Software Archeology: Using the Edge Portfolio Analyzer for LE Migrations

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Abstract

One of the more difficult tasks in any migration is understanding all the components that must be migrated, their relationships to each other and potential dependencies on system functions. Just as an archeologist would dig around looking for clues that might provide information about what happened in situations where there was no written record, you can look at your application load modules to find information about what is running in your system, even with little or no written records. In this session, the speaker will explain the interesting things you can find in your load modules using the Edge Portfolio Analyzer, how to use this information to make your migration to z/OS with LE easier and more accurate.

The presenters welcome your comments and questions. Please feel free to contact us via E-Mail or phone:

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Disclaimer: The information in this document represents information gathered by the presenters from various sources. We have done our best to provide accurate information. Any questions regarding the specific details on any product should be addressed to the vendor of that product. We have not independently verified each of the recommendations, and are not responsible for errors or omissions. Recommendations made are intended to be thought provoking and applicable to the general situation, and may not be appropriate for all users. It is your responsibility to evaluate the information and determine its applicability to your environment. If any errors are found, please let us know and we will make every effort to correct them in the future.

Software Archeology

- What have you heard about the information required to perform an LE migration?
- What is Software Archeology?
- Edge Portfolio Analyzer as an inventory tool and as a migration tool.
- Edge Portfolio Analyzer as an ongoing planning, analysis, configuration management and problem determination tool.

Compiler and LE Migration

What have you heard about information required for an LE Migration?

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Some LE Migration Issues

- Maintain runtime compatibility
  May require ReLink or ReCompile
  - Mixed library levels
  - COBOL: Mixed RES and NORES
  - PL/I Version 1 issues
  - Assembler that is not AMODE/RMODE ready
- Eliminate incompatible function(s)
  - "Assembler Helpers" that perform LINKs or other incompatible SVCs
  - Homegrown error handlers
  - InterLanguage Communication [ILC]
  - New behavior from runtime option changes

Four Migration Messages

- To know where you are going, you must know where you've been.
- You must know what you have to migrate.
- Plan, plan, plan, . . .
- Migration is an ongoing process.

Languages: How did we get here?

- COBOL
  - OS/VS COBOL [and older]
  - VS COBOL II
  - COBOL for MVS and VM
  - COBOL for OS/390 and VM
- PL/I
  - OS PL/I Version 1 [and older]
  - OS PL/I Version 2
  - PL/I for MVS and VM
  - VA PL/I for OS/390
- Other Languages
  - C/C++
  - FORTRAN [LE runtime support only]
  - Pascal [Not LE supported]

Language Products

- Original Compilers
  - Single product for each language
  - Each product had unique runtime
- Language Environment
  - Compiler-only products with a single common runtime
  - MVS packaging
    - Runtime was a separate product
  - OS/390 packaging
    - Integrated into OS/390
    - Used by OS/390 components

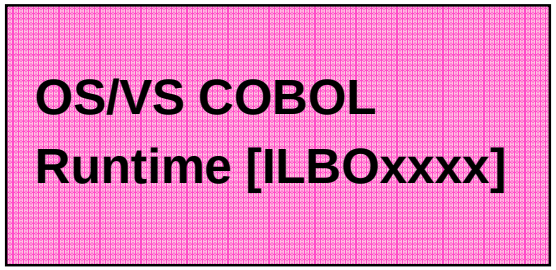
OS/VS COBOL Runtime

OS/VS COBOL

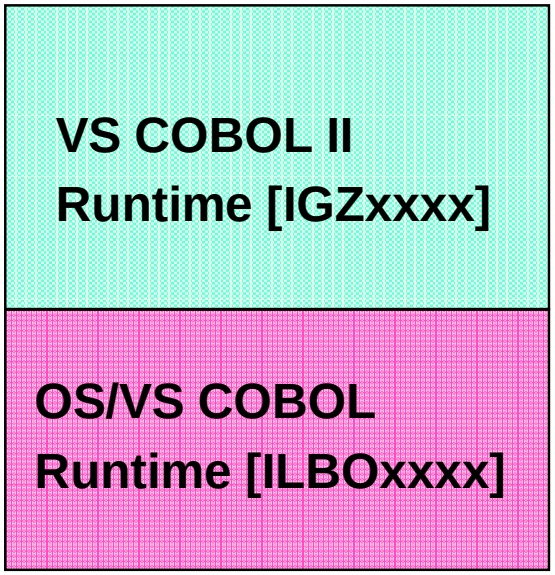
OS/VS COBOL Runtime [ILBOxxxx]

VS COBOL II Runtime

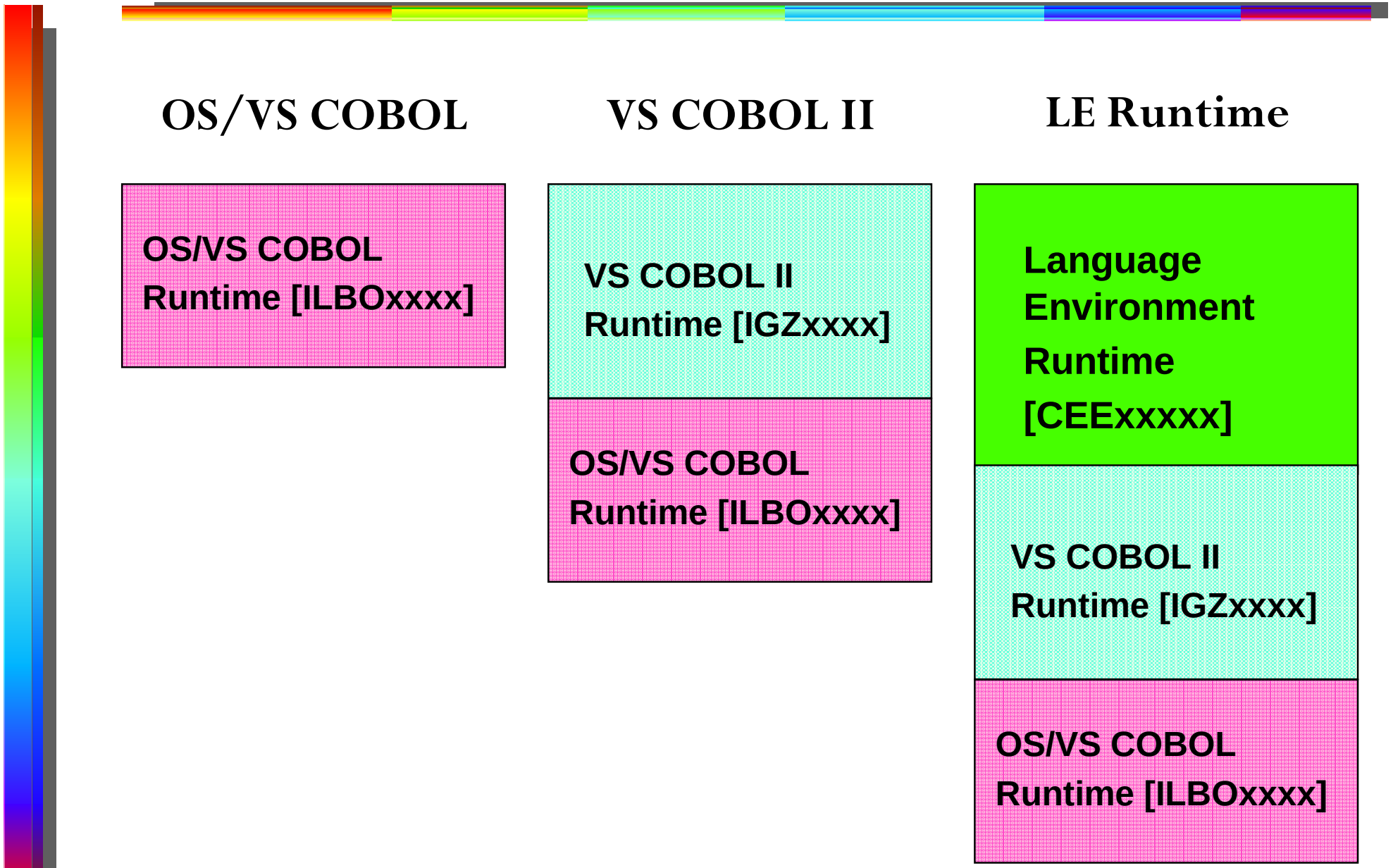
OS/VS COBOL



VS COBOL II



Language Environment Runtime



LE Migration

What do we have to migrate?

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COBOL Compiler Statistics

CSECTS WITH INTERNAL CONSISTENCY ERRORS	1
CSECTS CREATED BY COBOL	68
CSECTS CREATED BY VS COBOL II	33
CSECTS CREATED BY VS COBOL II RLSE 1.0	0
CSECTS CREATED BY VS COBOL II RLSE 1.1	0
CSECTS CREATED BY VS COBOL II RLSE 2.0	6
CSECTS CREATED BY VS COBOL II RLSE 3.0	13
CSECTS CREATED BY VS COBOL II RLSE 3.E	6
CSECTS CREATED BY VS COBOL II RLSE 3.1	0
CSECTS CREATED BY VS COBOL II RLSE 3.2	0
CSECTS CREATED BY VS COBOL II RLSE 4.0	8
CSECTS CREATED BY VS COBOL II RLSE UNK	0
CSECTS CREATED BY COBOL/370 RLSE 1.0	1
CSECTS CREATED BY COBOL/370 RLSE 1.1	1
CSECTS CREATED BY COBOL FOR MVS V1 R2.0	1
CSECTS CREATED BY COBOL FOR MVS V1 R2.1	0
CSECTS CREATED BY COBOL FOR 390 V2 R1.0	2
CSECTS CREATED BY COBOL FOR 390 V2 R1.1	0
CSECTS CREATED BY COBOL/370 RLSE UNK	0
CSECTS CREATED BY COBOL/370 // COB FOR MVS	5

COBOL Statistics [Part 2]

COBOL II BOOTSTRAPS (IGZEBST)	29
COBOL II RUNTIME TUNING (IGZETUN)	3
COBOL II RUNTIME OVERRIDES (IGZEOPT)	0
COBOL II RUNTIME DEFAULTS (IGZEOPD)	2
COBOL II OTHER IGZE AND IGZC CSECTS	37
COBOL/370 - LE/370 BOOTSTRAPS (IGZCBSN)	4
COBOL R/T ILB CSECTS UNKNOWN ORIGIN	0
COBOL R/T ILB CSECTS FROM OS/VS COBOL	20
COBOL R/T ILB CSECTS FROM VS COBOL II	6
COBOL R/T ILB CSECTS FROM LE/370	6
COBOL F RUN TIME LIBRARY	0

Assembler / User Statistics

UN-ATTRIBUTED LANGUAGE RUNTIME CEE...	147
LE/370 RUNTIME MODULES CEE...	14
LE/370 RUNTIME DEFAULTS - CEEDOPT	5
LE/370 RUNTIME OVERRIDE - CEEUOPT	9
IMS INTERFACE - DFSLI000	3
DB2 INTERFACE MODULES	0
CICS INTERFACE MODULES	0
ISPF INTERFACE MODULES	0
COMPUWARE SNAPAID MODULES	0
ASSEMBLER GENERATED CSECT	346
FORTRAN COMMON / PL/I STATIC EXTERNAL	5
CSECTS NOT IDENTIFIED	68
USER COUNTER 1 - ABEND ROUTINES	11
USER COUNTER 2 - USER ASM SUBROUTINES	5
USER COUNTER 3 - USER EXITS TO HLL RT	53
USER COUNTER 4 - TELON RUNTIME MODULES	0
IEF RUN TIME MODULES	0
USER COUNTER 6	0
USER COUNTER 7	0
USER COUNTER 8	0

Application Migration

What does the whole module look like?

COBOL II Detail Report

```
MOD- NAME TTRC L- ATTR LGTH E. P. L- DATE EPNAME ---- ATTRIBUTE FLAGS ------
  CSECT-NM    LENGTH DATE COMPILED
  ------------------------------------------------------------------------
UNIVSM5 0039312C 02E2 000908 000000 94.289 UNIVSM5 RMODE ANY AMODE 31
  CS- UNIVSM5 0004B8 10/16/94  13.15.43  NOADV APOST DATA 31 NODECK NODUMP
                                         DYNAM FASTSRT NOFDUMP C2 1.4.0
                                         NOLIB NOLIST MAP NONUM OBJECT OFFSET
                                         OPT   DFLT   DD  LVL 9402 NMPRNPF
                                         RENT  RES  NOSEQ SZE MAX  SOURCE
                                         NOSSRNG NOTERM NOTEST TRNCOPT
                                         DFLT RW NOVBREF XREF ZWB NONAME
                                         NOCMPR2 NMCLPRI NODBCS NOAWO
                                         CALL-DN
  CS- IGZEBST 000450 C- II BOOTSTRAP 0201 93006 C24.0
```

Note: Report reformatted somewhat to fit display

PL/I Detail Report

```
MOD-NAME   TTRC  L-ATTR  LGTH  E.P. L-DATE EPNAME --- ATTRIBUTE FLAGS
   CSECT-NM    LENGTH    DATE COMPILED       SOURCE AND OPTIONS
PMXOPT2  004A242C 02E2 0017D8 000000 96.018 CEESTART RMODE ANY AMODE  31
    CS-CEESTART 000080                        PL/I FOR MVS+VM  1110 96018 CGRUNTIME
    CS-CEEMAIN  000010                        PL/I FOR MVS+VM  1110 96018 EXTERNAL
    CS-CEEBETBL 000020                        LANGUAGE RUNTIME 0201 95215
    CS-CEEROOTA 0001E8                        LANGUAGE RUNTIME 0201 95215
    CS-**TRIAL1 0000A8  01/18/96   08:27:23  PL/I FOR MVS+VM  1110 96018 CODE 13
                                            MAIN     NOREORD  EXECOPS
                                         CMPATV2  NOCHGRAP NOOPT   NOINTER
                                            NOFLOW   NOCOUNT  NOTEST
    CS-**TRIAL2 000098                        PL/I FOR MVS+VM  1110 96018 STATIC
    CS-PLIXOPT  000058                        PL/I FOR MVS+VM  1110 96018 EXTERNAL
    CS-IBMRINP1 000028                        PL/I OPT RUNTIME 0201 95205
    CS-CEEUOPT  0006E0                        LE/370 OPTIONS   1110 96018
                                          USER OPTIONS - R1.5
                                       RPTSTG     RPTOPTS
                                            STACK 1000000,100000,ANYWHERE,KEEP
    CS-CEEOPIPI 000268                        LANGUAGE RUNTIME 0201 95215
    CS-CEESG010 000068                        LANGUAGE RUNTIME 0201 95205
    CS-CEEP#INT 000228                        LANGUAGE RUNTIME 0201 95215
    CS-CEEP#CAL 000098                        LANGUAGE RUNTIME 0201 95215
    CS-CEEP#TRM 000168                        LANGUAGE RUNTIME 0201 95215
    CS-CEEARLU  0000A8                        LANGUAGE RUNTIME 0201 95215
```

LE Migration

Compiler and run-time options are important!

COBOL Compiler Options

```
EDGE PORTFOLIO ANALYZER: COBRNRP 2000/07A - 2000/09/26 00:13  PAGE    1
**** COBOL WITH INVALID COMBINATIONS OF RES/NORES                    ****

 LOAD                          COBOL     RES
 MODULE     COBOL CSECTS      RUNTIME   OPTION          COMMENTS
 --------  ---------------  -------  ---------  ----------------------
 AIR104    MULTIPLE COBOL       Y     RES/NORES  REQUIRES INVESTIGATION
 AJW020    MULTIPLE COBOL       N     RES/NORES  REQUIRES INVESTIGATION
 ARS020    MULTIPLE COBOL       Y     RES/NORES  REQUIRES INVESTIGATION
 ARS030    SINGLE:ARS03A        Y           RES  REQUIRES INVESTIGATION
 AUD300    MULTIPLE COBOL       Y           RES  REQUIRES INVESTIGATION
```

```
EDGE PORTFOLIO ANALYZER: COBRNRP 2000/07A - 2000/09/26 00:13  PAGE    2
**** COBOL WITH INVALID COMBINATIONS OF RES/NORES                    ****

TOTAL MODULES ANALYZED                                               49
MODULES CONTAINING INVALID RES/NORES COMBINATION                      3
MODULE HAS COBOL RUNTIME LINKED IN BUT IS RES ONLY                    2
NOTE: COBOL RUNTIME CSECTS ARE NOT CONSIDERED WHEN CLASSIFYING
      A MODULE AS HAVING A SINGLE COBOL CSECT
```

LE User Runtime Options

```
P390G4 RW LOADMOD ANALYSIS - EDGE PORTFOLIO ANALYZER 2000/07A
 DSNAME = EPAPROD.TESTCASE.LOAD VOLUME = USERVL

CEEUOPT - LE User Specified Options
 MOD- NAME TTRC L- ATTR LGTH E. P. L- DATE EPNAME --------------------
  CSECT- NM LENGTH DATE COMPILED
-------------------------------------------------------------------------
CEEUOPT1 004C242C 03F2 000730 000000 96.018 CEEUOPT RMODE ANY AMODE 31
 CS- CEEUOPT 000730 LE/ 370 OPTIONS 0102 96018 USER OPTIONS LEVEL = 06
                                    HEAP 4096, 8192, ANYWHERE, KEEP
                                         9216, 3072
                                    LIBSTACK 8192,, FREE
                                    ANYHEAP 98304, 4096, ANYWHERE, FREE
                                    NOCBLQDA
```

Note: Report reformatted somewhat to fit display

Extracting Migration Issues from Load Modules

CSECT Cross Reference

```
EDGE PORTFOLIO ANALYZER: CSXREFC 2002/02A - 2002/03/18 10:51           PAGE    1
**** CSECT CROSS REFERENCE                                  MACHINE LIBR:2005 ****

CSECT    MODULE(S)
-------- ------------------------------------------------------------------------
CSECT01  ABCSECT1 XXXXXXX2 XXXXXXX3 XXXXXXX4 XXXXXXX5 XXXXXXX6 XXXXXXX7 XXXXXXX8
         ABCSEC17
CSECT01  ABCSECT1 XXXXXXX2 XXXXXXX3
```

```
EDGE PORTFOLIO ANALYZER: CSXREFC 2002/02A - 2002/03/18 10:51           PAGE    2
**** CSECT CROSS REFERENCE                                  MACHINE LIBR:2005 ****

MRSUM LIBRARY                                    VOLUME      LIBR
-----------------------------------------------  ------      ----
PROD01.PRODLIB                                   PROD01      2005
```

```
EDGE PORTFOLIO ANALYZER: CSXREFC 2002/02A - 2002/03/18 10:51           PAGE    3
**** CSECT CROSS REFERENCE                                  MACHINE LIBR:2005 ****

TOTAL MACHINE RECORDS                                                        48

CSECTS PROCESSED                                                             23
UNIQUE CSECT NAMES PROCESSED                                                  2

NOTE: ALL CSECTS FOR A MODULE ARE PROCESSED, EXCEPT RUN-TIMES AND
      INTERFACES
```

Global Cross Reference

```
EDGE PORTFOLIO ANALYZER: GBXREFC 2002/02A - 2002/04/03 11:11          PAGE    1
**** GLOBAL CSECT CROSS REFERENCE                                         ****

CSECT    MODULE/LIBR
-------- ------------------------------------------------------------------
CSECT01  ABCSECT1/ABCD XXXXXXX2/ABCD XXXXXXX3/ABCD XXXXXXX4/ABCD XXXXXXX5/2002
         ABCSECT6/2002 XXXXXXX7/2002
CSECT02  ABCSECT1/ABCD XXXXXXX2/ABCD XXXXXXX3/2002 XXXXXXX4/2002 XXXXXXX5/2002
         ABCSECT6/2002 XXXXXXX7/2002 XXXXXXX8/2002 XXXXXXX9/2002 XXXXXX10/2002
         ABCSEC11/2002
```

```
EDGE PORTFOLIO ANALYZER: GBXREFC 2002/02A - 2002/04/03 11:11          PAGE    2
**** GLOBAL CSECT CROSS REFERENCE                                         ****

MRSUM LIBRARY                                      VOLUME      LIBR
-------------------------------------------------  ------      ----
LIB1XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX    USER01      ABCD
ADQR.PRODLIB                                       VOL023      2002
```

```
EDGE PORTFOLIO ANALYZER: GBXREFC 2002/02A - 2002/04/03 11:11          PAGE    3
**** GLOBAL CSECT CROSS REFERENCE                                         ****

TOTAL MACHINE RECORDS                                                     67
TOTAL MRSUM RECORDS                                                        2

CSECTS PROCESSED                                                          39
UNIQUE CSECT NAMES PROCESSED                                               2

NOTE: ALL CSECTS FOR A MODULE ARE PROCESSED, EXCEPT RUN-TIMES AND
      INTERFACES
```

SCAN CSECT AMODE/RMODE

```
EDGE PORTFOLIO ANALYZER: XMODECP 2002/02A - 2002/04/16 12:32  PAGE    1
**** SCAN CSECT AMODE/RMODE FOR 24-BIT                              ****

 LOAD
 MODULE    AMODE  RMODE  CSECT     AMODE  RMODE  MRTYPE
 --------  -----  -----  --------  -----  -----  ------
 ACM120     24     24    B2345678          24     CR
 ACM140     24     24    G2345678   24     24     VO
 ACM150     24     24    A2345678   24     ANY    C2
 ACM180     24     24    C2345678   ANY    24     VS
 ACM190     24     24    D2345678   24     ANY    C2
```

```
EDGE PORTFOLIO ANALYZER: XMODECP 2002/02A - 2002/04/16 12:32  PAGE    2
**** SCAN CSECT AMODE/RMODE FOR 24-BIT                              ****

TOTAL MODULES ANALYZED                                              82
TOTAL CSECTS  ANALYZED                                             342

MODULES CONTAINING CSECT(S) WITH 24-BIT AMODE/RMODE                  5
CSECTS  CONTAINING 24-BIT AMODE/RMODE                                5
```

Sorted Details of Assembler with HLLs

EDGE PORTFOLIO ANALYZER: ASMHL3P 2002/02A - 2002/02/21 23:43 PAGE 1
**** INVENTORY OF ASM IN HLL SORTED: DESCENDING FREQ OF OCCURRENCE ****

CSECT	# MODULES CONTAINED IN	COMPILE DATES	SIZE VARIATIONS	SVC LOAD	SVC LINK	LOAD MODULE	LIBR ID
XJOBSTEP	23	2	1				
XDATECK	16	2	2				
XDATE	16	2	2				
CVDATE	16	2	1				
XABEND	10	2	3				
XUPSI	4						
XNAMEINV	3	2	3				
XCNVDATM	1					ADM125	2001
XCNTYNAM	1					AIR120	2001
XBATTERM	1					ADM125	2001
RUNMAIN	1				X	AWP140	2001
NIBSPRT	1					ADM075	2001
LINE2	1					ADM075	2001
LOAD1	1			X		ADM075	2001
MBFHLI	1			X		AUD300	2001

Module Consistency

```
EDGE PORTFOLIO ANALYZER: DUPNAMP 2002/02A - 2002/03/24 13:49  PAGE    1
**** CSECT CONSISTENCY REPORT                                      ****

 CSECT        COMPILE DATES      SIZE VARIATIONS
 --------     -------------      ---------------
 BADOUT                     2                    2
 BADRECS                    3                    2
 CAUSIN                     2                    2
 CERTS                      2                    2
 CONVIN                     2                    2
 CVDATE                     3                    2
```

```
EDGE PORTFOLIO ANALYZER: DUPNAMP 2002/02A - 2002/03/24 13:49  PAGE    2
**** CSECT CONSISTENCY REPORT                                      ****

TOTAL MACHINE RECORDS                                            2364

CSECTS ANALYZED                                                    66
UNIQUE CSECT NAMES IDENTIFIED                                      24
UNIQUE CSECT NAMES WITH DIFFERENT COMPILE DATES OR SIZES             6
```

All COBOL to Migrate

```
EDGE PORTFOLIO ANALYZER: COBMIGC 2002/02A - 2002/05/01 14:13  PAGE    1
**** COBOL LE MIGRATION ISSUES                                      ****
     MODULES WITH AT LEAST ONE COBOL CSECT NEEDING MIGRATION

 LOAD                          COBOL     RES
 MODULE     COBOL CSECTS     RUNTIME   OPTION          COMMENTS
 --------  --------------    -------   ---------   ----------------------
 ACM130    SINGLE:ACM130        N          NORES   LINKED NCAL?
 ACM135    MULTIPLE COBOL       Y      RES/NORES   REQUIRES INVESTIGATION
 ACM145    SINGLE:ACM145        Y            RES   REQUIRES INVESTIGATION
 ADM069    SINGLE:ADM069        Y          NORES
 ADM100    MULTIPLE COBOL       Y          NORES
 ADM220    MULTIPLE COBOL       N          NORES   LINKED NCAL?
```

```
EDGE PORTFOLIO ANALYZER: COBMIGC 2002/02A - 2002/05/01 14:13  PAGE    2
**** COBOL LE MIGRATION ISSUES                                      ****
     MODULES WITH AT LEAST ONE COBOL CSECT NEEDING MIGRATION

TOTAL MODULES ANALYZED                                              82
TOTAL MODULES WITH COBOL CSECTS                                     25

   FOR: MODULES WITH AT LEAST ONE COBOL CSECT NEEDING MIGRATION
MODULES WITH COBOL CSECTS TO MIGRATE                                 6
MODULES WITH ONLY COBOL CSECTS TO MIGRATE                            4
MODULES HAVING COBOL RUNTIME LINKED IN BUT ARE RES ONLY              1
MODULES HAVING INVALID RES/NORES COMBINATION                         1

NOTE: COBOL RUNTIME CSECTS ARE NOT CONSIDERED WHEN CLASSIFYING
      A MODULE AS HAVING A SINGLE COBOL CSECT
```

Issues Due to LE Changes

```
EDGE PORTFOLIO ANALYZER: COBAHPP 2002/02A - 2002/02/18 18:11  PAGE    1
**** FINDS COBOL W/DATA(31) + RENT AND POTENTIAL AMODE ERROR       ****
  LOAD    CONTAINS  MR     COMP          COMPL                    DYN  LIBR
 MODULE    CSECT   TYPE     ID     VER  DATE  DATA RENT AMODE CALL  ID
 -------- -------- ---- ---------- ---- ----- ---- ---- ----- ---- ----
 CSXREFCZ                                                  31        PDOM
          CSXREFC   C3  5648A2500  2100 98221  31   Y     ANY   N
          ASMH1     AR  569623400  0101 94272                24   N
 UNIVSM3                                                   24        PDOM
          UNIVSM1   VS  5740CB103  0203 94272                24   N
          ASMH1     AR  569623400  0101 94272                ANY   N
          UNIVS1    C2  566895801  1400 94272  31   Y     ANY   N
          UNIVSM5   C2  566895801  1400 94289  24   Y     ANY   Y
 UNIVSM5                                                   31        PDOM
          UNIVSM5   C2  566895801  1400 94289  31   Y     ANY   Y
 ZNIVS1                                                    31        PDOM
          UNIVS1    C2  566895801  1400 94272  31   Y     ANY   N
          ASMH1     AR  569623400  0101 94272                24   N
 ZNIVS2                                                    31        PDOM
          UNIVS1    C2  566895801  1400 94272  31   Y     ANY   N
          ASMH1     AR  569623400  0101 94272                24   N
```

All PL/I Version 1.x

```
EDGE PORTFOLIO ANALYZER: PV1SCNP 2002/02A - 2002/04/16 12:10  PAGE    1
**** PL/I VERSION 1.X                                              ****

 LOAD       CONTAINS
 MODULE     CSECT      PLI VER
 --------   --------   -------
 ACM130     ACM130XY    1.2.3
 ACM140     ACM140PQ    1.3.0
 ACM170     ACM150PQ    1.3.1
 WEX432     WEX732MF    1.4.0
 WEX732     WEX7333F    1.5.0
 WEX732     WEX741MF    1.5.1
 WEX788     WEX742MF    1.2.1
 WEX788     WEX743MF    1.2.2
 WEX788     WEX744MF    1.?

TOTAL MODULES ANALYZED                                              82
TOTAL CSECTS  ANALYZED                                             342

TOTAL MODULES CONTAINING PL/I V1                                     6
TOTAL CSECTS  CREATED BY PL/I V1                                     9

TOTAL CSECTS  CREATED BY PL/I V1.2.1                                 1
TOTAL CSECTS  CREATED BY PL/I V1.2.2                                 1
TOTAL CSECTS  CREATED BY PL/I V1.2.3                                 1
TOTAL CSECTS  CREATED BY PL/I V1.3.0                                 1
TOTAL CSECTS  CREATED BY PL/I V1.3.1                                 1
TOTAL CSECTS  CREATED BY PL/I V1.4.0                                 1
TOTAL CSECTS  CREATED BY PL/I V1.5.0                                 1
TOTAL CSECTS  CREATED BY PL/I V1.5.1                                 1
TOTAL CSECTS  CREATED BY PL/I V1.?                                   1
```

Special PL/I Issues

```
EDGE PORTFOLIO ANALYZER: PLESCNP 2002/02A - 2002/02/23 12:44  PAGE    1
**** FIND PL/I SPECIAL ITEMS                                        ****
 LOAD
 MODULE     ILC   FETCH/RELEASE   PLISORT   PLITEST   PLIDUMP
 --------   ---   -------------   -------   -------   -------
 AWP140      X
 BF1013                X                                 X
 MG0408                              X
 PK1260                                        X         X
```

```
EDGE PORTFOLIO ANALYZER: PLESCNP 2002/02A - 2002/02/23 12:44  PAGE    2
**** FIND PL/I SPECIAL ITEMS                                        ****
TOTAL MODULES ANALYZED                                              1959

MODULES CONTAINING PL/I INTERLANGUAGE COMMUNICATION                    1
MODULES CONTAINING FETCH/RELEASE STATEMENTS                            1
MODULES CONTAINING PLISORT                                             1
MODULES CONTAINING PLITEST                                             1
MODULES CONTAINING PLIDUMP                                             2
```

PL/I FETCH Details

```
EDGE PORTFOLIO ANALYZER: PLIFCHP 2001/06C - 2001/06/15 16:28  PAGE    1
**** FIND POTENTIAL PL/I FETCH CALLERS AND THEIR TARGET ROUTINES   ****
  LOAD        FETCH      FETCH       LIBR
  MODULE      CALLER     TARGET      U-ID
 --------    --------   --------    ----
 FETCH02                             PDOM
             *CALLER    SUBONE
             *CALLER    SUB4
             *CALLER    SUB5
             ***SUB3    SUB4
             ***SUB3    SUBONE
 FETCH03                             PDOM
             ***SUB3    DCLFCAL
             ***SUB3    DCLF
 PLI23EXT                            PDOM
             *SAMPLE    IEFBR14
MODULES ANALYZED                                                  261
MODULES WITH FETCH INTERFACE                                        3
FETCH TARGETS FOUND                                                 8
```

RELINKP REPORT

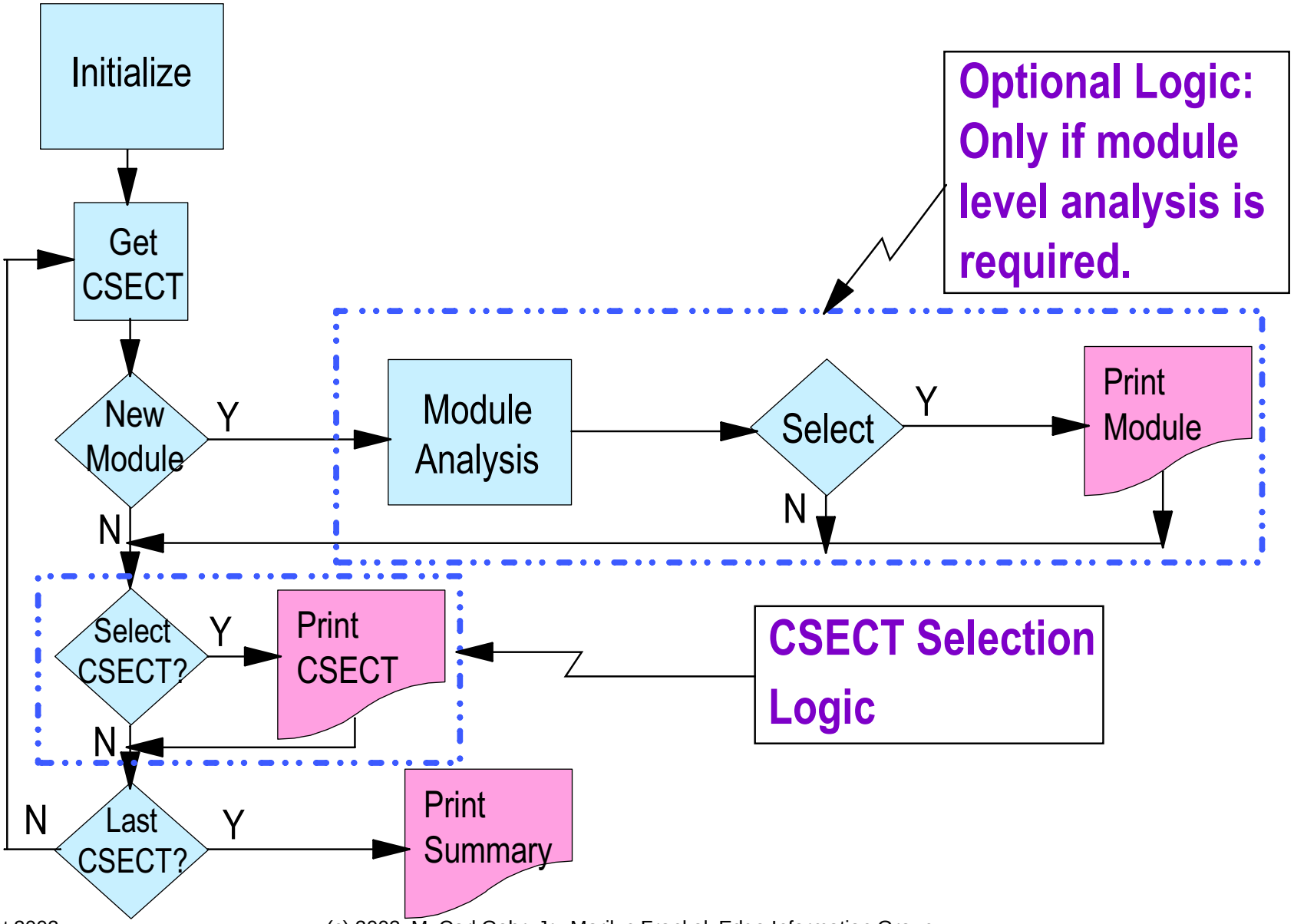
```
EDGE PORTFOLIO ANALYZER: RELINKP 2002/02A - 2002/02/04 17:33  PAGE    1
**** RELINK STATEMENT GENERATOR WITH ONE RELINK FILE                ****
**** OPTIONS IN EFFECT: LE    FORCEDBDC   1FILE                     ****

 MODULE   RELINK          COMP     COMP          COMPL  MR
 RELINKED FILE     CMD    NAME      ID      VER  DATE  TYPE COMMENTS
 -------- ------- ----- -------- ---------- ---- ----- ---- -----------
 GRXBC001 RELINK
 GRXBC001         INCL  CEESTART                            FORCE INCL
 GRXBC001         INCL  CEESG010                            PL/I    SIG
 GRXBC001         INCL  DFHELII                             CICS INTER
 GRXBC001         INCL  IBMBSPLA                         PR  FORCE INCL
 GRXBC001         REPL  DFHPL10I 566896201  0201 90271  CC
 GRXBC001         REPL  DFHCPLC  566896201  0201 90271  CC
 GRXBC001         REPL  DFHCPLRR 566896201  0201 90271  CC
 GRXBC001         REPL  PLISTART 5668-910   2300 96027  P2  N/RQD CICS
 GRXBC001         REPL  IBMBSPL1 5668-910   2300 96002  PR
 GRXBC001         REPL  DFSLI000 5668-910   2300 96002  DI
 GRXBC001         REPL  DFHELII  5668-910   2300 96002  CC
 GRXBC001         CHG   IBMBINT  TO CEEBINT                 CHG EXT REF
 GRXBC001         ORDER CEESTART
 GRXBC001         ENTRY A001                                FM OLD LMOD
 HCDBSATT         REPL  IMSCSET  566897322  0203 97322  CC
 HCDBSATT         ENTRY PLISTART                            FM OLD LMOD
```

```
EDGE PORTFOLIO ANALYZER: RELINKP 2002/02A - 2002/02/04 17:33  PAGE    2
**** RELINK STATEMENT GENERATOR WITH ONE RELINK FILE                ****
**** OPTIONS IN EFFECT: LE    FORCEDBDC   1FILE                     ****
TOTAL MODULES ANALYZED                                              15
TOTAL MODULES SELECTED FOR RELINK PROCESSING                         2
NOTE: THE FOLLOWING OPTIONS ARE IN EFFECT:
      LE             - STATEMENTS GENERATED ASSUME SYSLIB IS
                       LE RUN-TIME.
      FORCEDBDC      - INTERFACES FOR ALL DBDC WILL BE REPLACED.
      1FILE          - RELINK
```

RELINK FILE

```
**** EDGE PORTFOLIO ANALYZER: RELINKP 2002/02A - 2002/02/04 17:33
**** RELINK STATEMENT GENERATOR FOR FILE:  RELINK
**** OPTIONS IN EFFECT: LE    FORCEDBDC   1FILE
 INCLUDE SYSLIB(CEESTART) FORCED INCLUDE/REPLACE
 INCLUDE SYSLIB(CEESG010) LE SIGNATURE PL/I
 INCLUDE SYSLIB(DFHELII)  LE UNIVERSAL CICS INTERFACE
 INCLUDE SYSLIB(DFHEAIO)  FORCED INCLUDE/REPLACE
 INCLUDE SYSLIB(IBMBSPLA) FORCED INCLUDE/REPLACE
 INCLUDE SYSLIB(DSNRLI)   FORCED INCLUDE/REPLACE
 REPLACE DFHPL1OI         FORCED REPLACEMENT
 REPLACE DFHCPLC          FORCED REPLACEMENT
 REPLACE DFHCPLRR         FORCED REPLACEMENT
 REPLACE PLISTART         FORCED REMOVAL FOR CICS
 REPLACE IBMBSPL1         FORCED REPLACEMENT
 REPLACE DFSLI000         FORCED REPLACEMENT
 REPLACE DSNRLI           FORCED REPLACEMENT
 REPLACE DFHELII          FORCED REPLACEMENT
 REPLACE DFHEAIO          FORCED REPLACEMENT
 CHANGE IBMBINT(CEEBINT)  CHANGE TO LE EXT REF NAME
 INCLUDE OLD(GRXBC001)    PICKING UP OLD COMPOSITE MODULE
 ORDER  CEESTART          FORCE TO START OF MODULE
 ENTRY  A001              SPECIFING THE EP SYMBOL
 NAME   GRXBC001(R)       REPLACING COMPOSITE MODULE
 REPLACE IMSCSET          FORCED REPLACEMENT
 INCLUDE OLD(HCDBSATT)    PICKING UP OLD COMPOSITE MODULE
 ENTRY  A001              SPECIFING THE EP SYMBOL
 NAME   HCDBSATT(R)       REPLACING COMPOSITE MODULE
**** END
```

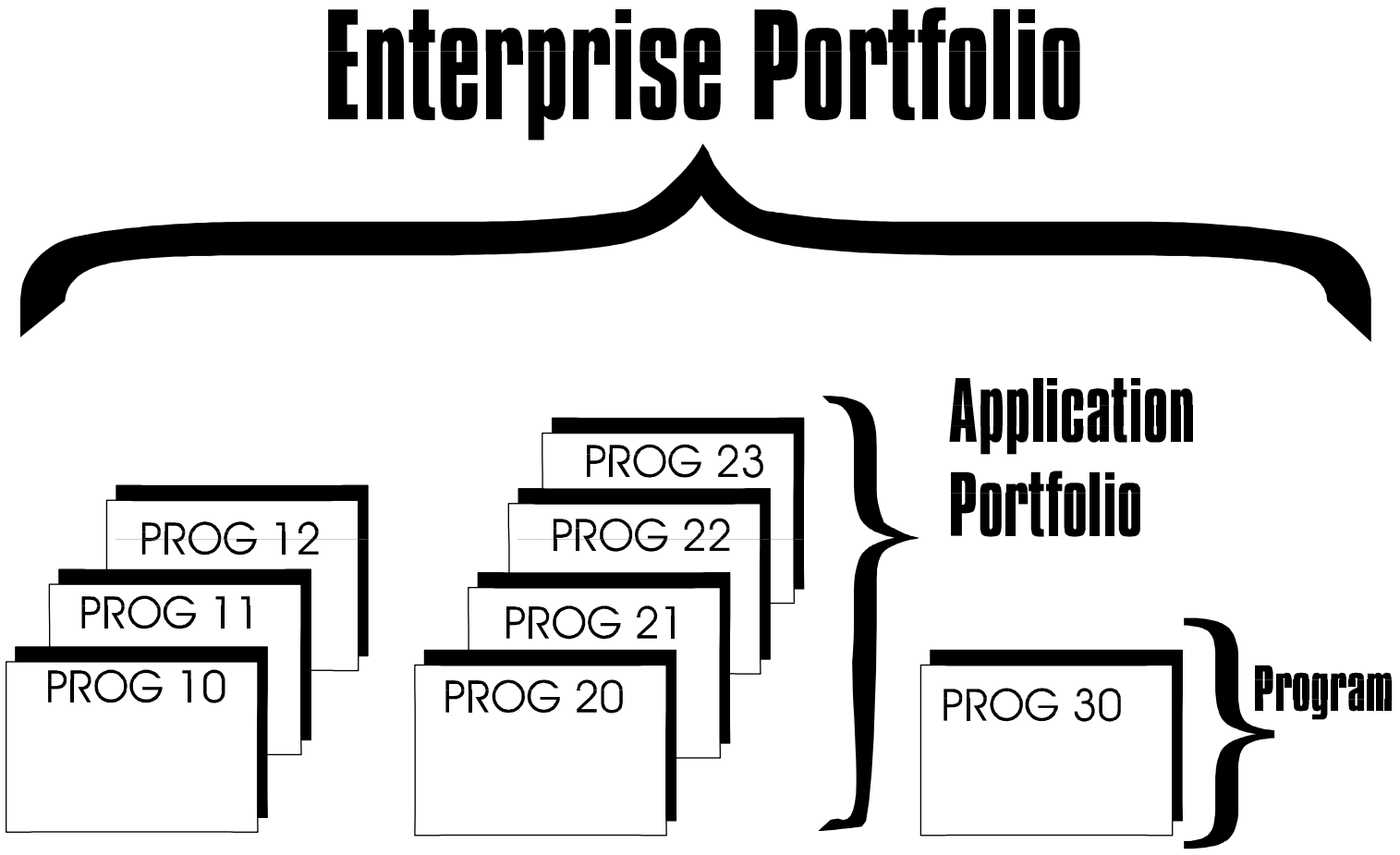
External Analyzer Logic



Software Archeology

Edge Portfolio Analyzer

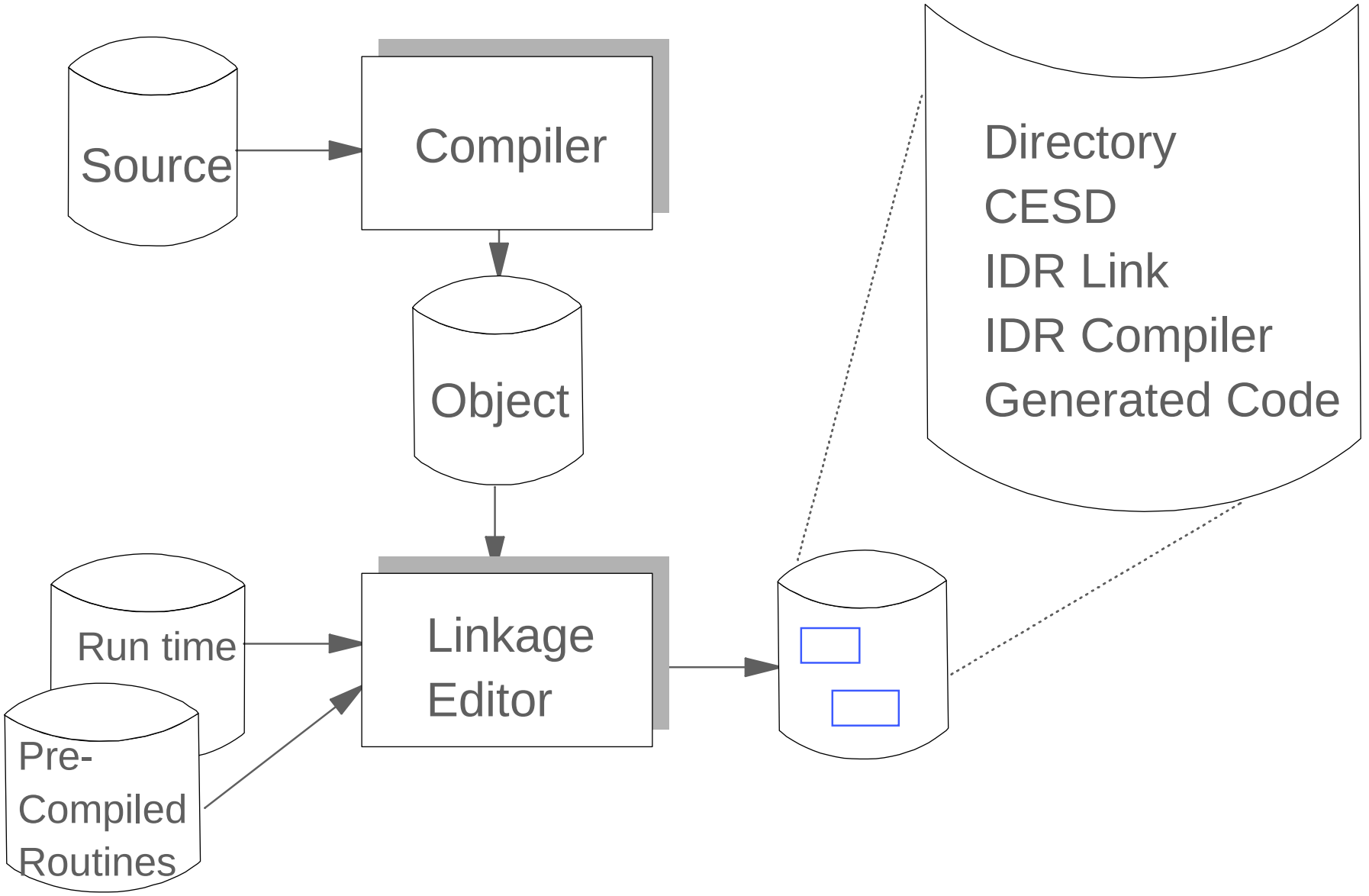
Portfolio Analysis - The Basis



Software Archeology

"Just as an archeologist would dig around looking for bones that might provide a clue about the origin of the beast, a similar process can be applied to software stored in IBM's MVS and OS/390 operating systems load libraries."

Looking at the Bones



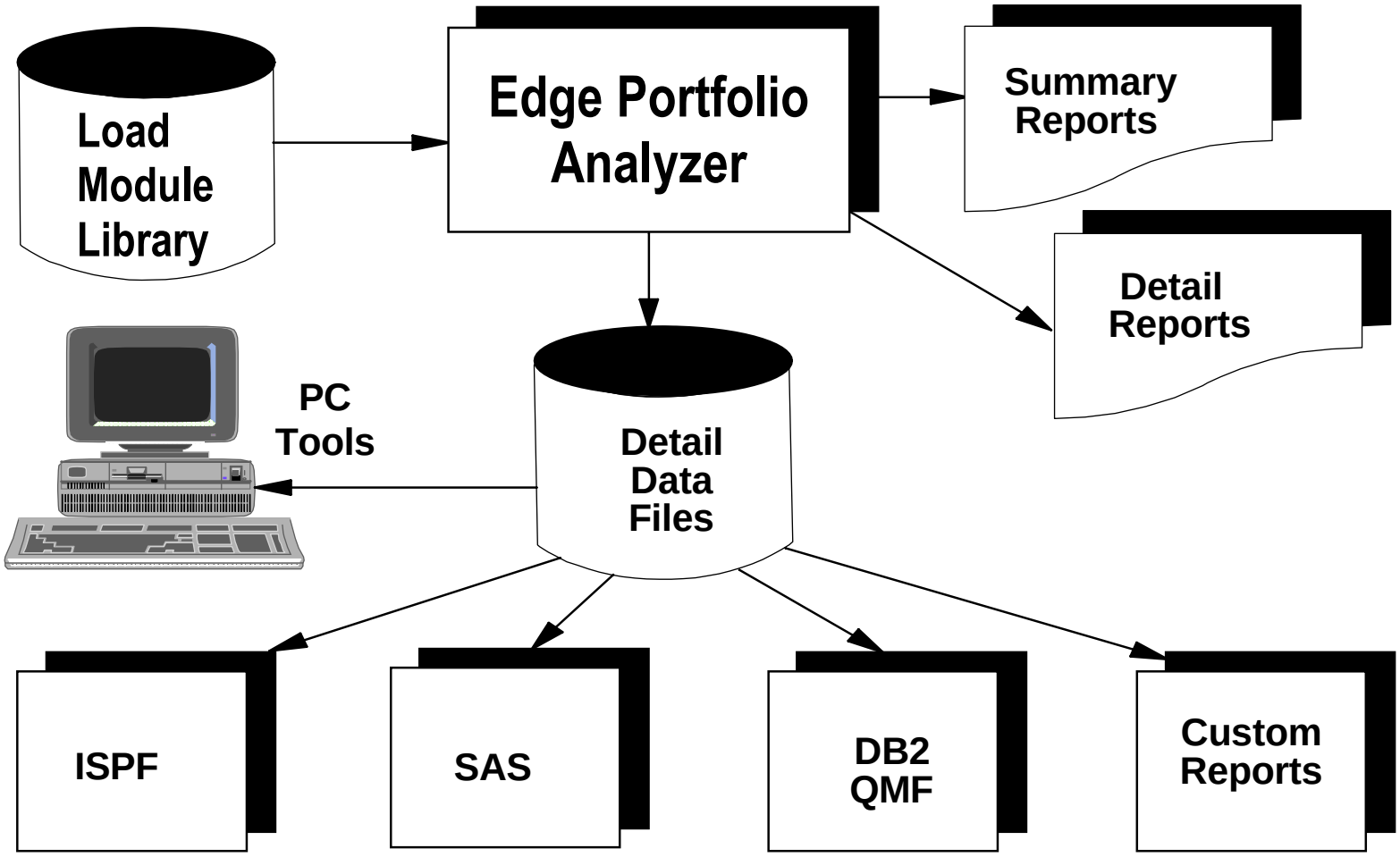
Edge Portfolio Analyzer:

A Software Inventory Tool

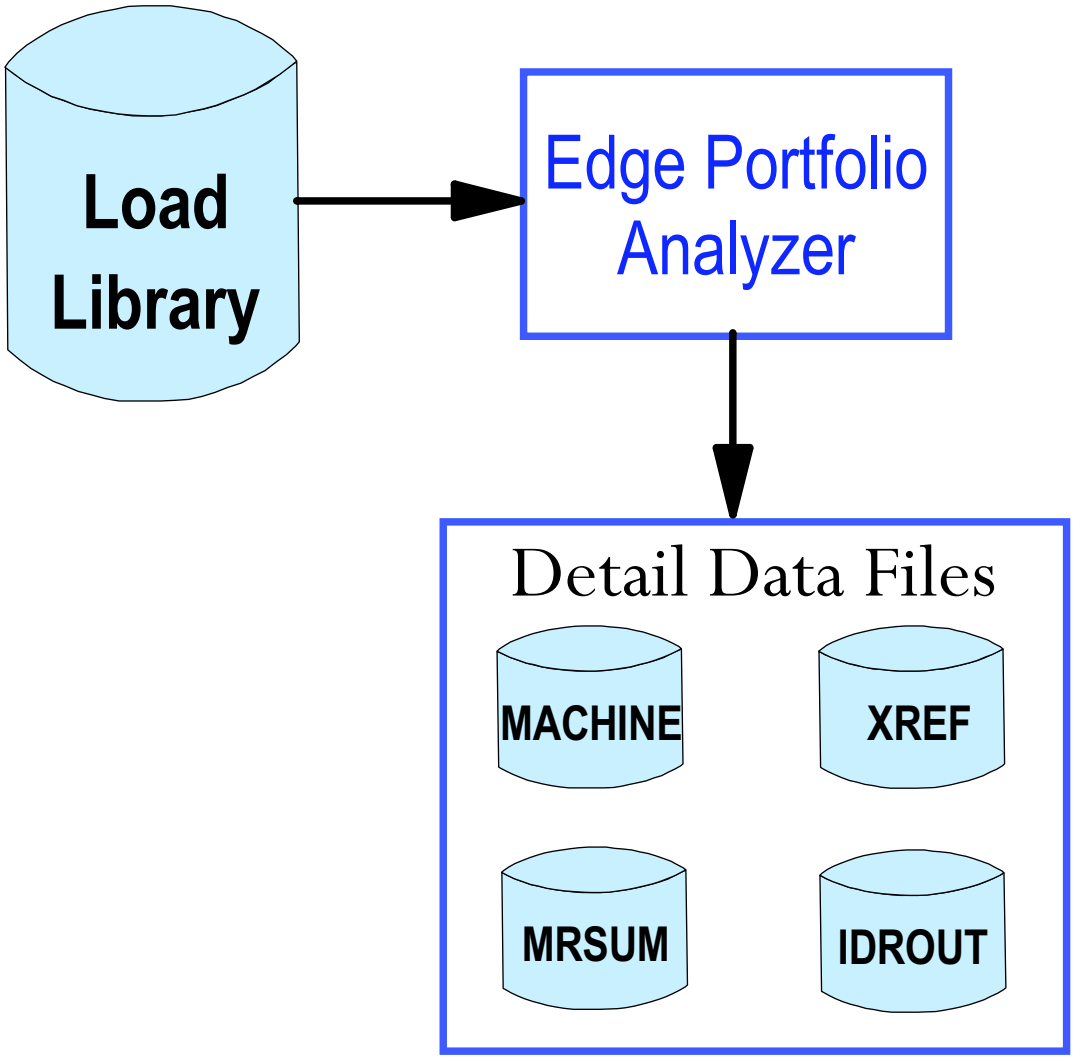
Philosophy

"The truth only exists in the code that goes into production every night."

How Do We Do It?



Detail Data Files



Detail Data Files *

- Do Not Process Listing Files!
- Use machine files for selective analysis or customized reporting.
- All data is character format in flat files
  - Easily loaded into relational tables
  - Process by almost any reporting or query program
  - Can be downloaded to PC or workstation

* a.k.a. Machine-Friendly Files

Edge Portfolio Analyzer

Language Environment Migration

LE Migration Process

Very High Level View...

- Move all runtime usage to LE
  - Eliminate references to old libraries
  - Remove STEPLIBs required during transition
  - Just in case: Retain old libraries for recovery
- After LE runtime is proven...
  - Begin use of new LE-based compilers
  - Start with subroutines
  - Work toward mainlines

The Migration Continues

- Each new release of OS/390 or z/OS will have new challenges.
  e.g., OS390 V2R10 has backward compatibility, but you may have to relink. What modules require attention? V2R9 changed HEAP(ANY) rules.
- Problem Determination and/or Problem Source Identification is an ongoing process.
- New applications and/or modification to existing applications create new exposures.

All of these require that you understand the details of your application portfolio.

Problem Determination

- Trouble putting code above 16 meg line?
  - Amode/Rmode Problem
  - Calling assembler program
- SYSPRINT data set appearing in IMS region
  - Find out what programs are issuing PUTs
- LE Release ID change
  - Find all modules containing CEEGPID
- Program exhibiting known error
  - Check if runtime module has date before fix

Thank you for attending . . .

Software Archeology

Using the Edge Portfolio Analyzer for LE Migrations

EDGE INFORMATION GROUP

Edge Portfolio Analyzer

Language Environment Migration Additional Reference Information

Selected External Analyzers

- ASMHLnx
  - Extracts uses of Assembler routines in the same module as High Level Language programs. There are three programs and three sets of JCL (n=1-3) in this set.
- COBAHPx
  - Finds load modules that may fail due to changes made in OS/390 V2.9. The problem occurs when a COBOL program, compiled DATA(31), RENT attempts to call an AMODE(24) program.

Selected External Analyzers

- COBLEZx
  - Selects COBOL modules containing only a single COBOL program, possibly combined with only COBOL run-time modules.
- COBMIGx
  - Identifies COBOL programs that should be relatively easy to migrate to COBOL for OS/390. These programs may have some migrations issues flagged.

Selected External Analyzers

- COBRNRx
  - Flags illegal use of RES/NORES or all-RES modules containing COBOL runtime routines.
- CSXREFx
  - Creates a report containing a list of CSECTs and the modules that contain those CSECTs.
- DUPNAMx
  - This program reports instances of the same CSECT name with multiple compile dates and/or multiple sizes.

Selected External Analyzers

- GBXREFx
  - Cross Reference of CSECTs in load modules. Output contains UID field to identify library as well as module name.
- LEV210x
  - This program flags references to the CEEGPID Callable Service that has changed in OS/390 V2R10.

Selected External Analyzers

- PIOSCNx
  - Lists any module that uses PL/I RECORD and/or STREAM I/O
- PLESCNx
  - List all modules containing:
    - PL/I Interlanguage Communication
    - PL/I FETCH and/or RELEASE
    - PL/I Sort Interface
    - PLITEST references
    - PLIDUMP references

Selected External Analyzers

- PLIFCHP
  - Identifies users of PL/I FETCH or RELEASE and the programs they reference dynamically. Only the JCL is in USERCODE. The program is distributed as Object Code Only (OCO).
- PV1SCNx
  - Lists all modules compiled by any release of PL/I Version 1.
- RELINKP
  - Creates ReLink statements. Only the JCL is in USERCODE. The program is distributed as Object Code Only (OCO).

Selected External Analyzers

- SYSDATx
  - Reports all requests for the system date by programs written in COBOL, PL/I and/or Assembler. Warns of bad PL/I DATE BIFs.
- XMODECx
  - Lists any module that contains CSECTs flagged with an AMODE and/or RMODE that will prohibit link editing for AMODE(ANY) and RMODE(ANY).

Problem Solving

- Define what went wrong-List Symptoms
- Be able to repeat the problem at will
  - Make sure the environment is same as what caused the problem - Systems and Sub System, Code, etc.
- Isolate Problem
- * Gather Data (write down results)
- * Find Pattern
- Test Theory

* Can use EPA and its E/As