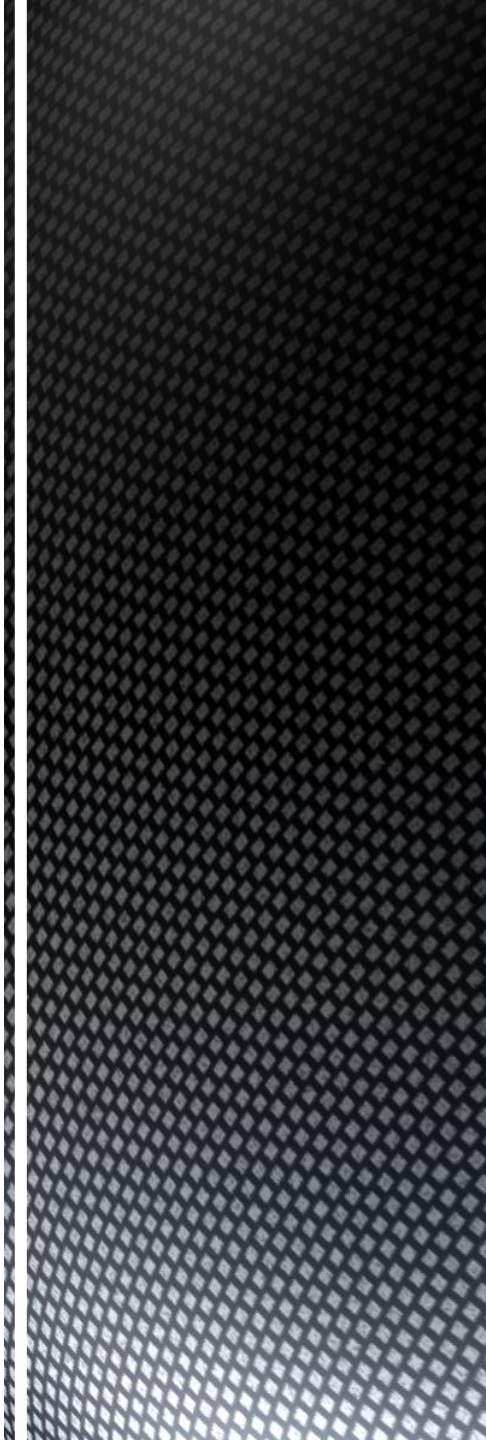
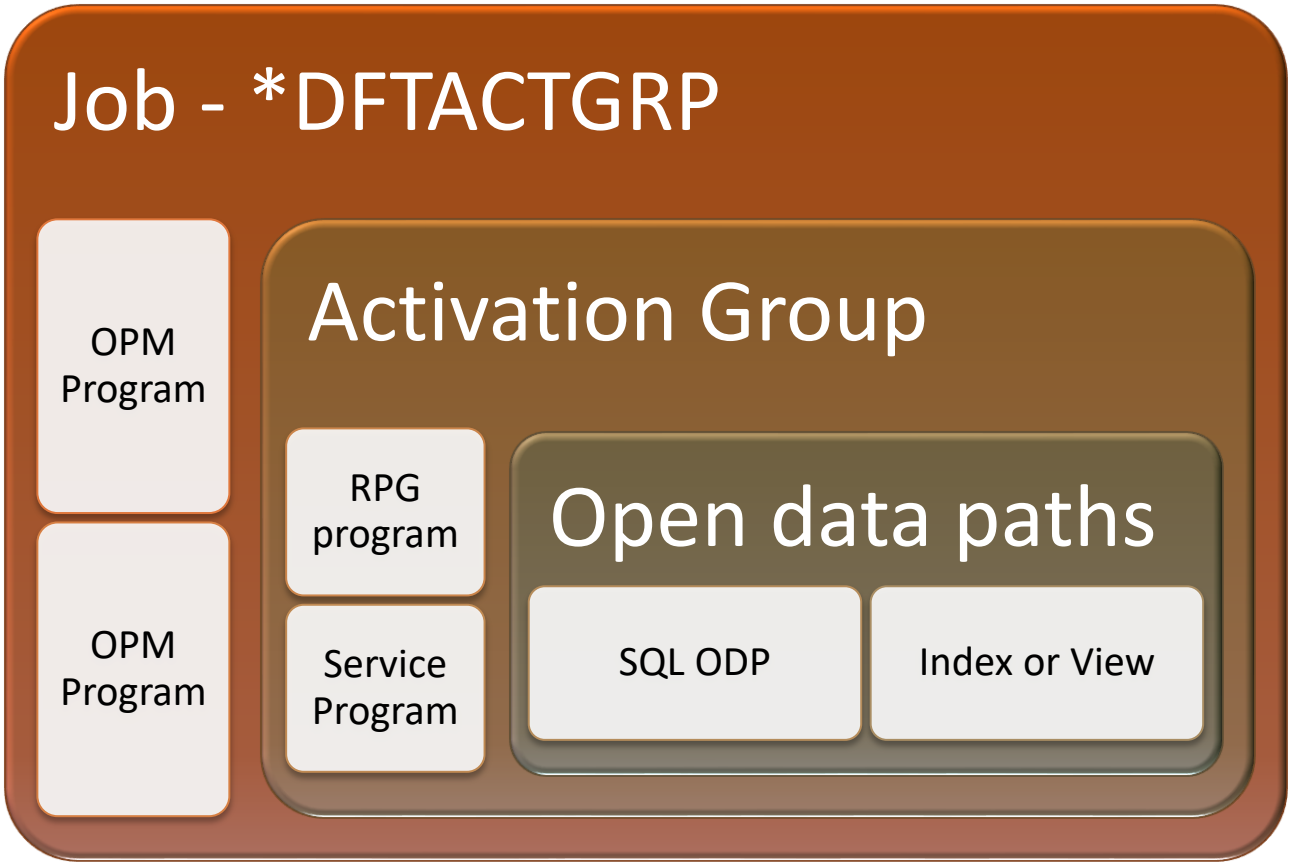
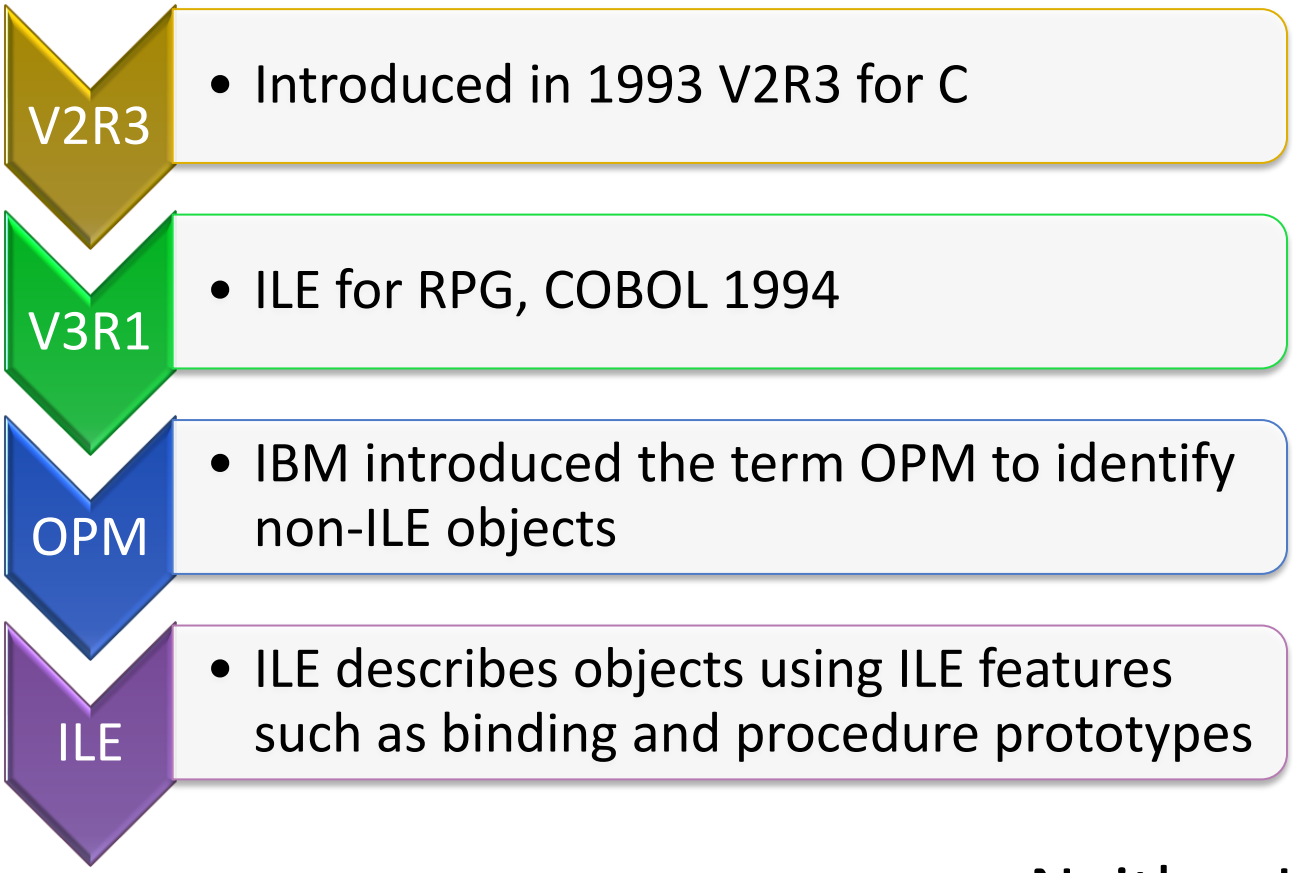
An ILE Building Block

Activation Groups



What is an Activation Group

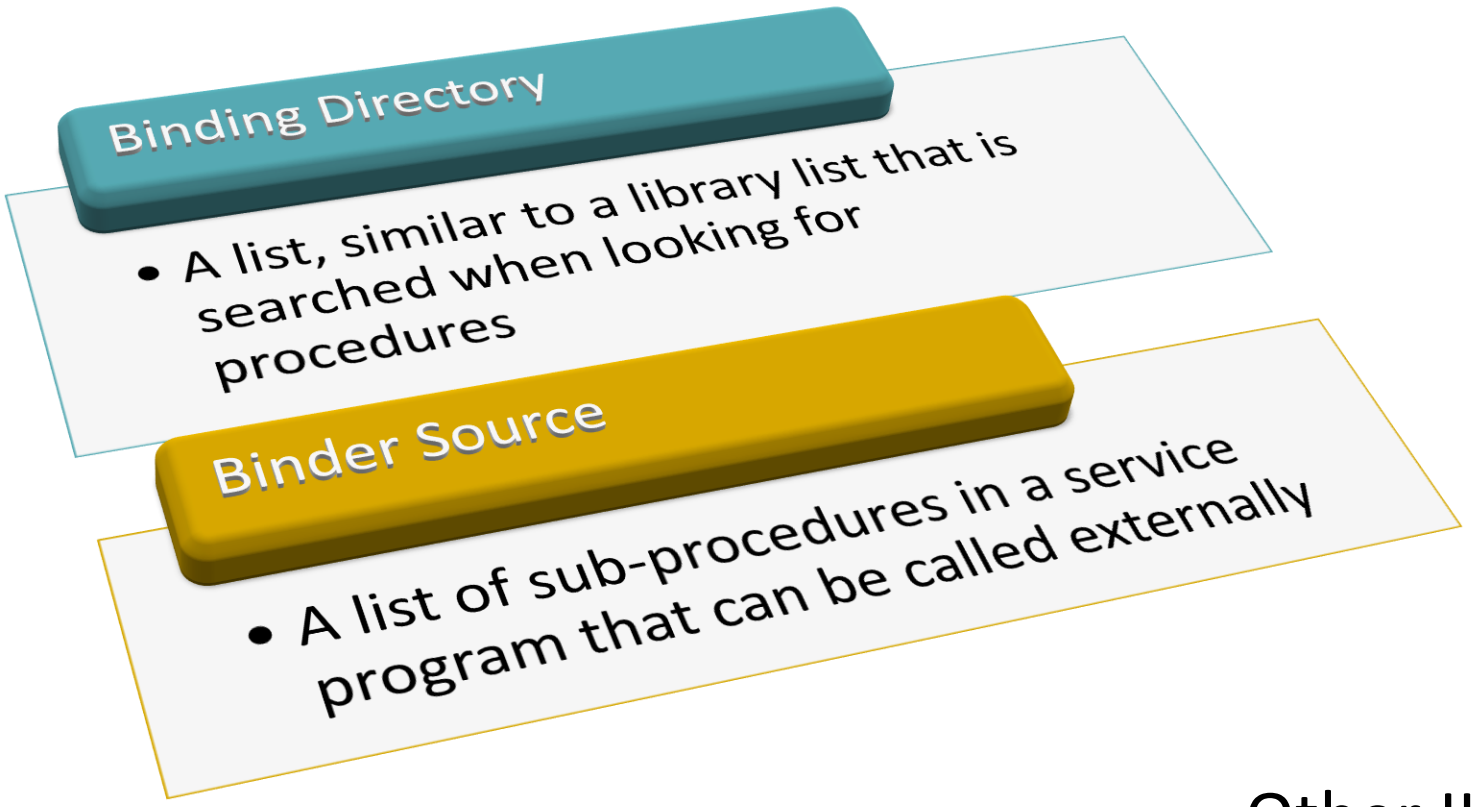




Neither ILE or Activation groups are new

ILE Concepts

- Activation group
  - A JOB process which allows programs to be grouped together to share common resources
- Sub-procedure
  - A program within a program
- Module
  - One or more procedures created as a non-executable object
- Linear Main Program
  - Executable code with a single entry point for a CALL, but without cycle logic
- Service program
  - A Program with multiple entry points
  - A collection of re-useable modules that may be bound to ILE programs



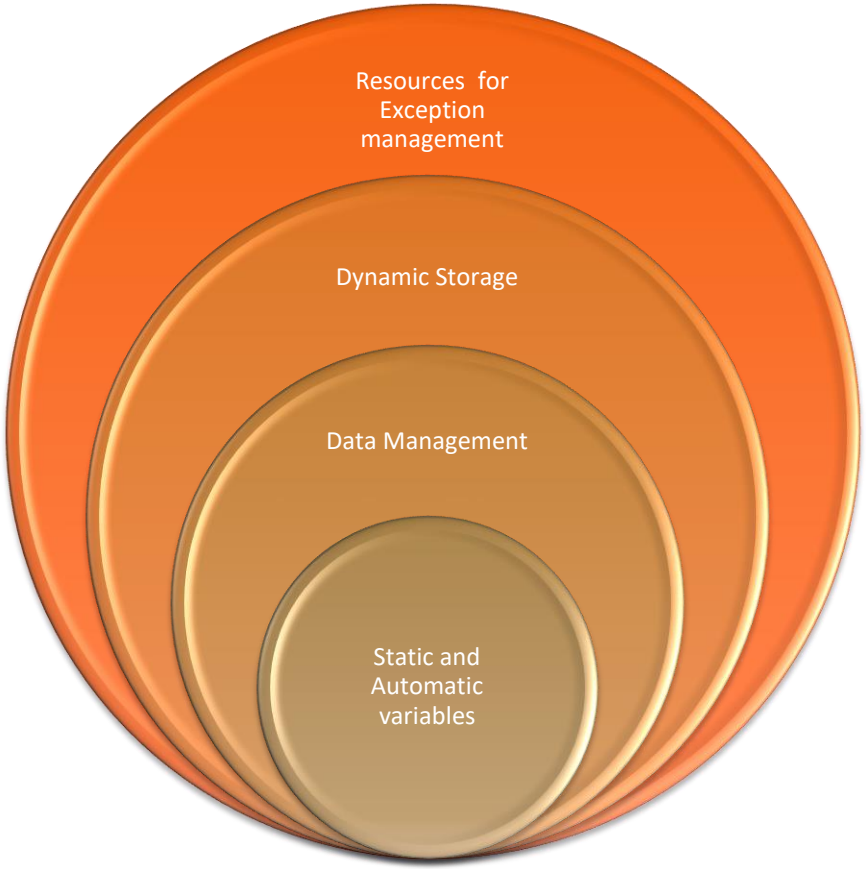
Other ILE Elements

Take Out the Trash

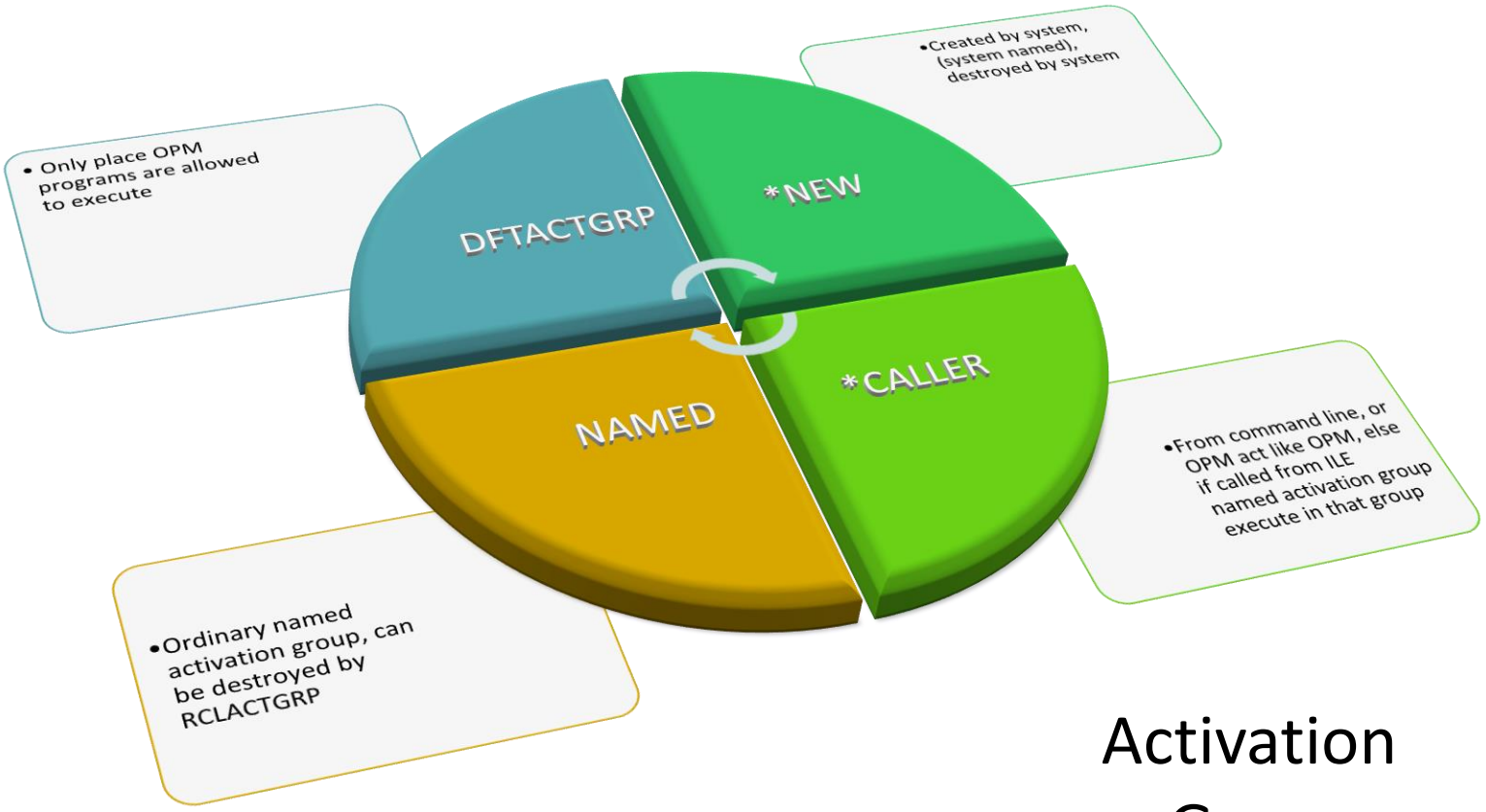
- Activation groups are like a garbage bag
  - Load a program, or group of programs into an activation group
  - When the process finishes throw away everything in the activation group
- When the activation group is destroyed
  - All resources allocated to the activation group are returned to the system

What's in the Bag?

- Memory for static and automatic variables
  - Static variables retain their values from call to call, while automatic variables lose value and memory locations
- Memory for dynamic storage
  - Introduced with ILE for RPG (always available to C)
- Temporary data management resources
  - ODP, commitment control, local SQL cursors
- Resources for exit points and exception handlers



Activation Groups, Variations on a Theme

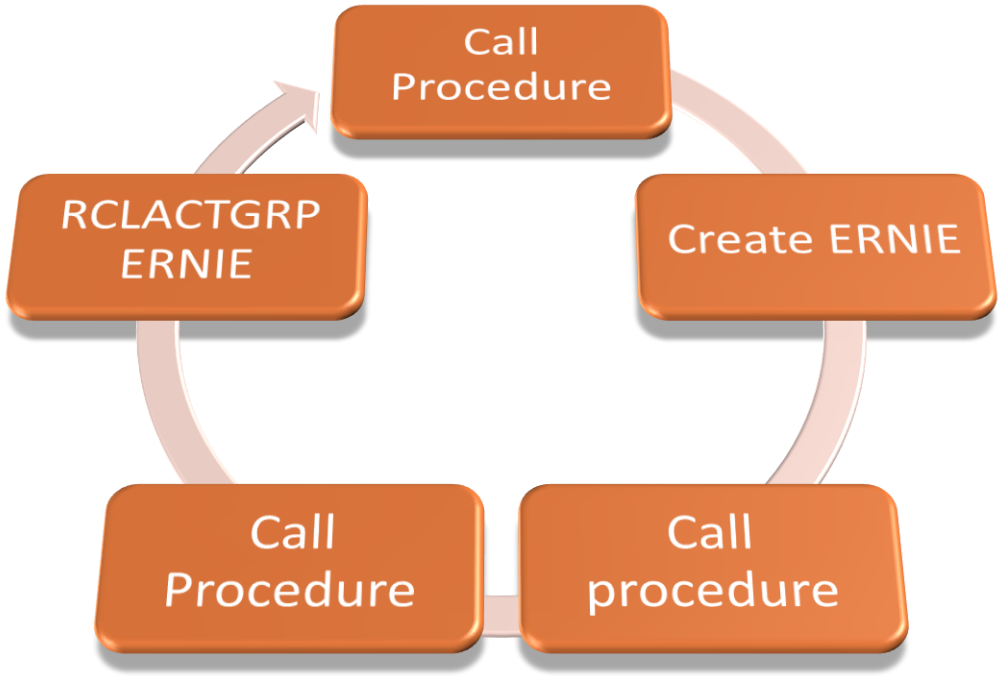


- DFTACTGRP(*YES) - Act like OPM, not allowed to use ILE functions
- DFTACTGRP(*NO) - Remain resident, LR still closes files and initializes variable

Default Activation Group

- Every job has a default activation group
  - Automatically started when job starts
  - Automatically destroyed when job ends
- It is the only activation group that can run non-ILE programs
- Reclaim Resources (RCLRSC) may be used to recover resources
  - Cannot destroy activation group
- Reclaim Activation Group (RCLACTGRP) has no effect on the default activation group

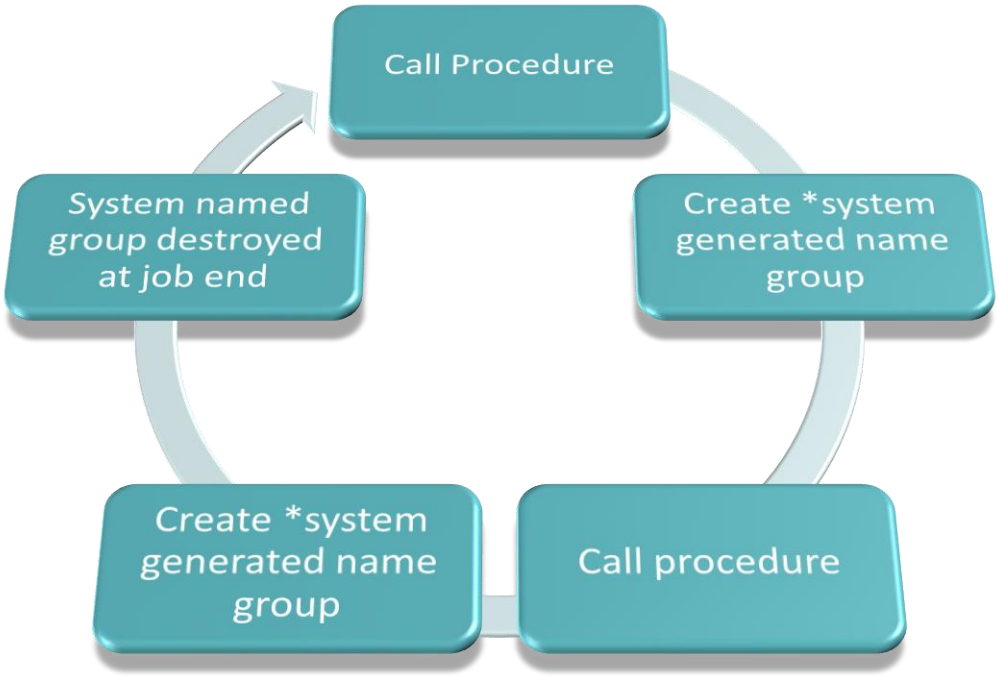
Named Activation Group



ILE Named Activation Group

- Created automatically when a program is called
  - Named activation groups will not be created if they already exist for the job
  - May be recovered (destroyed) by using the RCLACTGRP command or CEETREC system API
    - Are not affected by RCLRSC
  - Automatically destroyed at job end
  - Multiple named activation groups can be started by a single job

*NEW Activation Group



ILE *New Activation Group

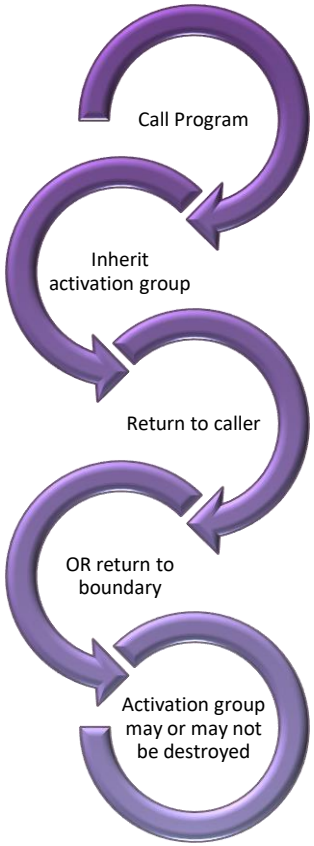
- Created automatically when a program is called as a named activation group
  - System generated name
  - Not affected by RCLRSC
  - Overhead of creating activation group each call
- Named activation groups will be created for each module specifying *NEW
- May be recovered (destroyed) by using CEETREC system API
- Automatically destroyed at job end
- Not recommended by IBM

*CALLER

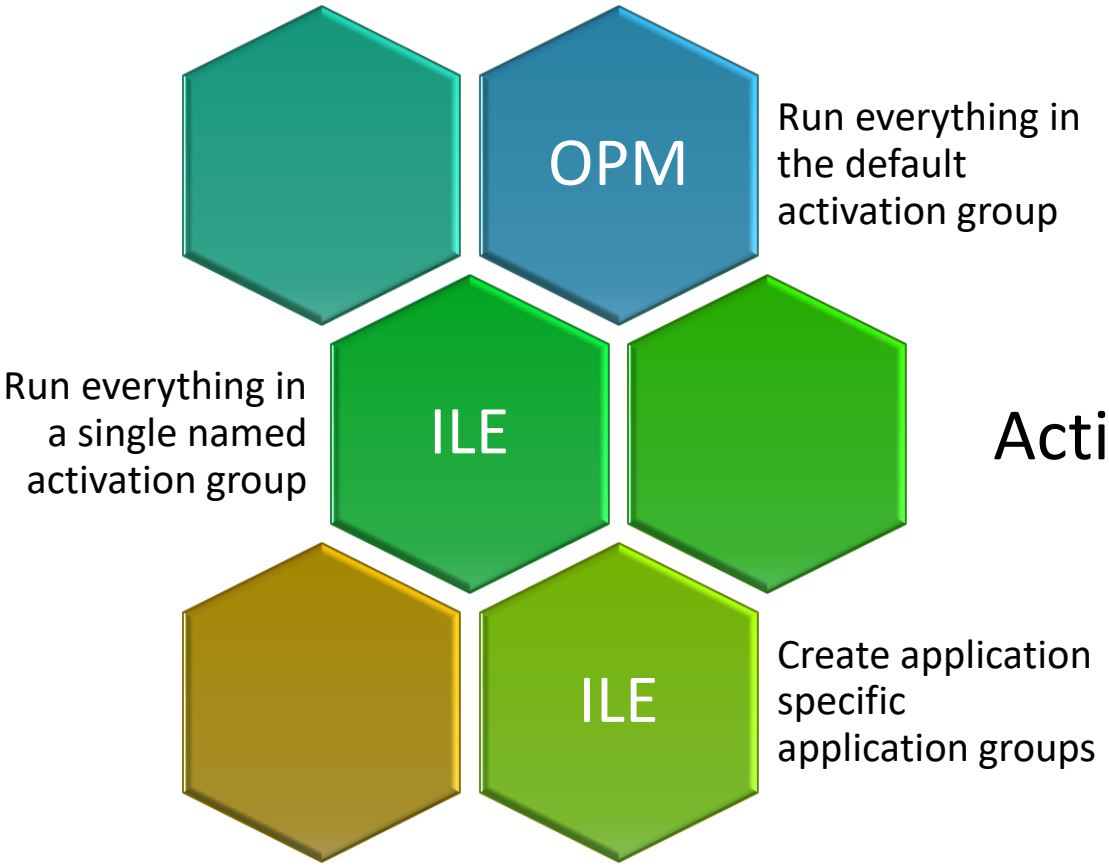
- Inherits activation group from calling program
  - Makes no attempt to create activation group
  - Not recommended for ILE programs
  - Recommended for service programs
- May return to caller, or activation group boundary unless
  - Call originated in the default activation group. In which case
    - RCLACTGRP has no effect
    - Resources can not be reclaimed
    - Job must end in order to release resources

* More on this later

*CALLER Activation Group



Activation Group Strategy

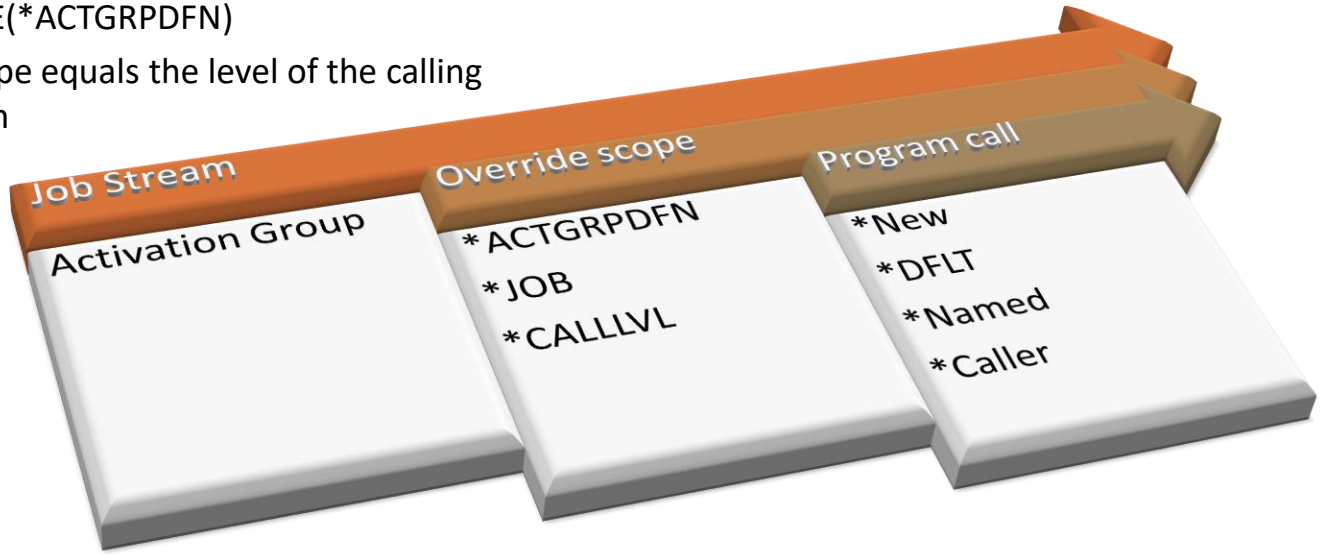


Activation Group Scope

- Activation group scoping within a job
  - OPNDBF FILE(ANYFILE) OPNSCOPE(*ACTGRP)
  - OPNQRYF FILE((ANYFILE)) OPNSCOPE(*JOB)
  - OVRDBF FILE(DATAFILE) SHARE(*YES) OVRSCOPE(*ACTGRPDFN)
  - From the default activation group behave like *CALLLVL
    - From an ILE activation group affect only the named activation group
- Activation groups are a job function
  - An override scoped to an activation group will not have an impact on other jobs on the system even if they share the same named activation group

IBM Default

- OVRDBF FILE(ANYFILE) TOFILE(OTHERFILE) OVRSCOPE(*ACTGRPDFN)
  - The scope equals the level of the calling program

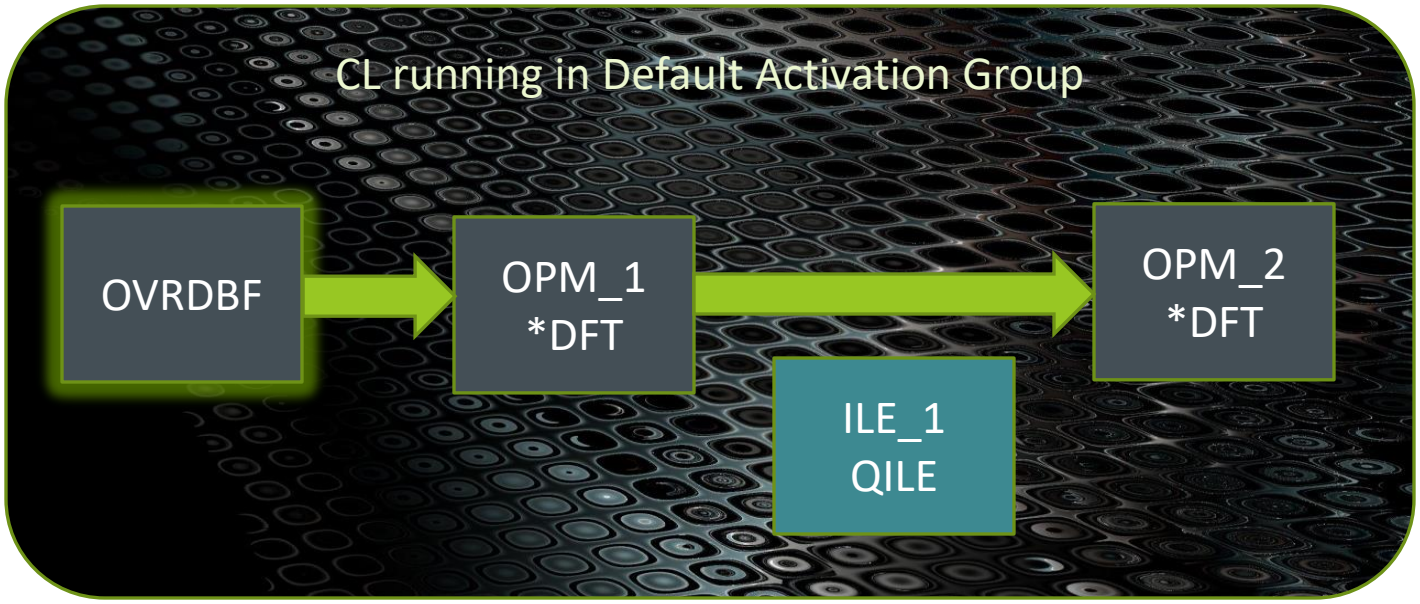


Apply to Job Stream

- OVRDBF FILE(ANYFILE) TOFILE(OTHERFILE) OVRSCOPE(*JOB)
  - The scope of the override is extended to the job in which the override occurs

Activation Group Scope Management

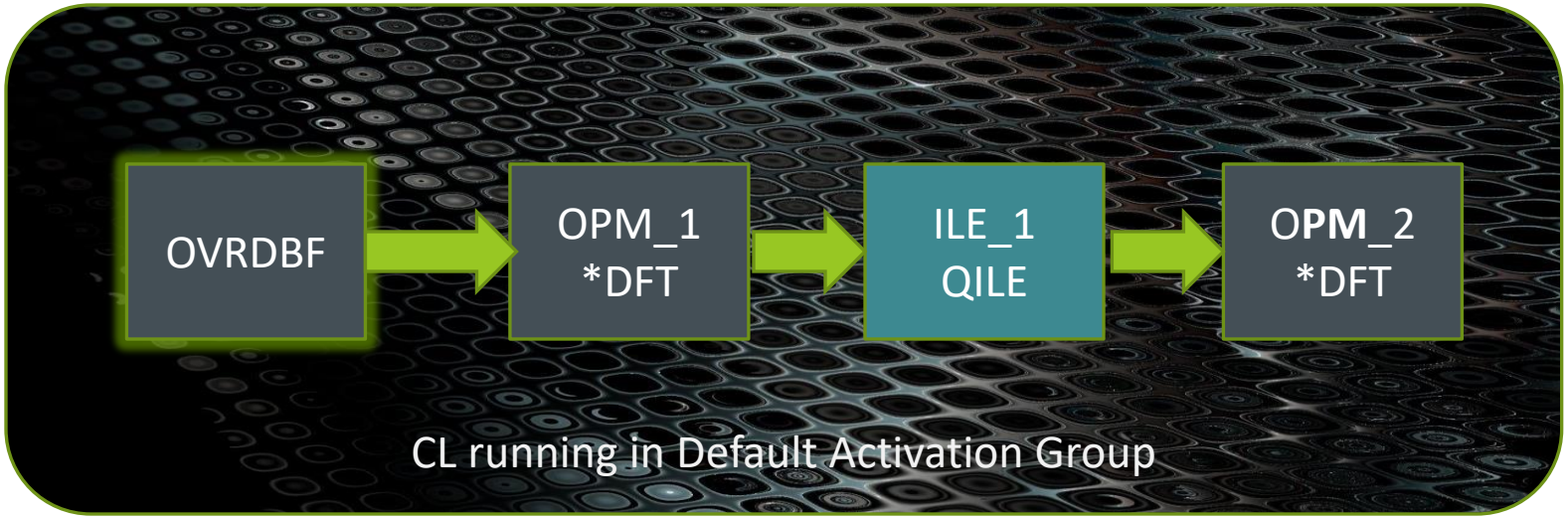
Override Scope



OVRDBF FILE(ANYFILE) SHARE(*YES) OVRSCOPE(*ACTGRPDFN)
OPNQRYF FILE((ANYFILE)) QRYSLT(&QRYSLT) KEYFLD((*NONE))

- ILE_1 uses named activation group QILE
- Override in effect for OPM_1 and OPM_2
- Override is not in effect for ILE_1

Override Scope



OVRDBF FILE(ANYFILE) SHARE(*YES) OVRSCOPE(*JOB)
OPNQRYF FILE((ANYFILE)) QRYSLT(&QRYSLT) KEYFLD((*NONE))

- ILE_1 uses named activation group QILE
- Override in effect for OPM_1 and OPM_2
- Override is in effect for ILE_1

Multiple Activation Groups Within a Job

- Job Activation groups
  - Share resources
  - Reduce overhead
- Multiple named activation groups can be defined for a job
  - RCLACTGRP may be used to free up resources as needed

- SHIPPING
  - Maintenance programs that might offer services to execute only once daily
- ORDINQ
  - Order inquiry functions used throughout the day
- Once SHIPPING processes are completed, RCLACTGRP SHIPPING will return its resources to the system, while ORDINQ resources are left resident

- Seven Deadly Sins of ILE
  - Executing ILE programs in DAG
  - Executing service programs in DAG
  - Using *NEW by default
  - Changing default to *CALLER
  - Failing to use RCLACTGRP
  - Allowing scoping parms to default
  - Using RCLRSC with ILE objects

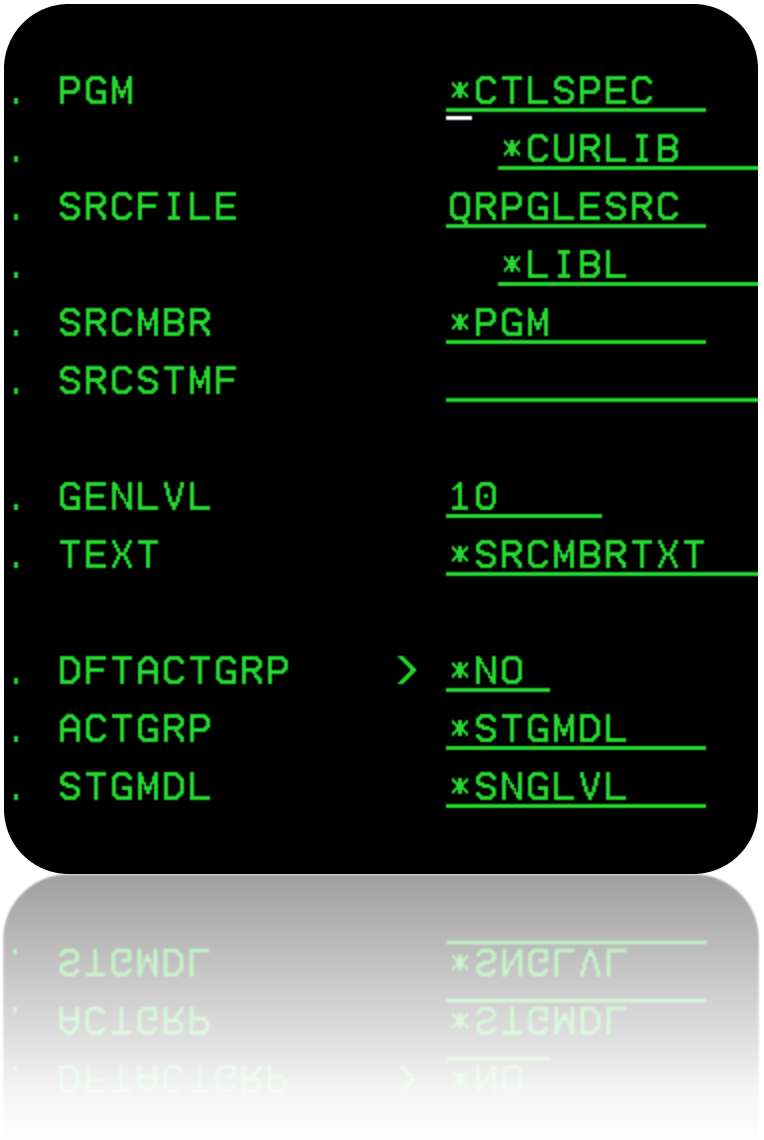
Pitfalls to Avoid (According to Jon Paris)

- Don’t let ILE or service programs execute in the DAG
  - ILE HLL end verbs will not complete in DAG
    - COBOL, STOP RUN.
    - C, exit()
  - Static address, memory allocations will not be returned to the system
  - Resources can’t be recovered until the job is ended

ILE Applications and DAG

- ILE RPG programs may execute in the DFTACTGRP
  - If *CALLER was used and called from an OPM
  - If *CALLER was used and the call originated in the DAG
    - From a command line, for example
  - DFTACTGRP *NO specified for the ILE program and *SNGLVL chosen for storage model
    - The DAG does not support *TERASPACE operations

- The IBM supplied activation group name varies depending on storage model
  - If *STGMDL was used and *SNGLVL was specified
    - Named ACTGRP = QILE
  - If *STGMDL was used and *TERASPACE is specified
    - ACTGRP = QILETS
  - If the STGMDL is set to *INHERIT
    - The ACTGRP must be *CALLER



Application Exit Strategy

- OPM Exit
  - Close files and return
  - Return without closing files
- ILE Exit
  - Close and return to Activation Group boundary
  - Return without close like OPM
- ILE Using CEE API's
  - Close application and allow system to recover resources

CEE Termination API's

- CEETREC - A normal end operation by high-level language exit statements.
- CEE4ABN – Abnormal termination ends the AG containing the nearest control boundary.
- CEE4RAGE – Register an AG exit procedure to execute when an activation group ends.
- CEERTX – Register a procedure to call for cleanup on exception

Program Exit Strategy

```
BEGSR @return;
   ErrorOccurred = CloseObjectCursor();
   *inlr = *on;
   return;
ENDSR;
```

A

```
P Quit             b
 /free
    ErrorOccurred = CloseObjectCursor();
    *inlr = *on                        ;
    exit(0)                            ;
 /end-free
P Quit             e
```

B

```
D Quit            pr
D Exit            pr                  extproc('exit')
D                                3u 0 value
```

Exit using CEETREC

```
Dcl-Pr CEETREC                  extproc('CEETREC');
   rc          Int(10) const options(*omit);
   user_rc     Int(10) const options(*omit);
End-Pr;
```

C

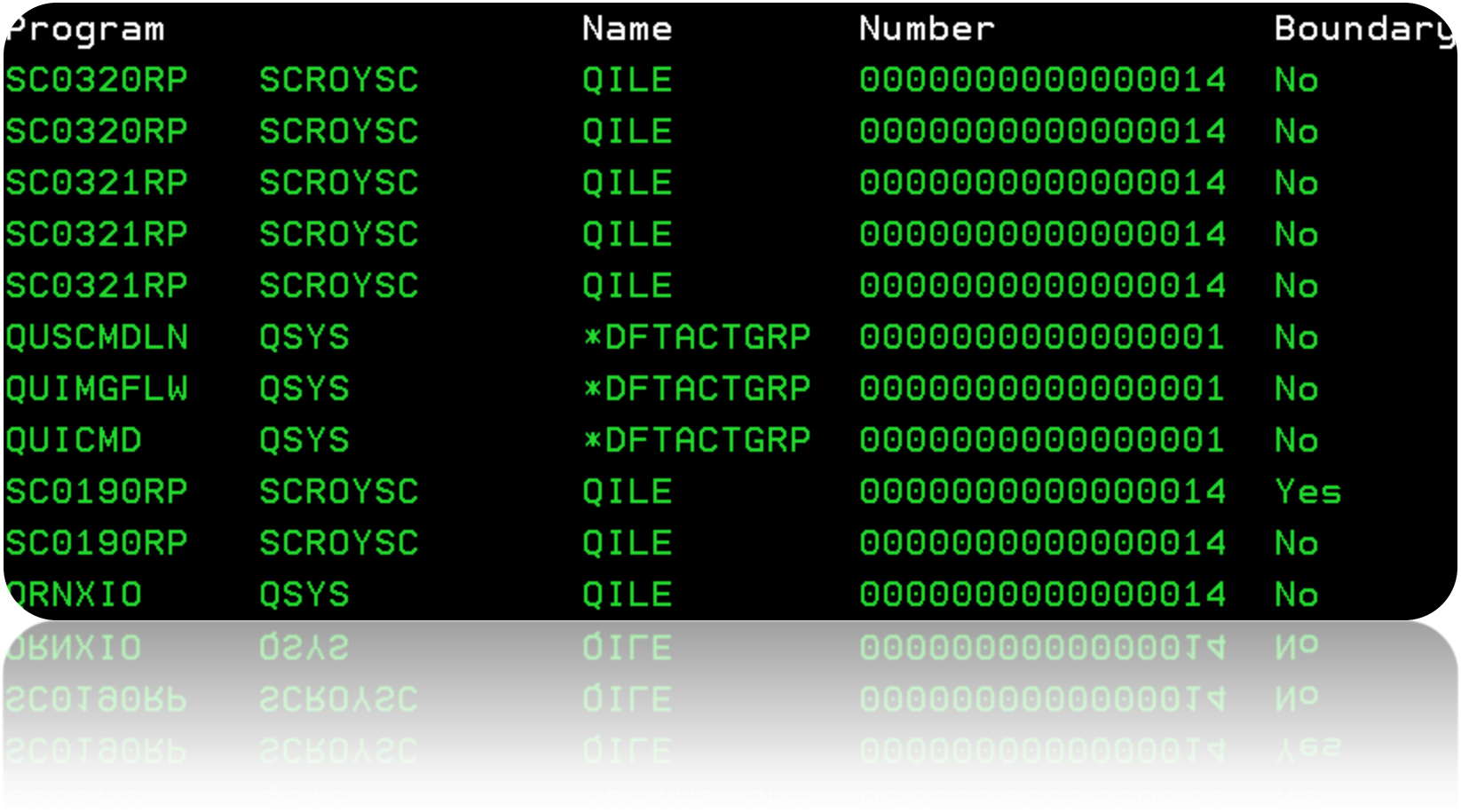
```
CEETREC(*omit: 0);
```

```
WHEN Function = 'EXIT'   ;
   QUIT()                ;
WHEN Function = 'CANCEL';
   EXSR returnToCaller   ;
```

```
Dcl-Proc Quit            ;
  Dcl-PI *n end-PI       ;
   CloseObjectCursor()   ;
   CEETREC(*omit: 0)     ;
   Return                ;
End-Proc Quit            ;
```

```
BEGSR returnToCaller;
   If %open(SC0320DF) ;
      CLOSE SC0320DF  ;
   ENDIF              ;
  CloseObjectCursor() ;
  *inlr = *on         ;
  return              ;
 ENDSR                ;
```

Application Exit Decisions



Program		Name	Number	Boundary
SC0320RP	SCROYSC	QILE	00000000000014	No
SC0320RP	SCROYSC	QILE	00000000000014	No
SC0321RP	SCROYSC	QILE	00000000000014	No
SC0321RP	SCROYSC	QILE	00000000000014	No
SC0321RP	SCROYSC	QILE	00000000000014	No
QUSCMDLN	QSYS	*DFTACTGRP	00000000000001	No
QUIMGFLW	QSYS	*DFTACTGRP	00000000000001	No
QUICMD	QSYS	*DFTACTGRP	00000000000001	No
SC0190RP	SCROYSC	QILE	00000000000014	Yes
SC0190RP	SCROYSC	QILE	00000000000014	No
QRNXIO	QSYS	QILE	00000000000014	No

Activation Group Control Boundary

ODP's remain in QILE

A

```
BEGSR returnToCaller;
   If %open(SC0320DF)                    ;
      CLOSE SC0320DF                     ;
```

Session A - [24 x 80]

File Edit View Communication Actions Window Help

Display Open Files

Job . . : WD_3022A1 User . . : SCROY Number . . . : 433819
Number of open data paths . . . . . : 9

File	Library	Member/ Device	Scope	Activation	Group
QDUODSPF	QPDA	WD_3022A1	*ACTGRPDFN	*DFTACTGRP	0000000000000002
QDDSPEXT	QSYS	WD_3022A1	*ACTGRPDFN	*DFTACTGRP	0000000000000002
QDUI132	QSYS	WD_3022A1	*ACTGRPDFN	*DFTACTGRP	0000000000000002
SCGATEPF	SCROYSC	SCGATEPF	*ACTGRPDFN	QILE	0000000000000014
SCFUNCPF	SCROYSC	SCFUNCPF	*ACTGRPDFN	QILE	0000000000000014
SCOPTNPF	SCROYSC	SCOPTNPF	*ACTGRPDFN	QILE	0000000000000014
SCOBJSPF	SCROYSC	SCOBJSPF	*ACTGRPDFN	QILE	0000000000000014
SCFUNCPF	SCROYSC	SCFUNCPF	*ACTGRPDFN	QILE	0000000000000014
QDDSPOF	QSYS	WD_3022A1	*ACTGRPDFN	*DFTACTGRP	0000000000000002

Bottom

Press Enter to continue.

F3=Exit F5=Refresh F11=Display I/O details F12=Cancel F16=Job menu

MA a 01/001

I902 - Session successfully started

C ODP's deleted from QILE

```
Dcl-Proc Quit ;
```

Session A - [24 x 80]

File Edit View Communication Actions Window Help

```
                          Display Open Files

Job . . :   WD_3022A1      User . . :   SCROY          Number . . . :   433819
Number of open data paths . . . . . . . . . . :      4


                          Member/
File        Library       Device       Scope        Activation Group
QDUODSPF    QPDA          WD_3022A1    *ACTGRPDFN   *DFTACTGRP 0000000000000002
QDDSPEXT    QSYS          WD_3022A1    *ACTGRPDFN   *DFTACTGRP 0000000000000002
QDUI132     QSYS          WD_3022A1    *ACTGRPDFN   *DFTACTGRP 0000000000000002
QDDSPOF     QSYS          WD_3022A1    *ACTGRPDFN   *DFTACTGRP 0000000000000002

                                                                        Bottom
Press Enter to continue.

F3=Exit    F5=Refresh    F11=Display I/O details    F12=Cancel    F16=Job menu
MA        a                                                          03/002
```

I902 - Session successfully started

- DSPJOB
  - Note that LR was set on in both programs, yet there are still ODP's in the job

File	Library	Device	Scope	Activation
QDUODSPF	QPDA	WD_3022A1	*ACTGRPDFN	*DFTACTGRP
QDDSPEXT	QSYS	WD_3022A1	*ACTGRPDFN	*DFTACTGRP
QDUI132	QSYS	WD_3022A1	*ACTGRPDFN	*DFTACTGRP
FPMFINC	PGMLIB	FPMFINC	*ACTGRPDFN	*DFTACTGRP
FLMFINC6J	PGMLIB	FLMFINC6J	*ACTGRPDFN	*DFTACTGRP
QDDSPOF	QSYS	WD_3022A1	*ACTGRPDFN	*DFTACTGRP

```
H OPTION(*NODEBUGIO:*SRCSTMT) DFTACTGRP(*YES)
CALL      'TSTILE1'

EVAL *INLR = *ON
RETURN

TSTILE1
H Dftactgrp(*no) actgrp(*CALLER)

 SETLL 1 VRWSTMTS;
 READ VRWSTMTS;

 Exec SQL
    Select floan into :loanNumber
    From FPMFINC
    Where floan = :shloan;

 *inlr = *on;
 Return;
```

DFTACTGRP(*YES) - ILE *CALLER

- DSPJOB
  - More ODP's in the job

File	Member/ Library	Device	Scope	Activation
QDUODSPF	QPDA	WD_3022A1	*ACTGRPDFN	*DFTACTGRP
QDDSPEXT	QSYS	WD_3022A1	*ACTGRPDFN	*DFTACTGRP
QDUI132	QSYS	WD_3022A1	*ACTGRPDFN	*DFTACTGRP
FPMFINC	PGMLIB	FPMFINC	*ACTGRPDFN	*DFTACTGRP
FLMFINC6J	PGMLIB	FLMFINC6J	*ACTGRPDFN	*DFTACTGRP
FPMFINC	PGMLIB	FPMFINC	*ACTGRPDFN	QILE
FLMFINC6J	PGMLIB	FLMFINC6J	*ACTGRPDFN	QILE
QDDSPOF	QSYS	WD_3022A1	*ACTGRPDFN	*DFTACTGRP

```
H OPTION(*NODEBUGIO:*SRCSTMT) DFTACTGRP(*YES)
CALL      'TSTILE2'

SETON                                          LR
RETURN

TESTILE2

H Dftactgrp(*no) actgrp('QILE')

 SETLL 1 VRWSTMTS;
 READ VRWSTMTS;

 Exec SQL
    Select floan into :loanNumber
    From FPMFINC
    Where floan = :shloan;

 *inlr = *on;
 Return;
```

DFTACTGRP(*YES)
- ILE 'QILE'

RCLACTGRP Command

- Activation Group Name (QILE)
  - QILE resources will be reclaimed if there are no active calls.
  - This is an advantage to using named activation groups

```
Selection or command
===> RCLACTGRP ACTGRP(QILE)
```

```
                    Reclaim Activation Group (RCLACTGRP)

Type choices, press Enter.

Activation group . . . . . .          _____          Name
Close option . . . . . . . . .        *NORMAL        *NORMAL, *ABNORMAL
```

- *ELIGIBLE
  - All eligible activation groups within the scope of the job will be reclaimed.
  - Don't do this in production
    - Not thread safe

- DSPJOB
  - QILE ODP's no longer show in the job

File	Library	Device	Scope	Activation
QDUODSPF	QPDA	WD_3022A1	*ACTGRPDFN	*DFTACTGRP
QDDSPEXT	QSYS	WD_3022A1	*ACTGRPDFN	*DFTACTGRP
QDUI132	QSYS	WD_3022A1	*ACTGRPDFN	*DFTACTGRP
FPMFINC	PGMLIB	FPMFINC	*ACTGRPDFN	*DFTACTGRP
FLMFINC6J	PGMLIB	FLMFINC6J	*ACTGRPDFN	*DFTACTGRP
QDDSPOF	QSYS	WD_3022A1	*ACTGRPDFN	*DFTACTGRP

- QILE activation group entries have been removed
- However the only way to recover ODP's in *DFTACTGRP is to Sign Off!

```
H OPTION(*NODEBUGIO:*SRCSTMT) DFTACTGRP(*YES)
CALL      'TSTILE3'

EVAL       *INLR = *ON
RETURN
```

```
TSTILE3

H Dftactgrp(*no) actgrp('QILE') bnddir('QC2LE')

D Quit            pr         extproc('exit')
D                       3u 0 value
```

```
 SETLL 1 VRWSTMTS;
 READ VRWSTMTS;

 Exec SQL
    Select floan into :loanNumber
    From FPMFINC
    Where floan = :shloan;
```

```
*inlr = *on;
Quit(0);
Return;
```

DFTACTGRP(*YES) - C Exit()

```
File        Library     Device       Scope         Activation
QDUODSPF    QPDA        WD_3022A1    *ACTGRPDFN    *DFTACTGRP
QDUI132     QSYS        WD_3022A1    *ACTGRPDFN    *DFTACTGRP
QDDSPOF     QSYS        WD_3022A1    *ACTGRPDFN    *DFTACTGRP
```

- CEETREC exits and no ODP's from the program appear in the open file list
- However, CEETREC will not recover an ODP if *CALLER is the activation group entry

```
File        Library     Device       Scope         Activation
QDUODSPF    QPDA        WD_3022A1    *ACTGRPDFN    *DFTACTGRP
QDUI132     QSYS        WD_3022A1    *ACTGRPDFN    *DFTACTGRP
FPMFINC     P3076801    FPMFINC      *ACTGRPDFN    *DFTACTGRP
QDDSPOF     QSYS        WD_3022A1    *ACTGRPDFN    *DFTACTGRP
```

```
H/TITLE *** TEST ILE CALL ***
C                   CALL 'TSTILE4'
 ****
C                   SETON                     LR
C                   RETRN
```

```
TSTILE4

H Dftactgrp(*no) actgrp('QILE')

 SETLL 1 VRWSTMTS;
 READ VRWSTMTS;

 Exec SQL
   Select floan into :loanNumber
   From FPMFINC
   Where floan = :shloan;

 *inlr = *on;
 CEETREC(*omit: 0);
 Return;
```

RPG – ILE CEETREC

```
**-- Register termination exit:
D CeeRtx          Pr                  ExtProc( 'CEERTX' )
D  procedure                    *     ProcPtr   Const
D  token                        *     Options( *Omit )
D  fb                           12a   Options( *Omit )
```

```
CeeRtx( %Paddr( CleanUp ): *Omit: *Omit );
```

Other than Normal RETURN

```
d cleanUp         pr
d  info                         *
```

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HOMEPAGE ABOUT CONTACT PREVIOUS

Steve Croy