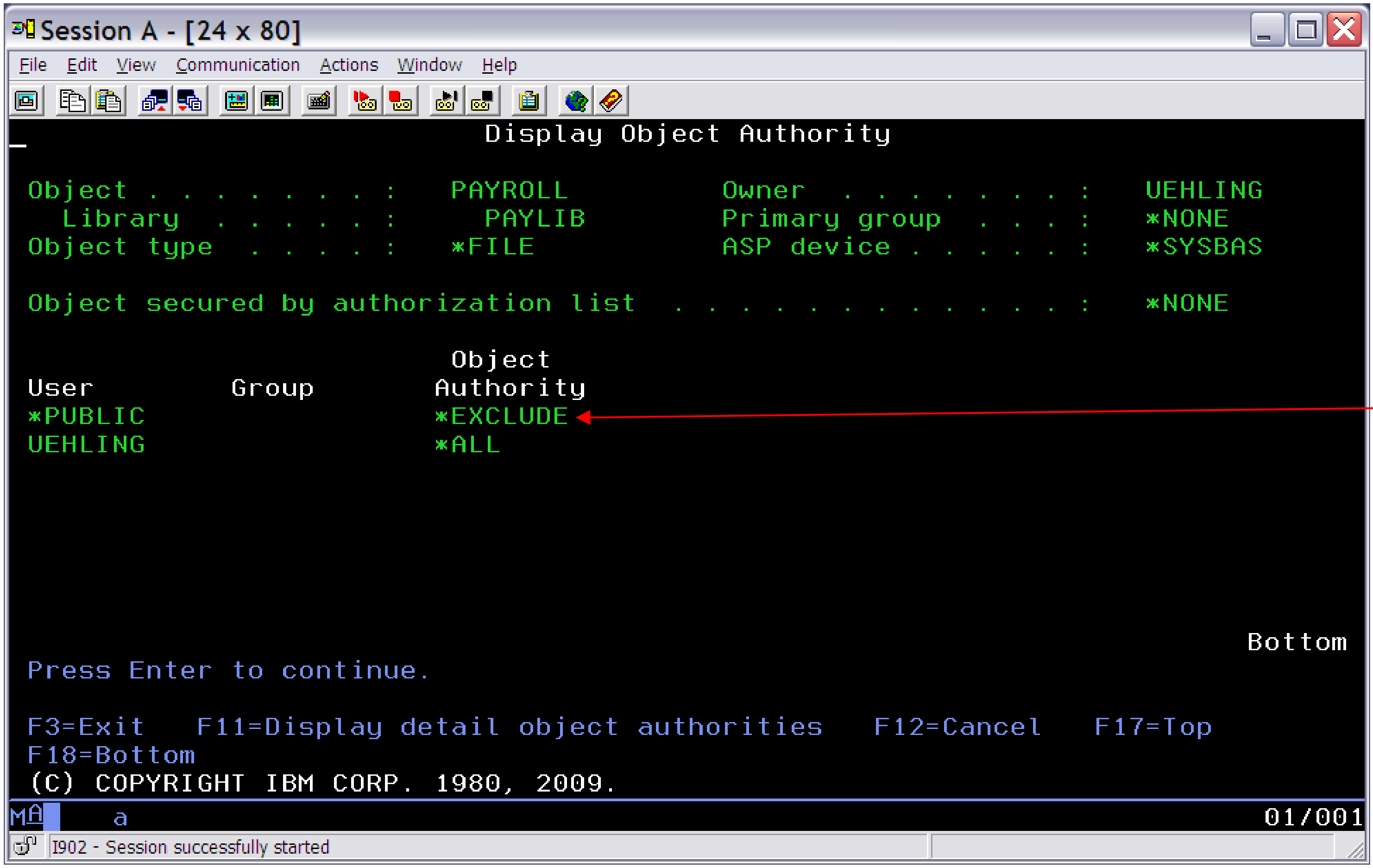
| | |
|---|---|
| *OBJOPR – Object Operational | Look at the description of an object and use the object as determined by the data authorities the user has. |
| *OBJMGT – Object Management | Move  or rename an object or add members to database files.  Superset of *OBJALTER and *OBJREF |
| *OBJEXIST – Object Existence | Change ownership and delete the object, free storage for the object, perform save and restore operations |
| *OBJALTER – Object Alter | Add, clear, initialize and reorganize members of database files, after and add attributes of database files, add and remove triggers, change attributes of SQL packages |
| *OBJREF – Object Reference | Specify database file as the parent in a referential constraint |
| *AUTLMGT – Authorization List Management | Add and remove users and their authorities from an authorization list. |

# Data Authorities - Defined

| | |
|---|---|
| *READ | Display the contents of an object, such as viewing the records in a file |
| *ADD | Add entries to an object, such as adding messages to a message queue, or records to a file |
| *UPD (Update) | Change entries in an object, such as changing records in a file |
| *DLT (Delete) | Remove entries from an object, such as removing messages from a message queue or deleting records from a file |
| *EXECUTE | Run a program or search a library or directory |

# Public Authority

- CRTPF FILE(PAYLIB/PAYROLL) RCDLEN(80) **AUT(*EXCLUDE)**
- DSPOBJAUT OBJ(PAYLIB/PAYROLL) OBJTYPE(*FILE)



```
                             Display Object Authority
_
 Object . . . . . . . . :   PAYROLL         Owner . . . . . . . :   UEHLING
   Library  . . . . . . :     PAYLIB        Primary group . . . :   *NONE
 Object type  . . . . . :   *FILE           ASP device  . . . . :   *SYSBAS

 Object secured by authorization list . . . . . . . . . . . . :   *NONE

                            Object
 User         Group        Authority
 *PUBLIC                   *EXCLUDE
 UEHLING                   *ALL







                                                                         Bottom
 Press Enter to continue.

 F3=Exit   F11=Display detail object authorities   F12=Cancel   F17=Top
 F18=Bottom
 (C) COPYRIGHT IBM CORP. 1980, 2009.
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I902 - Session successfully started
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Public authority

# Public Authority Considerations

- What public authority setting should be set for the application objects?
  - A product "build" procedure should exist to set public authority during application development (or ensure public is set via the CRTxxx interface)
  - Set *EXCLUDE public authority for "sensitive" data objects and *USE or *CHANGE for objects used during run-time that do not contain sensitive data.
    - If adopted authority or profile swap is used within the application then all objects can have PUBLIC(*EXCLUDE), which provides great security! This is discussed later in this presentation.
    - **NOTE: *USE or *CHANGE on a DB2 or IFS File will expose data. *USE allows the data to be "read" or FTP download from the server**
  - **Never set *ALL** public authority as this allows any user the ability to delete or change ownership of the object

# Public Authority Considerations continued…

What public authority value should be used for objects created when the application is run by an end user?

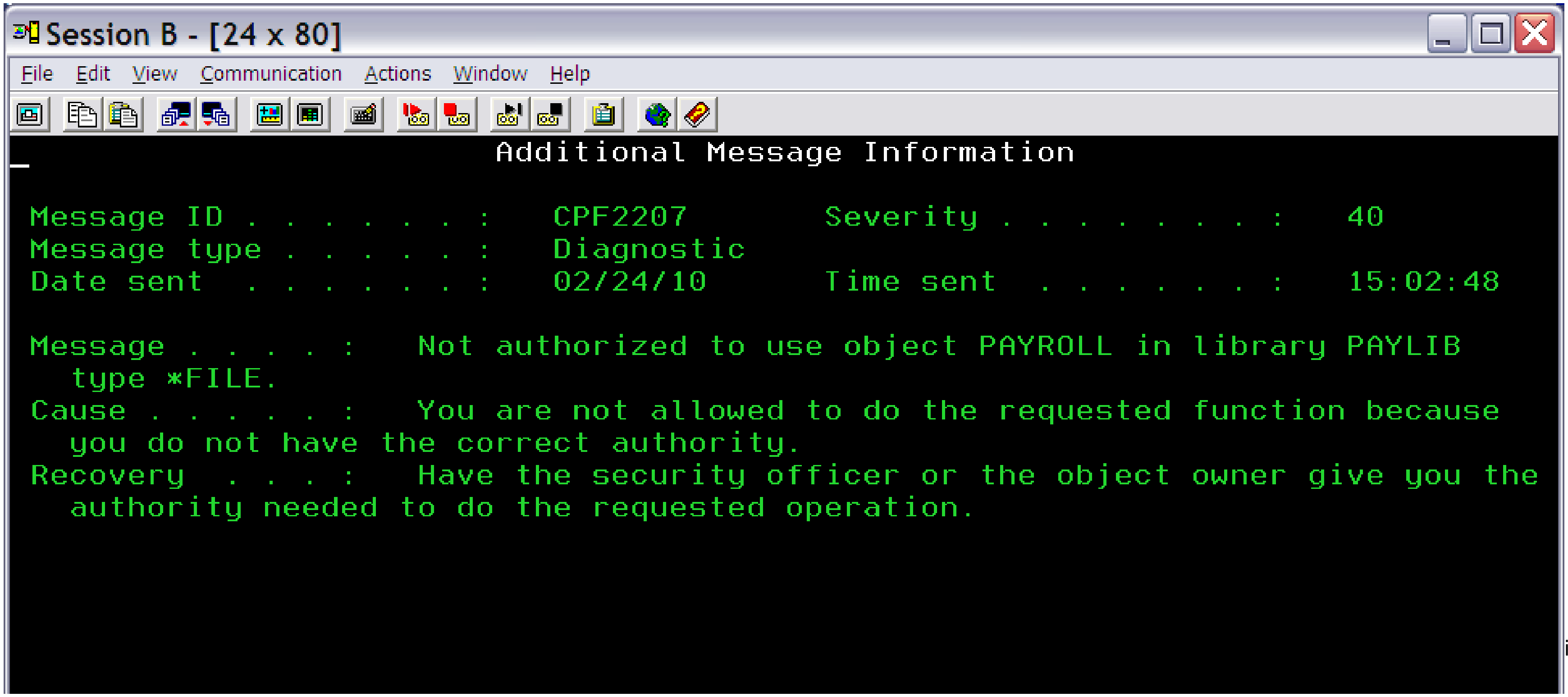
- Set *EXCLUDE public authority for “sensitive” data objects and *USE or *CHANGE for objects used during run-time that do not contain sensitive data
  - If adopted authority or profile swap is used within the application then all objects can have PUBLIC(*EXCLUDE), and provides great security!. This is discussed later in this presentation.
  - **NOTE: *USE or *CHANGE on a DB2 or IFS File will expose data. *USE allows the data to be “read” or FTP download from the server**

- **Never set *ALL** public authority as this allows any user the ability to delete or change ownership of the object
- Set public authority for the object via the AUT parm of the CRTXXX interface at application run-time… or….
- Use the GRTOBJAUT or CHGAUT interface, within your application, to change public authority at run-time

# Authority problems at application run-time

- Authority problems can occur at application run-time when the user running the application is a low power user and tight security is applied to the objects

  - Techniques, which can be utilized by the application, exist to avoid these authority problems and will be discussed in this presentation
    1. Authorization lists used to secure the application objects
    2. Adopted user profile authority
    3. Profile Swapping



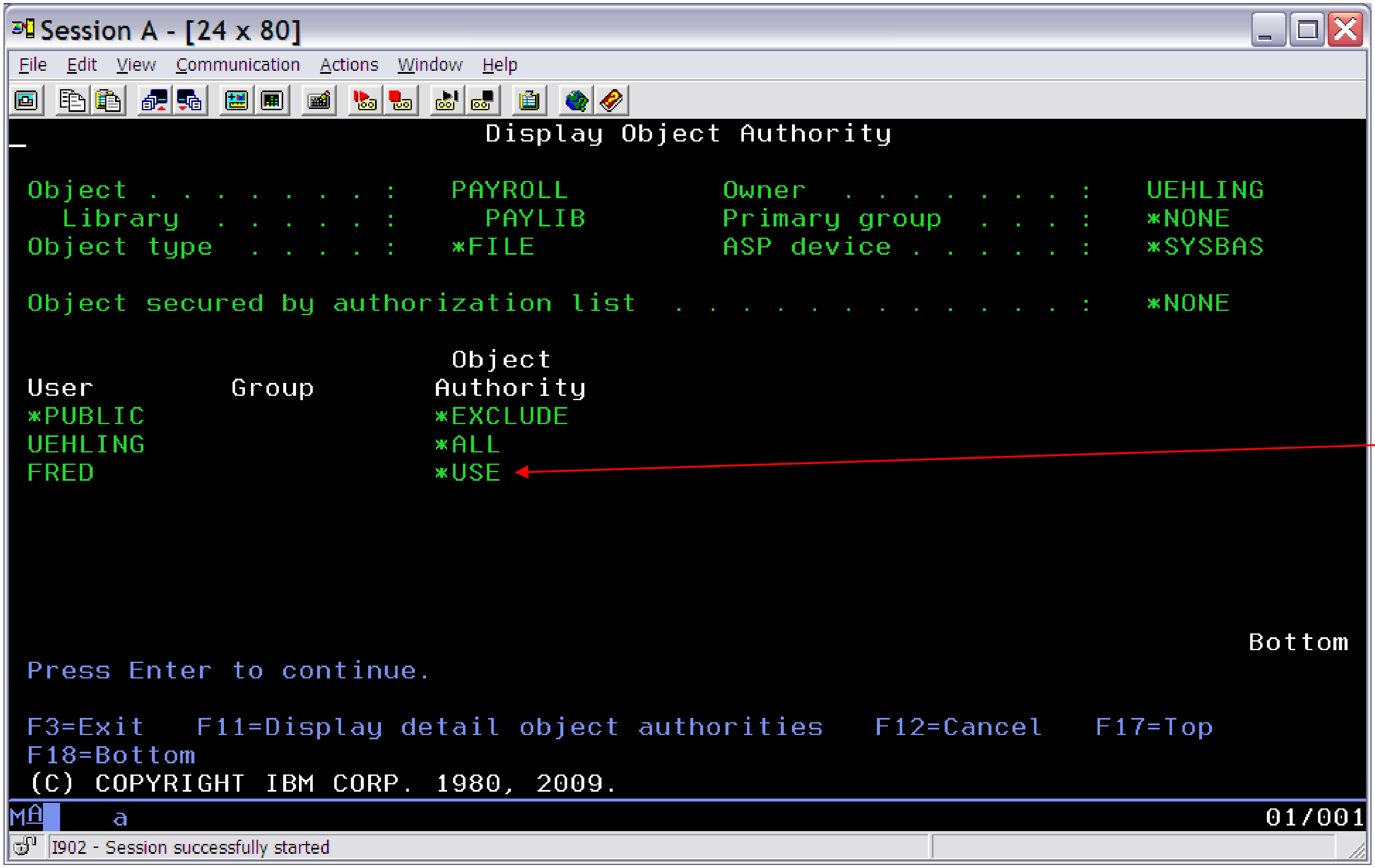
```
                         Additional Message Information

 Message ID . . . . . . :   CPF2207       Severity . . . . . . . :   40
 Message type . . . . . :   Diagnostic
 Date sent  . . . . . . :   02/24/10      Time sent  . . . . . . :   15:02:48

 Message . . . . :   Not authorized to use object PAYROLL in library PAYLIB
   type *FILE.
 Cause . . . . . :   You are not allowed to do the requested function because
   you do not have the correct authority.
 Recovery  . . . :   Have the security officer or the object owner give you the
   authority needed to do the requested operation.
```

# Private Authority

- GRTOBJAUT OBJ(PAYLIB/PAYROLL) OBJTYPE(*FILE) **USER(FRED)** AUT(*USE)
- DSPOBJAUT OBJ(PAYLIB/PAYROLL) OBJTYPE(*FILE)



```
                           Display Object Authority

 Object . . . . . . . :   PAYROLL          Owner . . . . . . . :   UEHLING
   Library . . . . . :     PAYLIB          Primary group . . . :   *NONE
 Object type . . . . :   *FILE             ASP device . . . . . :   *SYSBAS

 Object secured by authorization list . . . . . . . . . . . . :   *NONE

                          Object
 User         Group       Authority
 *PUBLIC                  *EXCLUDE
 UEHLING                  *ALL
 FRED                     *USE

                                                                        Bottom
 Press Enter to continue.

 F3=Exit   F11=Display detail object authorities   F12=Cancel   F17=Top
 F18=Bottom
 (C) COPYRIGHT IBM CORP. 1980, 2009.
MA     a                                                              01/001
I902 - Session successfully started
```

Private authority

# Private Authority Considerations

- Private authority to application objects should be avoided or minimally used
  - Private authorities increase the maintenance overhead for the system administrator
    - Adding new application users is problematic
  - Private authorities can cause system performance problems at both run-time and system save
  - Private authorities complicate a security audit

# Private Authority Considerations continued…

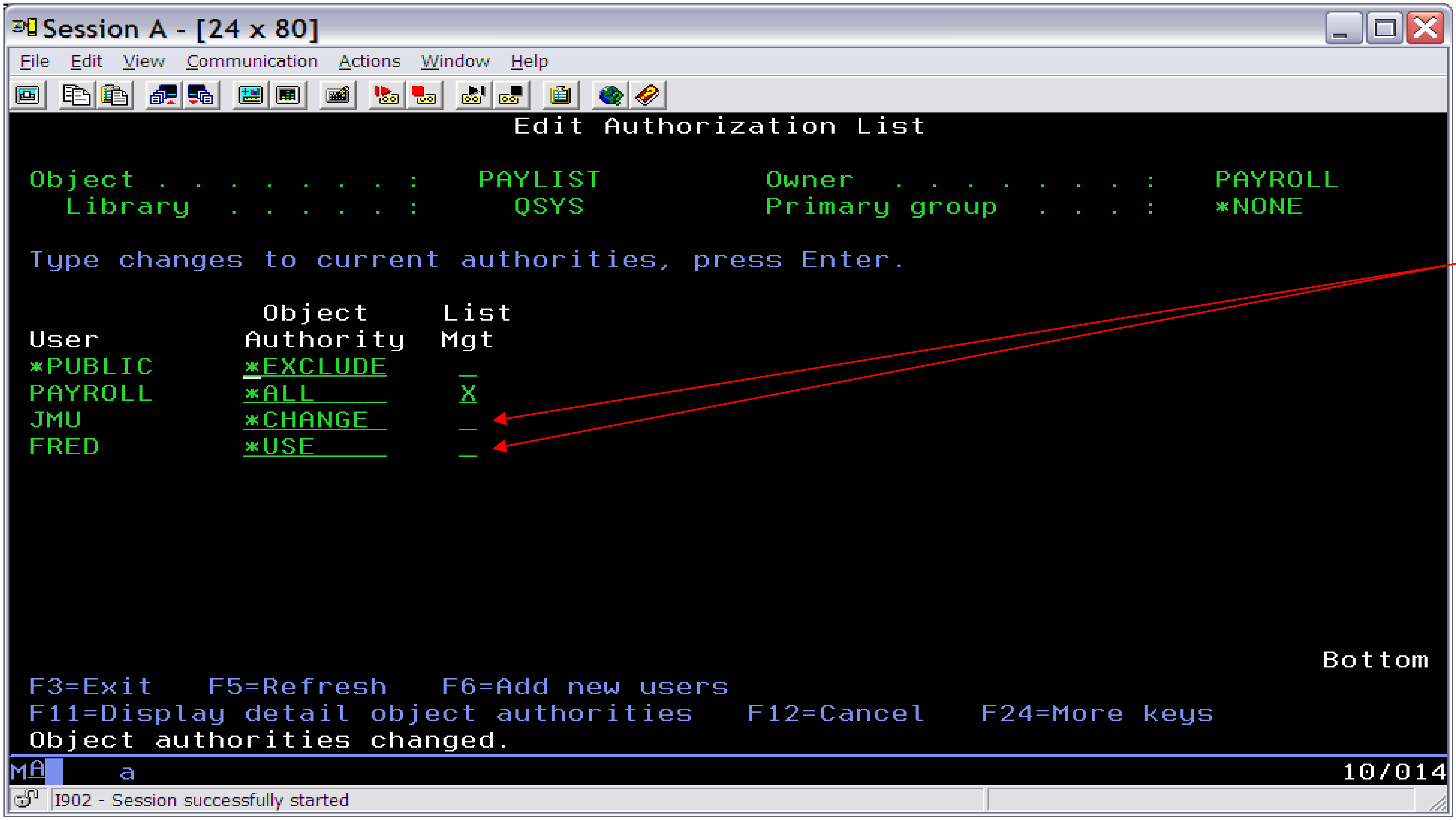
- Private authorities, if necessary, should be implemented via an authorization list (next topic)

- Group user profiles provide an alternative to granting private authorities to individual users (but groups are usually not controlled by the application development environment)

- Private authorities will provide object access, outside of an application run-time environment, to perform operations such as a “Query” or “FTP” so at times are necessary

# Authorization lists (Create the *AUTL and add users)

- CRTAUTL AUTL(PAYLIST) AUT(*EXCLUDE)
- EDTAUTL AUTL(PAYLIST)
- Add the users and authority via F6


Session A - [24 x 80]
File Edit View Communication Actions Window Help

```
                             Edit Authorization List

 Object . . . . . . . . . :    PAYLIST         Owner . . . . . . . :    PAYROLL
   Library  . . . . . . . :      QSYS          Primary group . . . :    *NONE

 Type changes to current authorities, press Enter.

                      Object     List
 User                 Authority  Mgt
 *PUBLIC              *EXCLUDE    _
 PAYROLL              *ALL        X
 JMU                  *CHANGE     _
 FRED                 *USE        _

                                                                         Bottom
 F3=Exit   F5=Refresh   F6=Add new users
 F11=Display detail object authorities   F12=Cancel   F24=More keys
 Object authorities changed.
MA      a                                                               10/014
```

I902 - Session successfully started

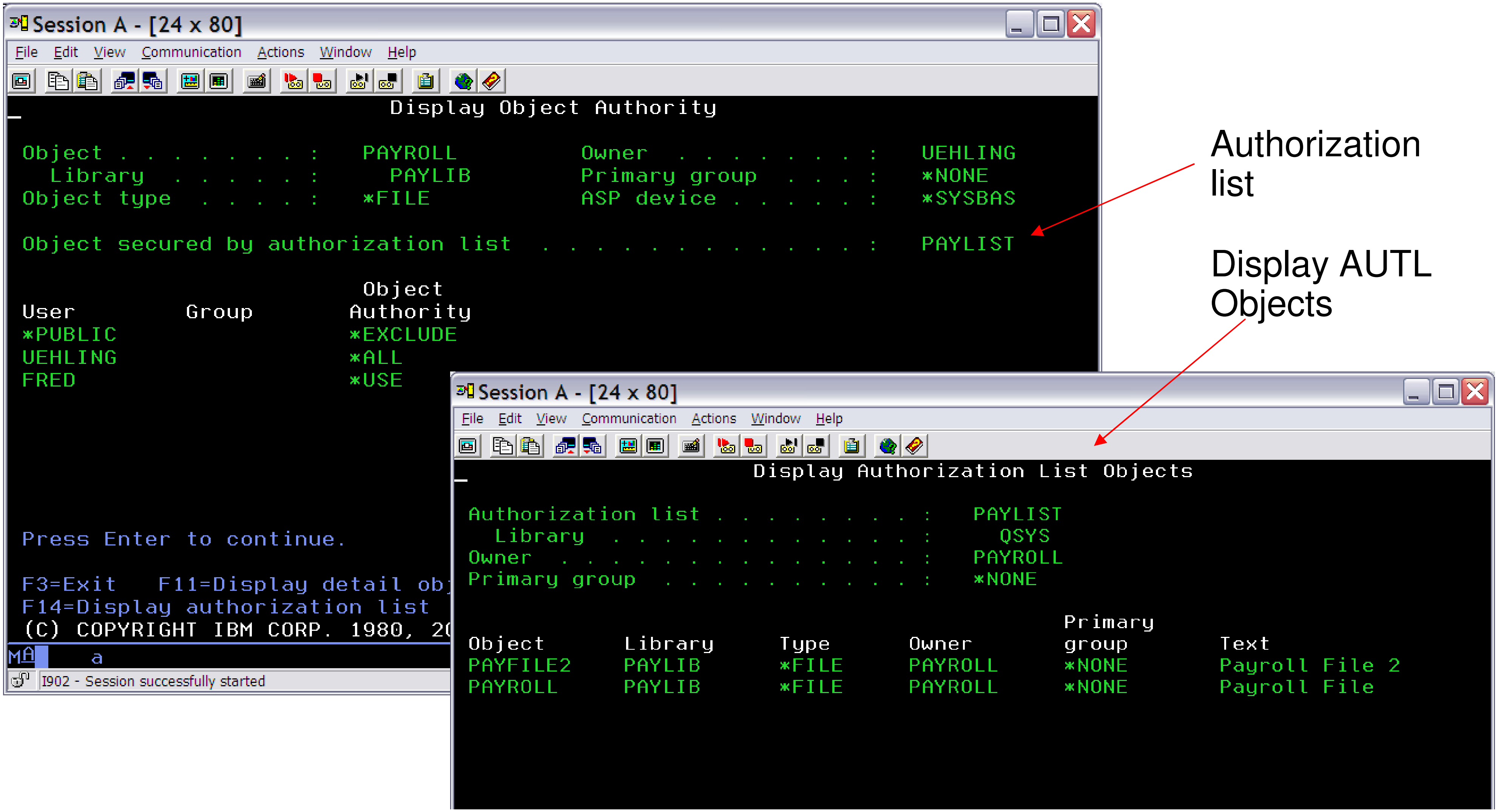
Authorized Users

# Authorization lists continued (Secure the objects)...

- GRTOBJAUT OBJ(PAYLIB/PAYROLL) OBJTYPE(*FILE) **AUTL(PAYLIST)**
- GRTOBJAUT OBJ(PAYLIB/PAYFILE2) OBJTYPE(*FILE) **AUTL(PAYLIST)**

or

- CRTPF FILE(PAYLIB/PAYROLL) RCDLEN(80) **AUT(PAYLIST)**



```
                         Display Object Authority
_
 Object . . . . . . . . :   PAYROLL         Owner  . . . . . . . :   UEHLING
   Library  . . . . . . :     PAYLIB        Primary group  . . . :   *NONE
 Object type  . . . . . :   *FILE           ASP device . . . . . :   *SYSBAS

 Object secured by authorization list  . . . . . . . . . . . . :   PAYLIST

                            Object
 User         Group        Authority
 *PUBLIC                   *EXCLUDE
 UEHLING                   *ALL
 FRED                      *USE

 Press Enter to continue.

 F3=Exit   F11=Display detail obj
 F14=Display authorization list
(C) COPYRIGHT IBM CORP. 1980, 20
MA       a
```

```
                      Display Authorization List Objects
_
 Authorization list . . . . . . . . :   PAYLIST
   Library  . . . . . . . . . . . . :     QSYS
 Owner  . . . . . . . . . . . . . . :   PAYROLL
 Primary group  . . . . . . . . . . :   *NONE

                                                  Primary
 Object       Library      Type       Owner       group       Text
 PAYFILE2     PAYLIB       *FILE      PAYROLL     *NONE       Payroll File 2
 PAYROLL      PAYLIB       *FILE      PAYROLL     *NONE       Payroll File
```

Authorization list

Display AUTL Objects

# Authorization list considerations

- Authorization lists provide a great mechanism to authorize objects with the same set of users and authority

- Documentation is a requirement to let the system administrator know what authorization list(s) are used to secure the data (so they can add/remove users when necessary)

- The “application” authorization list should be created during application install via the pre-install exit program of RSTLICPGM (or created by the system administrator prior to restore of the application on the system
  - CRTAUTL AUTL(PAYLIST) AUT(*EXCLUDE)
  - This provides support to “connect” the authorization list to each secured object during the object restore process

# Authorization list considerations continued…

- Authorization lists help the system admin manage authority on the system
  - Adding new application users is accomplished by adding the new user to the authorization list

- Authorization lists can cause system performance problems at both run-time and system save (private authorities are still involved)
  - Use the authorization list only when necessary on a minimal number of objects that need to be authorized for "outside the application" access
  - Authorization lists can be used to secure "sensitive" objects
  - Objects that are used at application run-time, that do not contain sensitive data, should be secured with public authority or accessed via other security techniques (described in this presentation)

# Determining Object Access

# How Does the System Determine Access an Object?

- When the user logs into the server and tries to access an object, the OS will make checks to determine if the user is authorized to perform the action against the object
  - Object access is defined by the object type
    - Call a *PGM
    - Run a *CMD
    - Open a *FILE
    - Etc…
  - Authority requirements differ between object types and usage
    - *USE to call a *PGM or run a *CMD
    - *USE to open a file for read and *CHANGE to open for update

**• NOTE: *ALLOBJ special authority gives the user access to all objects on the system. *ALLOBJ = Security officer!**

# How Does the System Determine Access an Object?

- To access or use an object, the user must have sufficient authority to the object. The authority could come from:
  - *ALLOBJ special authority (Security officer Authority)
    - (privilege given to a user via the CRT/CHGUSRPRF command)
  - Private authority to the object
  - Authorization list authority
  - *PUBLIC authority
  - Adopted authority (discussed later)

# i5/OS Authority Search Order

| | | |
|---|---|---|
| *ALLOBJ<br>Private<br>Authorization List | **USER** | Stops when ANY authority is found |
| *ALLOBJ<br>Primary Group<br>Private<br>Authorization List | **GROUP(S)** | Repeats for each group until sufficient authority is accumulated or no more groups |
| Object<br>Authorization List | ***PUBLIC** | Checked when no authority is found for User or Group(s) |
| Adopted | | Only checked when authority is not sufficient |

# IBM i System Integrity Considerations

# Authority checking and integrity - Security level 40 & 50

User written applications, running at security level 40 or 50, **MUST** use system interfaces (commands and APIs) to gain access to the objects.

- Authority checking is enforced by the system interface
- Parameter Validation is performed
- Object Domain checking is performed
- Object Hardware storage protection is performed

- Direct access by user programs to system objects is not allowed at Security level 40 and 50 due to domain and hardware storage protection attributes of the objects. “Direct access” means addressing the object internals directly via “pointer” access (accessing the object “internals” directly via address).

- Test your application on security level 50, QSECURITY system value = 50

# Object Domain attributes - Object integrity

Every object: *CMD, *FILE, *PGM, etc. has a “domain”
Every program has a “state” (*SYSTEM or *USER)

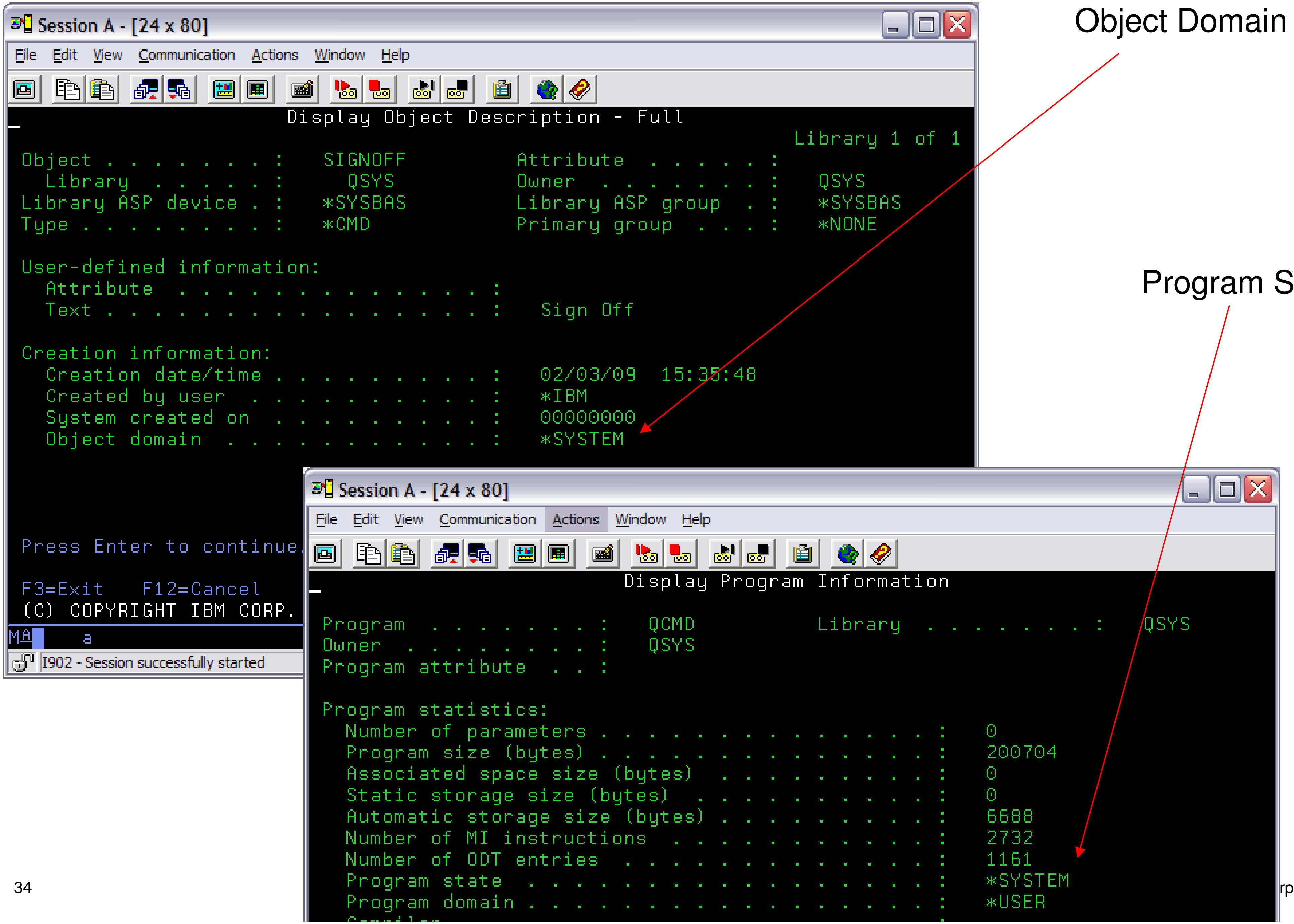
Program state is compared against object Domain

Program run state: *SYSTEM or *USER (DSPPGM/DSPSRVPGM)
Object Domain: *SYSTEM or *USER (DSPOBJD)

Programs running *SYSTEM state can access both *USER and *SYSTEM domain.
Programs running *USER state can only access *USER domain objects.

- **Security level 30 ALLOWS access regardless of state/domain combination**
- **Security level 40 and 50 enforce domain checking**

# Object Domain, Program State


Session A - [24 x 80]
File Edit View Communication Actions Window Help
MA a
I902 - Session successfully started
Session A - [24 x 80]
File Edit View Communication Actions Window Help

Object Domain

Program State

```
                      Display Object Description - Full
                                                              Library 1 of 1
 Object . . . . . . . :   SIGNOFF         Attribute . . . . . :
   Library . . . . . :     QSYS           Owner . . . . . . . :    QSYS
 Library ASP device . :   *SYSBAS         Library ASP group  . :    *SYSBAS
 Type . . . . . . . . :   *CMD            Primary group . . . :    *NONE

 User-defined information:
   Attribute . . . . . . . . . . . . . :
   Text . . . . . . . . . . . . . . . . :   Sign Off

 Creation information:
   Creation date/time . . . . . . . . . :   02/03/09   15:35:48
   Created by user  . . . . . . . . . . :   *IBM
   System created on  . . . . . . . . . :   00000000
   Object domain  . . . . . . . . . . . :   *SYSTEM




 Press Enter to continue.

 F3=Exit   F12=Cancel
 (C) COPYRIGHT IBM CORP.
```

```
                      Display Program Information

 Program  . . . . . . . :   QCMD            Library  . . . . . . . :   QSYS
 Owner  . . . . . . . . :   QSYS
 Program attribute  . . :

 Program statistics:
   Number of parameters . . . . . . . . . . . . . . :   0
   Program size (bytes) . . . . . . . . . . . . . . :   200704
   Associated space size (bytes)  . . . . . . . . . :   0
   Static storage size (bytes)  . . . . . . . . . . :   0
   Automatic storage size (bytes) . . . . . . . . . :   6688
   Number of MI instructions  . . . . . . . . . . . :   2732
   Number of ODT entries  . . . . . . . . . . . . . :   1161
   Program state  . . . . . . . . . . . . . . . . . :   *SYSTEM
   Program domain . . . . . . . . . . . . . . . . . :   *USER
```

# User domain objects

## *Creating User Domain Objects*

You are not guaranteed that you will be able to create user domain user objects **(*USRSPC, *USRIDX, and *USRQ)** in any library other than QTEMP

- QALWUSRDMN system value controls into which libraries/directories the objects can be created.
- QTEMP is the only library that can always contain user domain versions of these objects.

NOTE: User domain objects are a security risk because they can be directly read on any security level via pointer access.

# Trojan Horse concerns

## *Library qualify object reference*

- Program and command invocation should be library qualified rather than *LIBL
  - CALL **PAYLIB/PAYROLL** (parms)
  - **QSYS/CRTDTAARA** DTAARA(LIB/DTAARA1) TYPE(*CHAR)
- By qualifying the object reference, you prevent trojan horse attacks via the library list.  For example, someone creates a program called PAYROLL and places it in a library in the library list ahead of PAYLIB.
- For objects that contain translatable text (message files, panel groups, etc) you should use *LIBL for library qualification in order to pick up different versions of the translated text.
- **NOTE:  Using library qualified references can cause potential testing difficulties.  A test system or partition is required to test application changes rather than just manipulating a library list to test.  The security benefits outweigh the test considerations!**

# Parameter Validation Considerations

## *Test input parameters for valid values*

- Testing parameter input is a good programming practice
  - Testing ranges of valid values for numeric parms
  - Testing for valid “strings” (*GOOD vrs *GOOOD)
  - Testing for valid “syntax” of date, time, names, etc.
  - ETC…

- The lack of parameter validation could cause an application to fail and introduce a security problem
  - Abnormal application end could leave a job with libraries in the library list, open files, etc.
  - Abnormal application end could leave a job at a command line with a profile swap or adopted authority condition
  - Make sure to add appropriate Exception Handling to your code to prevent abnormal end
  - ETC…

# Menu Security

- Menu Security = Display a menu with allowable options and forget about object security!
  - Still a common “UNSECURE” practice today

- Don't rely on menu security!
  - Menu Security was acceptable… 20 years ago
  - Typical Design was PUBLIC(*ALL) for object security

- Objects are exposed…
  - FTP from a client system, read/change any data file that has PUBLIC(*CHANGE or *ALL), or download any PUBLIC(*USE) file

- Secure your sensitive objects with the appropriate level of authority at the object level!

# Security Implementation Options

1. Adopted User profile Authority
2. Profile Swap to obtain additional Authority

# Adopted User Profile Authority

# Adopted User Profile Authority

## *Adopted Authority implementation*

- The implementation is to "Secure" all application objects so the application is in control of all read and update operations
  - Set PUBLIC authority to *EXCLUDE for **ALL** application objects
  - The system administrator can grant authority to the "entry point" of the application to provide access to authorized users
- Within the application, use program adopted authority to gain access to objects in the QSYS file system while the application is running
- To access objects in the IFS file system, Profile Swap can be used (see Profile Swap topic in this presentation)

# Adopted User Profile Authority

## *Adopted Authority Considerations*

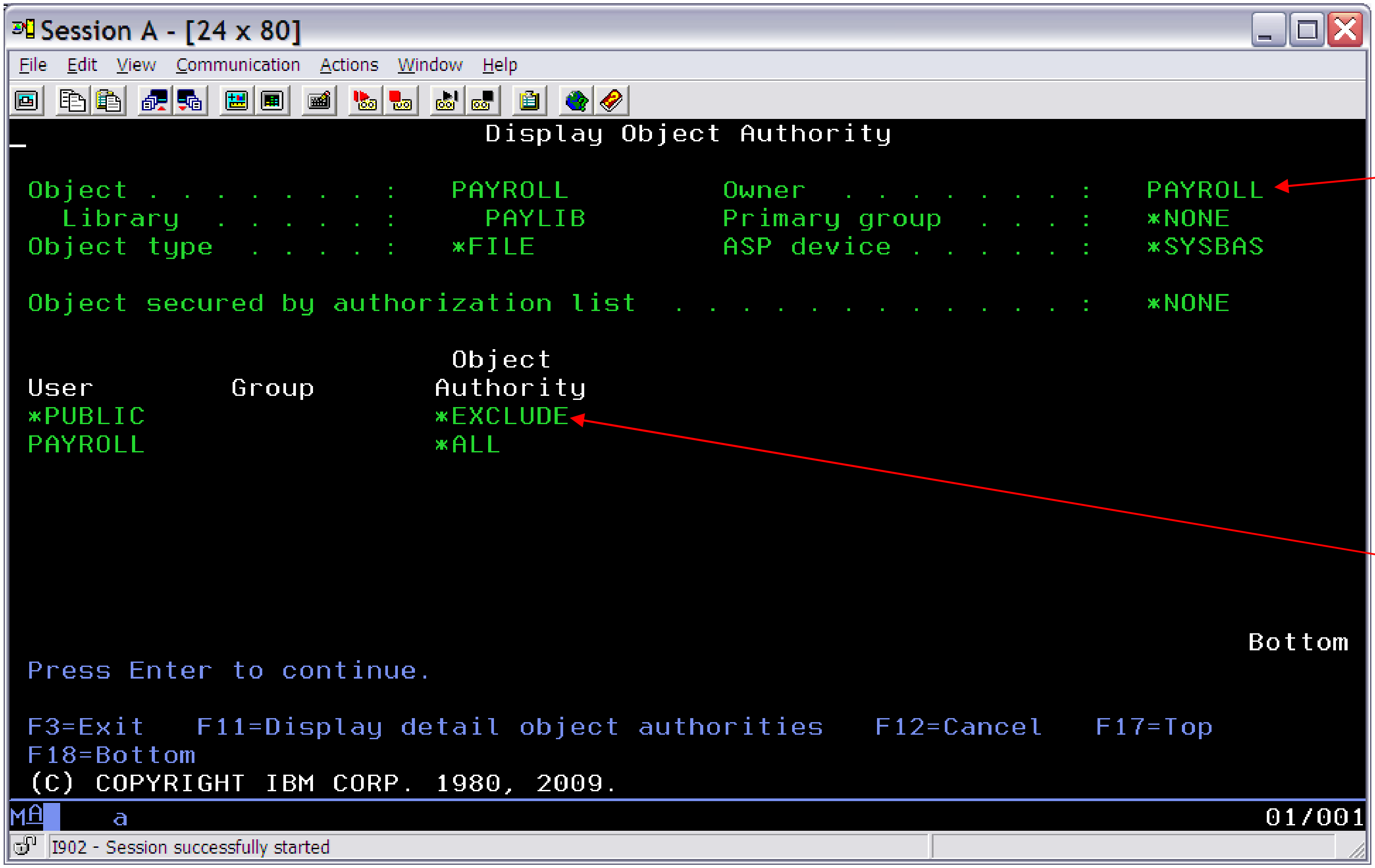
- If all objects are PUBLIC(*EXCLUDE), an end user has NO access to any of the objects without running the application
  - This means, to run a QUERY, FTP or other interface, outside of the application, authority will be required.   Private authority would need to be granted to certain objects for the list of users who need access outside the application

- Certain “network” interfaces, specifically in the DB2 area, will not work without “extra” security considerations.  Interfaces like DRDA, Web Query, ODBC, JDBC, etc. cannot easily use adopted authority so private authority would be required (unless you design a procedure to call via the network interface)

# Adopted User Profile Authority

## *Authorization scheme using adopted authority*

- Create all application objects with PUBLIC(*EXCLUDE) authority
- Set the Ownership of all application objects to the application profile



```
                            Display Object Authority

 Object . . . . . . . :   PAYROLL         Owner . . . . . . . :   PAYROLL
   Library . . . . . :     PAYLIB         Primary group . . . :   *NONE
 Object type . . . . :   *FILE            ASP device . . . . . :   *SYSBAS

 Object secured by authorization list . . . . . . . . . . . . :   *NONE

                         Object
 User        Group      Authority
 *PUBLIC                *EXCLUDE
 PAYROLL                *ALL









                                                                      Bottom
 Press Enter to continue.

 F3=Exit   F11=Display detail object authorities   F12=Cancel   F17=Top
 F18=Bottom
 (C) COPYRIGHT IBM CORP. 1980, 2009.
MA     a                                                               01/001
I902 - Session successfully started
```

Owner is the Application Profile

Public Authority set to *EXCLUDE

# Adopted User Profile Authority

## *Adopted Authority – Program attribute*

- When a program or service program adopts authority, it uses both the authority of the “process (job) user” **and** the authority of the program/srvpgm **owner**.
- Adopted authority specified when program/srvpgm is created
  - C, CL, RPG, etc. --> by specifying USRPRF(*OWNER) on the CRTxxxPGM or CRTBNDxx commands
  - Or via the CHGPGM CL command, USRPRF(*OWNER) parm

# Adopted Authority

- Used to temporarily give additional authority
- When a program with USRPRF(*OWNER) runs, the authority in effect is the job user plus the owner of the program
- Both special authorities and private authorities are adopted (the program owner’s groups are not included)
- Additional authority is in effect for as long as the program is in the call stack

# Adopted User Profile Authority considerations

## *Adopted Authority considerations*

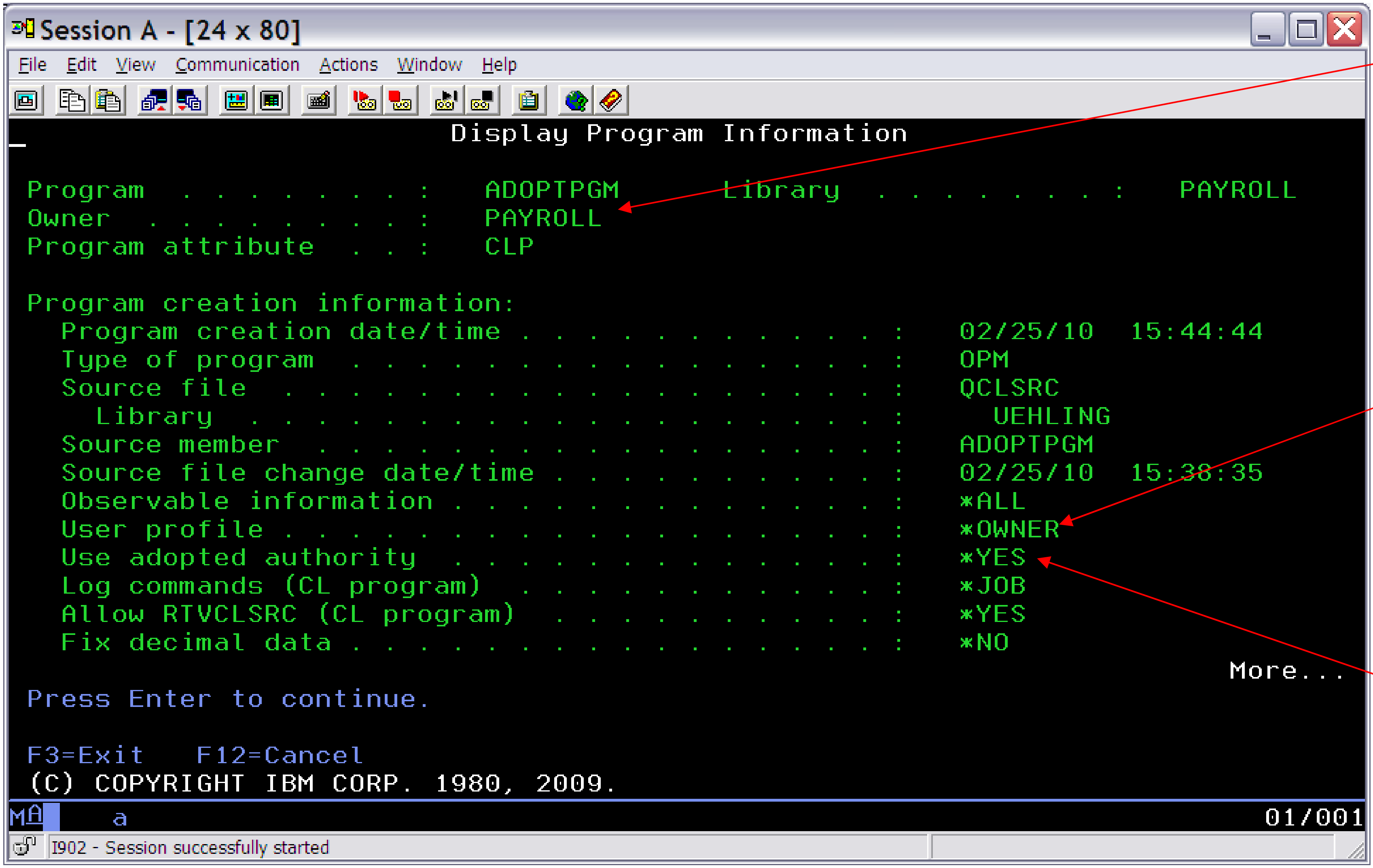
- Application designer must be careful to not include adopted authority in any authority checks the application specifically makes (e.g. CHKOBJ or authority checking APIs)

- IFS interfaces do not honor adopted authority
  - Must "swap" to powerful profile to ensure a user is authorized to access an IFS object (swap discussed later…)

- Make sure command line (or exit program) **not available** to end user when adopting authority or swapped to a powerful profile.  Use LMTCPB(*YES) user profile parm to prevent command line access with authority of the adopted/swapped profile.
  - Adopted authority and swapped user profile authority given to the command line user
  - Technique to allow a command line will be discussed in the "use adopted authority" charts

# Creating a program that adopts authority

- CRTCLPGM PGM(PAYROLL/ADOPTPGM) TEXT('Program that adopts owner authority') **USRPRF(*OWNER)**
- DSPPGM PGM(PAYROLL/ADOPTPGM)



```
                       Display Program Information
_
 Program  . . . . . . . :   ADOPTPGM      Library . . . . . . . :   PAYROLL
 Owner  . . . . . . . . :   PAYROLL
 Program attribute  . . :   CLP

 Program creation information:
   Program creation date/time . . . . . . . . . . . :   02/25/10  15:44:44
   Type of program  . . . . . . . . . . . . . . . . :   OPM
   Source file  . . . . . . . . . . . . . . . . . . :   QCLSRC
     Library  . . . . . . . . . . . . . . . . . . . :     UEHLING
   Source member  . . . . . . . . . . . . . . . . . :   ADOPTPGM
   Source file change date/time . . . . . . . . . . :   02/25/10  15:38:35
   Observable information . . . . . . . . . . . . . :   *ALL
   User profile . . . . . . . . . . . . . . . . . . :   *OWNER
   Use adopted authority  . . . . . . . . . . . . . :   *YES
   Log commands (CL program)  . . . . . . . . . . . :   *JOB
   Allow RTVCLSRC (CL program)  . . . . . . . . . . :   *YES
   Fix decimal data . . . . . . . . . . . . . . . . :   *NO
                                                                      More...
 Press Enter to continue.

 F3=Exit   F12=Cancel
 (C) COPYRIGHT IBM CORP. 1980, 2009.
MA      a                                                              01/001
I902 - Session successfully started
```

**Program adopts the owners authority**

**Program adopts authority**

**Another attribute to be discussed… next**

# “Use Adopted Authority” – program attribute

## *“Use Adopted Authority” program attribute*

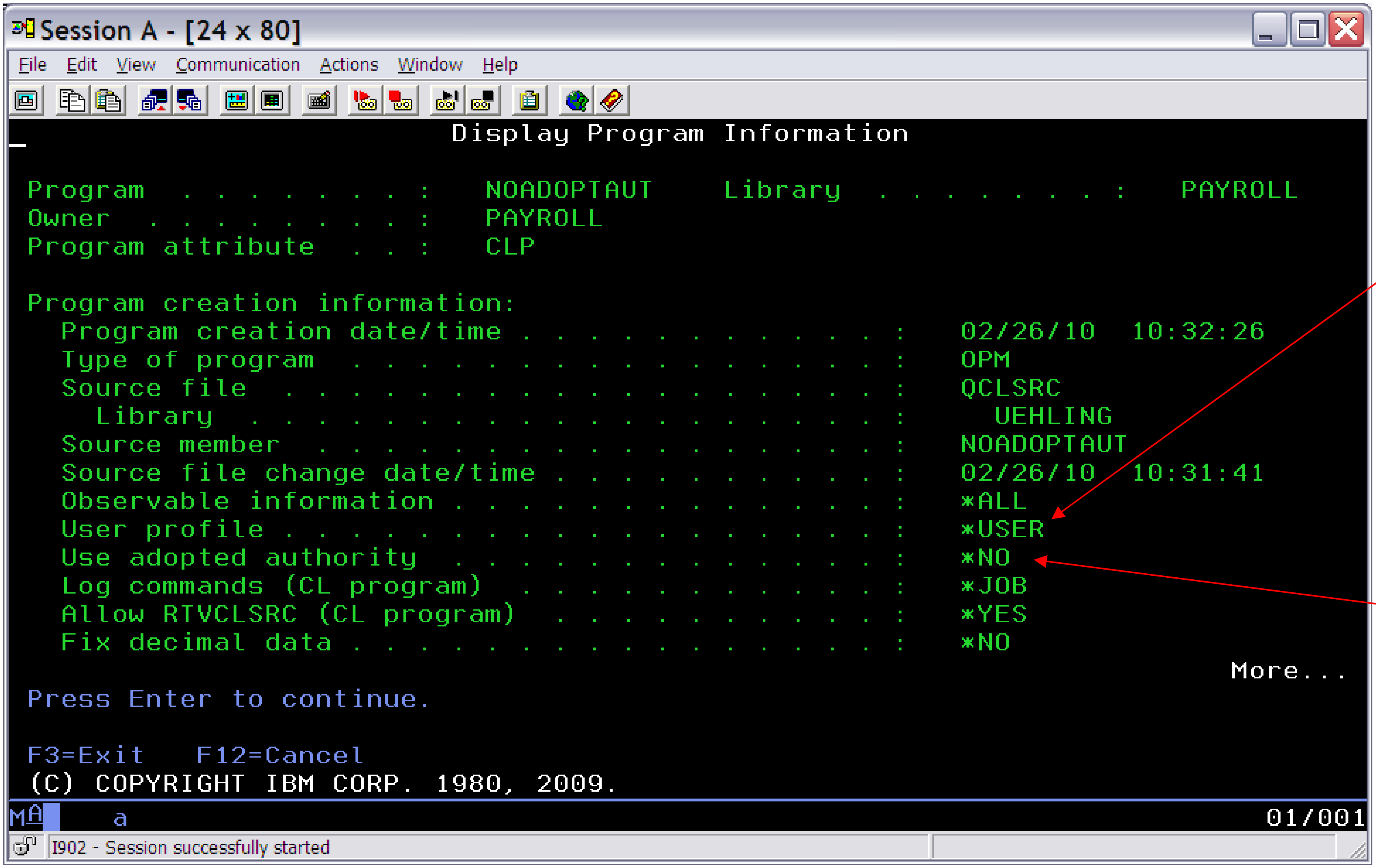
- A second program attribute, “Use Adopted Authority”, can be set on an application program
  - Set via the CHGPGM CL command, USEADPAUT parm
  - Attribute is **not** available on the CRTxxxPGM commands

- This attribute causes all previously adopted authority, available to the job from previously called programs, to be dropped/ignored when this program is called

- This attribute allows an application to present a command line, perform authority checks, etc., from the program with the Use Adopted Authority = *NO attribute, without previously adopted authority being considered

# Use Adopted Authority program attribute

- CRTCLPGM PGM(PAYROLL/NOADOPTAUT) TEXT(‘USEADPAUT example')
- CHGPGM PGM(PAYROLL/NOADOPTAUT) **USEADPAUT(*NO)**
- DSPPGM PGM(PAYROLL/NOADOPTAUT)



```
                          Display Program Information

 Program  . . . . . . . . :   NOADOPTAUT    Library . . . . . . . . :   PAYROLL
 Owner  . . . . . . . . . :   PAYROLL
 Program attribute  . . . :   CLP

 Program creation information:
   Program creation date/time . . . . . . . . . . . :   02/26/10  10:32:26
   Type of program  . . . . . . . . . . . . . . . . :   OPM
   Source file  . . . . . . . . . . . . . . . . . . :   QCLSRC
     Library  . . . . . . . . . . . . . . . . . . . :     UEHLING
   Source member  . . . . . . . . . . . . . . . . . :   NOADOPTAUT
   Source file change date/time . . . . . . . . . . :   02/26/10  10:31:41
   Observable information . . . . . . . . . . . . . :   *ALL
   User profile . . . . . . . . . . . . . . . . . . :   *USER
   Use adopted authority  . . . . . . . . . . . . . :   *NO
   Log commands (CL program)  . . . . . . . . . . . :   *JOB
   Allow RTVCLSRC (CL program)  . . . . . . . . . . :   *YES
   Fix decimal data . . . . . . . . . . . . . . . . :   *NO
                                                                        More...
 Press Enter to continue.

 F3=Exit   F12=Cancel
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```

**Program does not adopt authority**

**Program does NOT use previously adopted user profile authority**

# “Use Adopted Authority” – continued…

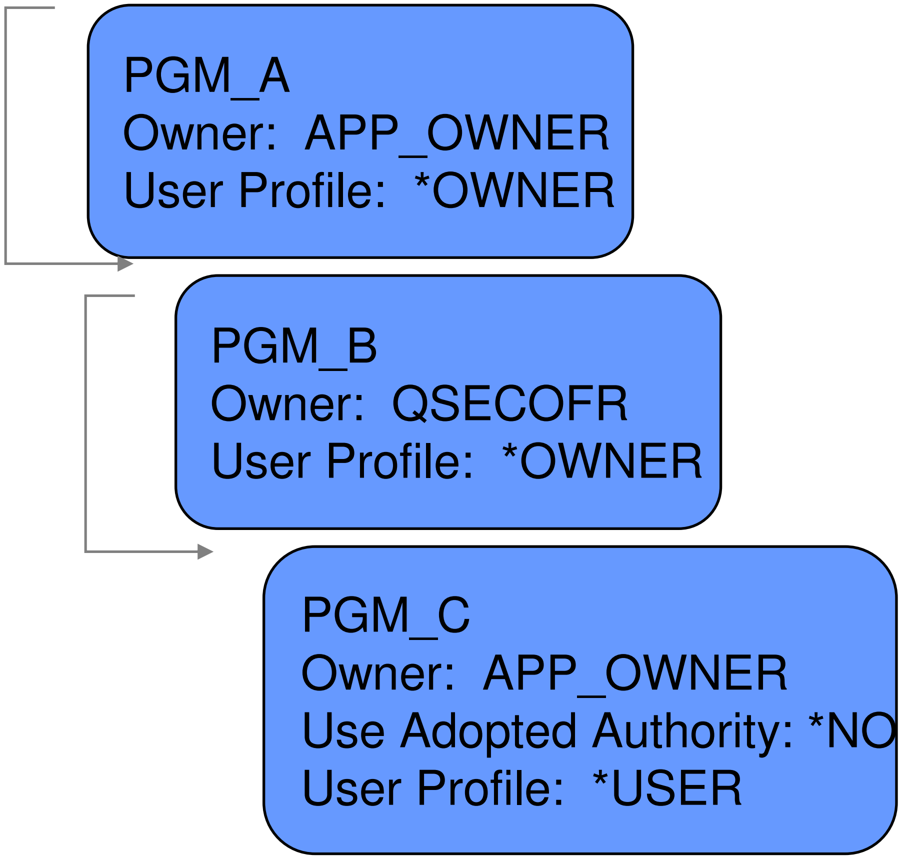
## *“Use Adopted Authority” program attribute*

- The “Use Adopted Authority = *NO” attribute blocks all adopted authority from previously called programs in the job

- The program with the “Use Adopted Authority = *NO” attribute can itself adopt authority
  - All previously adopted authority, from previously called programs, is “not used”
  - The Owner of this program (the owner of the program with the Use Adopted Authority = *NO) can be “adopted”. This provides the ability to drop all adopted authority and include only the adopted authority from the well known “program owner”.

# Adopted Authority Example

## Program Call Stack



PGM_A
Owner: APP_OWNER
User Profile: *OWNER

PGM_B
Owner: QSECOFR
User Profile: *OWNER

PGM_C
Owner: APP_OWNER
Use Adopted Authority: *NO
User Profile: *USER

**Signed on User - JEFF**

## Users Checked

JEFF then APP_OWNER

JEFF then APP_OWNER (from PGMA) then QSECOFR

~~PGMC = USEADPAUT(*NO)~~

Only JEFF because USEADPAUT(*NO) and USRPRF(*USER)

Scenario:
Need to modify a file
Requires *CHANGE authority
*PUBLIC authority of file is *EXCLUDE

# Adopted Authority Summary

- Secure the application objects with PUBLIC(*EXCLUDE)
  - Provides a secure environment for all application objects
- Use program adopted authority to gain access to the application objects at application run-time
- Use the “Use Adopted Authority = *NO” attribute if a command line, an authority check, etc. is necessary
- Use an Authorization List to provide “private authority” access to a set of data files that may need to be examined “outside” of the application, via Query, FTP, etc.
- Profile “Swap” is required for accessing secure IFS objects (next topic)

# Profile "Swapping"

# Profile Swapping for Object Access

## *Profile Swapping implementation*

- The implementation is to “Secure” all application objects so the application is in control of all read and update operations
  - Set PUBLIC authority to *EXCLUDE for all application objects
  - The system administrator can grant authority to the “entry point” of the application to provide access to authorized users
- Within the application, use profile swapping to gain access to objects in the IFS file system while the application is running
  - Profile swap can be used to gain access to objects in the QSYS file system as well as IFS

# Proflie Swapping for Object Access

## *Profile Swapping Considerations*

- If all objects are PUBLIC(*EXCLUDE), an end user has NO access to any of the objects without running the application
  - This means, to run a QUERY, FTP or other interface, outside of the application, authority will be required. Private authority would need to be granted to certain objects for the list of users who need access outside the application

- Certain “network” interfaces, specifically in the DB2 area, will not work without “extra” security considerations. Interfaces like DRDA, Web Query, ODBC, JDBC, etc. cannot easily use adopted authority so private authority would be required (unless you design a procedure to call via the network interface)

# Profile Swapping

- Used to change the job user profile running the application
  - NOTE: Profile Swap changes the jobs User Profile.  All audit records sent by the system will reflect the “swapped user profile”… but the job name in the audit record doesn’t change.
- When the profile swapping interface is used to gain object access, the process user profile of the job is changed from the currently running user to the swapped user
  - Job running as user **“JEFF”** is swapped, by the swap API called by the application, to run as user **“PAYROLL”**
- All authority checks are based on the “Swapped Profile” (A profile swap will change both the process profile and group profile list) The swapped profile is in effect until another “Swap Profile” is run or the job ends

# Profile Swapping considerations

## *Profile Swapping considerations*

- Application designer must be careful to not include swapped profile in any authority checks the application specifically makes (e.g. CHKOBJ or authority checking APIs)

- Make sure command line (or exit program) **not available** to end user when adopting authority or swapped to a powerful profile. Use the LMTCPB(*YES) user profile parm on the "swapped" user profile to limit command line access.
  - Adopted authority and swapped user profile authority given to the command line user
  - For profile swapping, you need to "swap back" to the previous (original) user if presenting a command line interface

# Profile Swapping

## *Profile swap*

Use of the QSYGETPH (profile handle create), QWTSETP (profile swap) and QSYRLSPH (release profile handle) APIs allow the user profile of a job to be swapped.

- Log in as user "JEFF"
- Swap to user “PAYROLL"

Swap APIs

1. QSYGETPH – Get Profile Handle
2. QWTSETP – Swap profile in the job using profile handle
3. QSYRLSPH – Release profile handle

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# Profile Swap example code

## *Profile Swap instructions*

1. The source code in the following slide can be used to Test User Profile Swap
2. Copy the source code, next slide, into a source physical file, perhaps member PAYADP in file QCLSRC, and update the source with a test user name
3. The CL program you create needs to adopt authority of a powerful user, such as QSECOFR.  The profile swap APIs (QSYGETPH) require a significant amount of authority to run.  The adopt will provide authority required to swap when this program is run by a low power user
4. Create the program with PUBLIC(*EXCLUDE) authority.  This program is only an example program.  When using profile swap in an application, the program should **never return control** to the end user (command line) without swapping back to the original user first..
    1. Signon as user QSECOFR to create the program… or
    2. Signon as an *ALLOBJ user, create the program, and then change the owner to QSECOFR.  The program doesn't have to be owned by QSECOFR, any *ALLOBJ profile will work, but QSECOFR exists on every system so it is a good choice to use
5. CRTCLPGM PGM(PAYROLL/PAYADP) USRPRF(*OWNER) AUT(*EXCLUDE)

# Example CL program to Swap User Process user profile

```
/* Signon with an *ALLOBJ user, QSECOFR,  to create this program.  Create this program with USRPRF(*OWNER) to adopt      */
/* authority required to get a profile handle for a USRPRF.   NOTE: Control access to this program, PUBLIC(*EXCLUDE).    */
/* NOTE: For testing purposes, use command, DSPJOB OPTION(*STSA), before and after each QWTSETP invocation to see         */
/* the swap results (current user profile changes with the swap).                                                        */

PGM
 DCL &HNDLCUR *CHAR 12  VALUE(' ')   /* 12 character profile handle variable for the original user */
 DCL &HNDL *CHAR 12  VALUE(' ')      /* 12 character profile handle variable for the new user      */

/* Call QSYGETPH to get a profile handle for the current job user profile.  */
 CALL QSYS/QSYGETPH ('*CURRENT' '*NOPWDCHK' &HNDLCUR)
/* Call QSYGETPH to get a profile handle for the profile to swap to.  NOTE: Change XXX to the user who you want to swap to.    */
 CALL QSYS/QSYGETPH ('XXX' '*NOPWDCHK' &HNDL)

/* DSPJOB OPTION(*STSA)   -   for testing, display the job, current user profile  */
/* Call QWTSETP to swap to the new profile.   Job will run under user profile XXX after the swap                 */
 CALL QSYS/QWTSETP &HNDL
/* DSPJOB OPTION(*STSA)   -   for testing, display the job, current user profile  */

/* add application logic here */

/* CLEANUP processing */
/* Call QWTSETP to swap back to the original user profile.                    */
 CALL QSYS/QWTSETP &HNDLCUR
/* DSPJOB OPTION(*STSA)   -   for testing, display the job, current user profile  */

/* Call QSYRLSPH to release the two profile handles                   */
 CALL QSYS/QSYRLSPH &HNDLCUR
 CALL QSYS/QSYRLSPH &HNDL
ENDPGM
```

# Profile Swap Cleanup and release of profile handle

## *Profile swap (Cleanup)*

Use of the QSYGETPH and QWTSETP APIs allow the user profile of a job to be swapped.

  - Log in as user "JEFF"
  - Swap to user “PAYROLL"

- The job is now running under user “PAYROLL".  If the application fails, the job continues to run under “PAYROLL"

- A Scope Message provides the ability to cleanup or swap back to original user.
  - NOTE: Scope handling programs can be used to cleanup anything within the application, such as profile swapping, libraries in the library list, open files, etc.

- Code example follows...

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# Scope Message program

```
/* Signon with an *ALLOBJ user to create this program.  Create this program with USRPRF(*OWNER) in order to adopt           */
/* authority required to get a profile handle for a USRPRF.   NOTE: Control access to this program, PUBLIC(*EXCLUDE).        */

 PGM
 DCL &ERRCDE *CHAR 8 VALUE(X'0000000000000000')
 DCL &MSGKEY *CHAR 4 VALUE(X'00000000')
 DCL &HNDLCUR *CHAR 12  VALUE(' ')
 DCL &HNDL *CHAR 12  VALUE(' ')

 /* Call QSYGETPH to get a profile handle for the current user. */
 CALL QSYS/QSYGETPH ('*CURRENT' '*NOPWDCHK' &HNDLCUR)

 /* The following API will send a scope message that causes program SCOPEPGM in library QGPL to be called when  */
 /* this program ends either normally or abnormally.                                                             */

CALL QSYS/QMHSNDSM                                   +
 ('*CSE      '              /* Scope type             */ +
  'SCOPEPGM  QGPL      '    /* Scope program name     */ +
  &HNDLCUR                  /* Scope data             */ +
   X'0000000C'              /* Scope data length - 12 */ +
  &MSGKEY                   /* Message key            */ +
  &ERRCDE)                  /* Error code             */

/* Call QSYGETPH to get a profile handle for a user. NOTE: Change XXX to the user who you want to swap to    */
CALL QSYS/QSYGETPH ('XXX' '*NOPWDCHK' &HNDL)
/* Call QWTSETP to swap to the profile.                                                                       */
CALL QSYS/QWTSETP &HNDL


/* Normal application logic                                                                                   */

ENDPGM
```

# Scope Handling program

```
PGM (&DATA)       /* SCOPEPGM */

/***********************************************************************/
/* This program is called when the invocation that ran the       */
/* QMHSNDSM API returns either normally or abnormally.    */
/**********************************************************************/

DCL &DATA *CHAR 12   /* Data received as input when this scope               */
                     /* handling program is called. This data                */
                     /* is variable length and is declared and               */
                     /* set by the program that issues the                   */
                     /* QMHSNDSM API.                                        */
                     /* For this test program, pass the 12                   */
                     /* byte profile handle of the original                  */
                     /* user obtained via *CURRENT on QSYGETPH.      */


/* Program logic to cleanup. */

/* Call QWTSETP to swap back to the original profile. */
CALL QSYS/QWTSETP &DATA

/* Call QSYRSLPH to release the profile handle.          */
CALL QSYS/QSYRLSPH &DATA

ENDPGM
```

# Profile Swapping Summary

- Secure the application objects with PUBLIC(*EXCLUDE)
  - Provides a secure environment for all application objects
- Use profile swapping to gain access to the application objects at application run-time
- Make sure you swap back to the original user if presenting a command line or performing an authority check, etc.
- Use an Authorization List to provide “private authority” access to a set of data files that may need to be examined “outside” of the application, via Query, FTP, etc.
- Profile “Swap” is required for accessing secure IFS objects

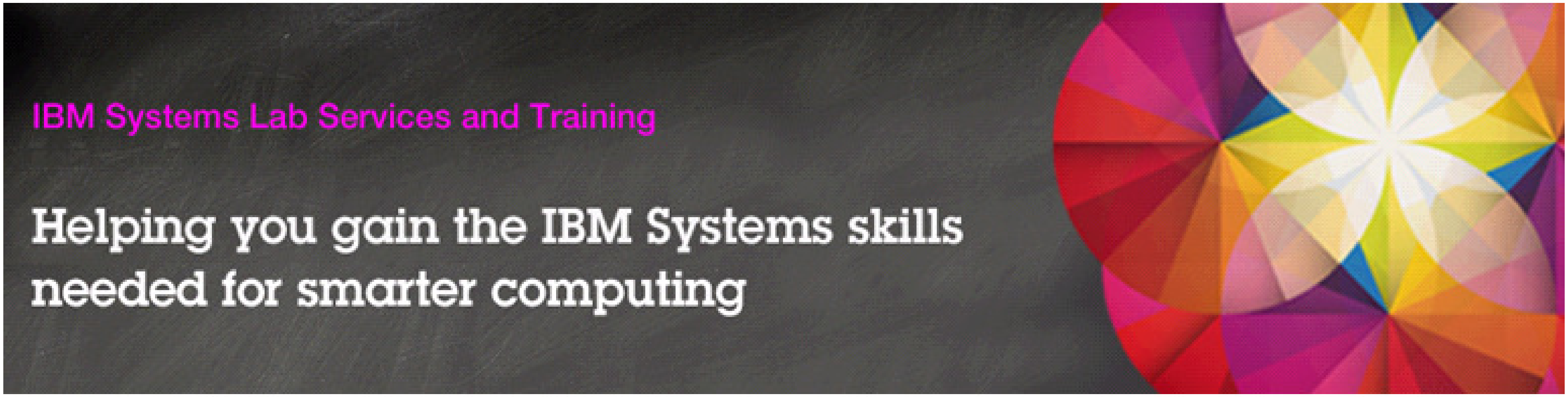
# Summary

- Secure objects with PUBLIC(*EXCLUDE) authority

- Use Adopted Authority and/or Profile Swapping to gain object access

- Private Authorities and Authorization Lists can be used to provide object authority outside of the application

- Always take care when presenting the user a command line when using either adopted user profile authority or profile swapping



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