COBOL modernization: Bring OS/VS COBOL to enterprise COBOL with IBM tools

Debug Tool Utilities and Advanced Functions

Reasons for Compiler and Runtime Modernization:

- Compiler Currency:
  - Keep the shop current for support reasons, running the "*supported*" version of z/OS Enterprise COBOL and PLI (i.e. ***Sarbanes Oxley compliance***)
  - Assure that the applications *will execute* with new releases of IBM operating systems and subsystems (i.e. ***CICS 3.1***)
- Enable "Enterprise Modernization":
  - support "Web services and Java connectors" via ***IBM WebSphere Developer for zSeries (WDz)*** development.

- COBOL Modernization Process with IBM Tools
  - *Migrate to the Language Environment Runtime*
  - *Discovery*
  - *Convert*
  - *Test and Promote*

Supported COBOL Compilers and Runtimes and Need for Cobol Modernization

Present IBM z/OS COBOL Compliers and Support:

MVS & VM	PIDs	Market Withdrawn	Service Withdrawn
OS/VS COBOL V1.2.4	***5740-CB1*** ***5740-LM1***	Yes **06/30/1992** Yes **06/30/1992**	Yes **06/30/1994** Yes **06/30/1994**
VS COBOL II V1.4.0	***5668-958*** ***5688-022*** ***5688-023***	Yes **06/30/1997** Yes **06/30/1997** Yes **06/30/1997**	Yes **03/31/2001** Yes **03/31/2001** Yes **03/31/2001**
COBOL/370 1.1	***5688-197***	Yes **10/31/1995**	Yes **09/31/1997**
COBOL for MVS & VM Ver 1 Rel 2	***5688-197***	Yes **09/06/2000**	Yes **12/31/2001**
COBOL for OS/390 & VM Ver 2	***5648-A25***	Yes **12/31/2002 (MVS Feature)**	Yes **12/31/2004 (MVS Feature)**
Enterprise COBOL for z/OS V3R1	***5655-G53***	Yes **09/27/2002**	Yes **04/04/2004**
Enterprise COBOL for z/OS V3R2, V3R3	***5655-G53***	Yes	Yes
Enterprise COBOL for z/OS V3R4	***5655-G53***	No	No

Status of Unsupported COBOL with DB2 and IMS:

- DB2 8.0
  - Programs compiled and linked with the ***OS/VS COBOL*** compiler are not supported (in DB2 version 8.0 or IMS version 9.0 environment)
  - Any change to the old ***OS/VS COBOL*** programs will have to be compiled with a supported level of LE conforming COBOL
- IMS 9.0
  - Programs compiled and linked with the ***OS/VS COBOL*** tools will run in the IMS version 9.0 environment unsupported

Status of OS/VS COBOL and COBOL II with CICS:

- CICS TS 2.2
  - ***OS/VS COBOL*** pre-compiler will not work
  - Must use ***COBOL/390*** precompiler
- CICS TS 2.3
  - ***OS/VS COBOL*** load module must run with the LE runtime
  - Any modules attempting to use the ***OS/VS COBOL*** runtime will abend at initialization
- CICS TS 3.1
  - Any modules compiled with ***OS/VS COBOL*** **will abend when loaded**, even when running with LE runtime
  - ***COBOL II*** modules are unsupported but do run with the LE runtime

Reasons for COBOL Modernization:

- Prevent CICS System Failure:
  - **Load modules** compiled with OS/VS COBOL running in TS CICS 3.1 regions **will abend** when invoked
  - Not using the OSVS COBOL compiler is not the issue
  - The question is:

    "Do you have any load modules running in a CICS region that were built with the OSVS COBOL compiler any time in the past?"

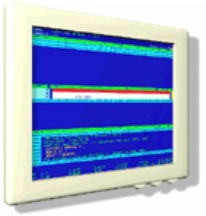
IBM Tool to Enable COBOL Modernization

IBM Tools To Support Compiler Modernization:

- ***IBM Debug Tool Utilities and Advanced Functions for z/OS Version 7.1.0***

Program Number 5655-R45

Debug Tool Utilities and Advanced Functions Functional (DTUAF)



- Set of tools to support z/OS application development and support
- Common User Interface Across Systems And Subsystems
- Consistent Across Languages
  - COBOL, C, C++, PL/I. Assembler
- Environments Supported
  - CICS, TSO, JES/Batch, IMS Including IMS/TM, DB2 Including Stored Procedures

- Utilities and Advanced Functions Features:
  - **Source-level Debugger**
  - Language Sensitive
  - Logging Of Debug Session
  - Frequency Sampler
  - Playback support
  - **Load Module Analyzer**
  - **A new code coverage tool**
  - **Debug support for OS/VS COBOL**
  - **COBOL Modernization Utility**
  - Information Available At

    www.ibm.com/software/awdtools/deployment

COBOL Modernization Process

IBM COBOL Modernization Process:

1. *Migrate to the Language Environment Runtime*

   Convert and test all applications to the LE runtime environment

2. *Discovery*

   Identify all OS/VS COBOL executables and source

3. *Convert*

   Convert the OS/VS COBOL (COBOL 74) source to COBOL 85 standard and rebuild the modules

4. *Test and Promote*

   Test all converted modules and migrate to production

IBM Tools to Support COBOL Modernization Process:

- *Migrate to the Language Environment Runtime*
  - Convert and test all applications to the LE runtime environment
    - ***IBM Debug Tool Utilities and Advanced Functions Load Module Analyzer Utility***
    - ***IBM Debug Tool Utilities and Advanced Functions Coverage Utility***
- *Discovery*
  - Identify all OS/VS COBOL executables and source
    - ***IBM Debug Tool Utilities and Advanced Functions Load Module Analyzer Utility***
- *Convert*
  - Convert the OS/VS COBOL (COBOL 74) source to COBOL 85 standard and rebuild the modules
    - ***IBM Debug Tool Utilities and Advanced Functions COBOL Modernization Tool***
    - ***IBM Debug Tool Utilities and Advanced Functions Interactive Debugger***
- *Test and Promote*
  - Test all converted modules and migrate to production
    - ***IBM Debug Tool Utilities and Advanced Functions Interactive Debugger***
    - ***IBM Debug Tool Utilities and Advanced Functions Coverage Utility***

IBM COBOL Modernization Process:

- Migrate to the Language Environment Runtime
  - Convert and test all applications to the LE runtime environment
- *Discovery*
  - *Identify all back level (i.e. OS/VS COBOL and VS COBOL II) executables and source files*
- Convert
  - Convert the OS/VS COBOL (COBOL 74) source to COBOL 85 standard and rebuild the modules
- Test and Promote
  - Test all converted modules and migrate to production

Static Runtime Compiler Version Discovery:

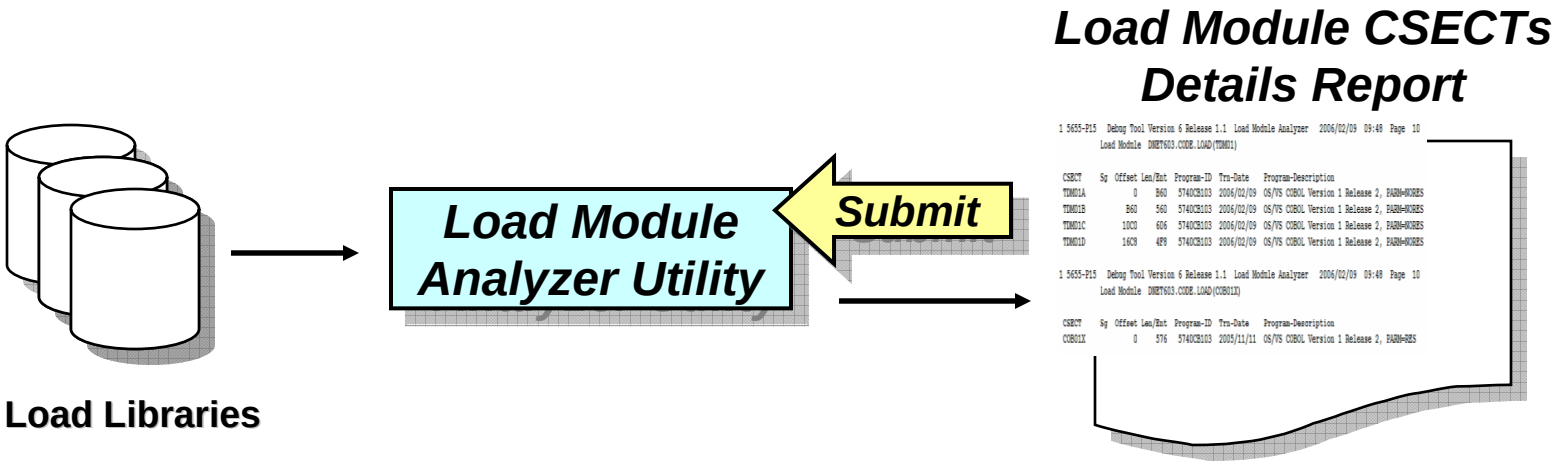
DTAF Load Module Analyzer

DTUAF Load Module Analyzer Utility Overview:

- *Utility for reporting details of CSECTs contained in a z/OS executable*
- *Part of the Debug Tool Utilities and Advanced Functions*
- *Supports LE migrations and COBOL & PLI compiler version upgrades*
- *Works for all Versions of IBM z/OS compilers and assemblers:*
  - *PLI, COBOL, C/C++, PLX, assembler, etc.*
- *Reports compiler versions and compile dates for all CSECTs*
- *Order Debug Tool Utilities and Advanced Functions PID*
  - ***5655-R45***

- *LMA Utility Features:*
  - **Reports compiler versions for all CSECTs that make up a load module**
  - **Reports compile dates for all CSECTs that make up a load module**
  - **Can be exectuted interactively from ISPF panels**
  - **Can be submitted to run in batch**
  - **Report display options are configurable:**
    - Utility report features
    - Filter compiler versions reported
    - Filter CSECTs that are part of the LE runtime
    - Filter CSECTs that are part of the compiler
- *Information available at* www.ibm.com/software/awdtools/deployment

DTUAF Load Module Analyzer Utility:

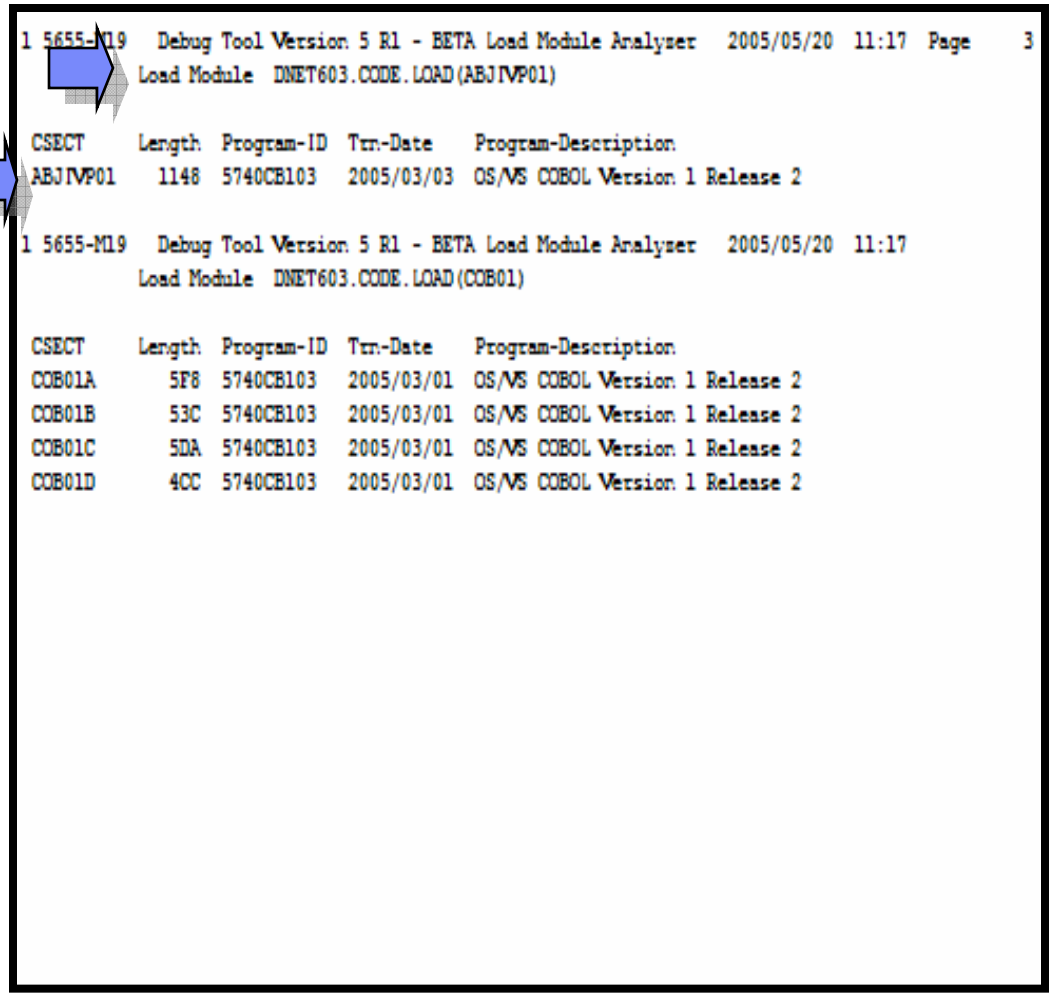


DTUAF Load Module Analysis Utility:

- Reports compiler version and dates for all CSECTs that make up a load module
- Can identify load modules running in production that was compiled with OS/VS COBOL
- From the reporting of back level compiler version modules:
  - Source conversion requirements can be defined
  - Testing plans can be defined

DTUAF Load Module Analysis Utility Report:

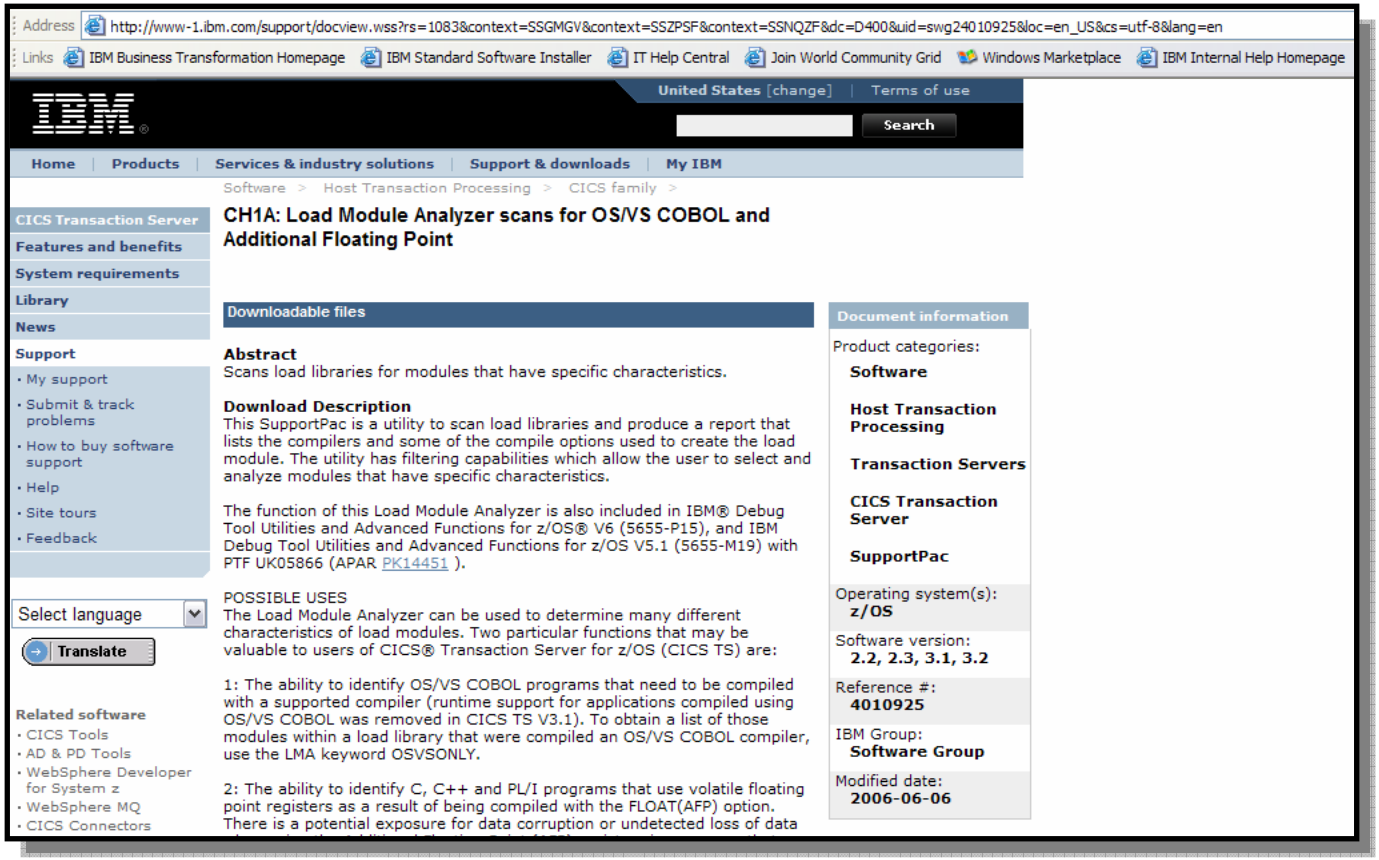
- Report Output
  - Section three:
    - List of load modules names
    - List of CSECTs that make up the load module
    - List of the compile dates for each CSECT
    - List of the compiler version for each CSECT



```
1 5655-M19   Debug Tool Version 5 R1 - BETA Load Module Analyzer   2005/05/20  11:17  Page     3
             Load Module  DNET603.CODE.LOAD(ABJIVP01)

 CSECT     Length  Program-ID  Trn-Date    Program-Description
 ABJIVP01    1148  5740CB103   2005/03/03  OS/VS COBOL Version 1 Release 2

1 5655-M19   Debug Tool Version 5 R1 - BETA Load Module Analyzer   2005/05/20  11:17
             Load Module  DNET603.CODE.LOAD(COB01)

 CSECT     Length  Program-ID  Trn-Date    Program-Description
 COB01A      5F8   5740CB103   2005/03/01  OS/VS COBOL Version 1 Release 2
 COB01B      53C   5740CB103   2005/03/01  OS/VS COBOL Version 1 Release 2
 COB01C      5DA   5740CB103   2005/03/01  OS/VS COBOL Version 1 Release 2
 COB01D      4CC   5740CB103   2005/03/01  OS/VS COBOL Version 1 Release 2
```

Evaluation Version of Load Module Analyzer

- Download a copy from the CICS Support Website:
  - ***http://www-1.ibm.com/support/docview.wss?rs=1083&context=SSGMGV&context=SSZPSF&context=SSNQZF&dc=D400&uid=swg24010925&loc=en_US&cs=utf-8&lang=en***



IBM COBOL Modernization Process:

- Migrate to the Language Environment Runtime
  - Convert and test all applications to the LE runtime environment
- Discovery
  - Identify all OS/VS COBOL executables and source
- ***Convert***
  - ***Convert the OS/VS COBOL (COBOL 74) source to COBOL 85 standard and rebuild the modules (including Report Writer syntax)***
- Test and Promote
  - Test all converted modules and migrate to production

DTUAF COBOL Modernization Utility Overview:

- *Utility to analyze, report, and convert COBOL source to be compliant with selected COBOL compiler versions*
- ***Part of the Debug Tool Utilities and Advanced Functions***
- *Supports conversions from and to:*
  - *OS/VS COBOL, COBOL II, COBOL for VM & MVS, OS/390 COBOL, z/OS COBOL, Enterprise COBOL*
- *Identifies, sizes, and upgrades COBOL programs to enable migration to CICS 3.1*
- *Converts standard 68 and 74 standard to 85*
- *Order Debug Tool Utilities and Advanced Functions PID*
  - ***5655-R45***

- *COBOL Modernization Utility Features:*
  - Identifies COBOL language elements and CICS commands in the input source programs that are:
    - Not supported by the target language
    - Supported in a different manner
  - Converts COBOL 74 & 68 elements to the equivalent in the target language
  - Reports identification of source requiring conversion for COBOL 68 & 74 to COBOL 85
  - Converted Source
    - Converted COBOL program source
    - Converted COBOL copy files
- **information available at:** www.ibm.com/software/awdtools/deployment

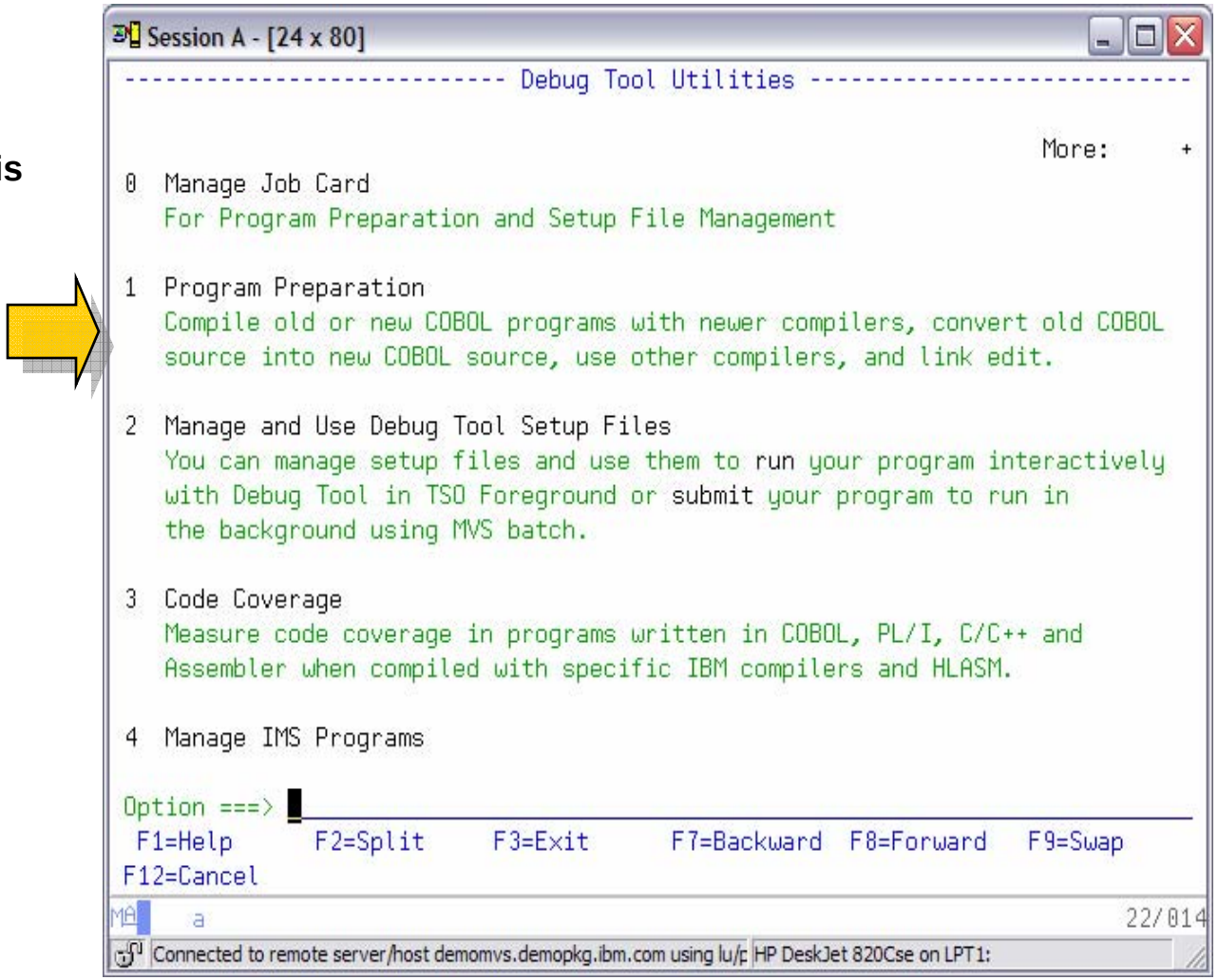
COBOL Modernization Utility Function:

- Analyses and Reports COBOL Source Inventory:
  - Identification of source requiring conversion for COBOL 68 & 74 to COBOL 85
    - Source elements identified
    - Source elements converted
    - Source elements requiring manual conversion
- Converts COBOL Source:
  - Converted COBOL program source
  - Converted COBOL copy files

IBM Debug Tool Utilities and Advanced Functions:

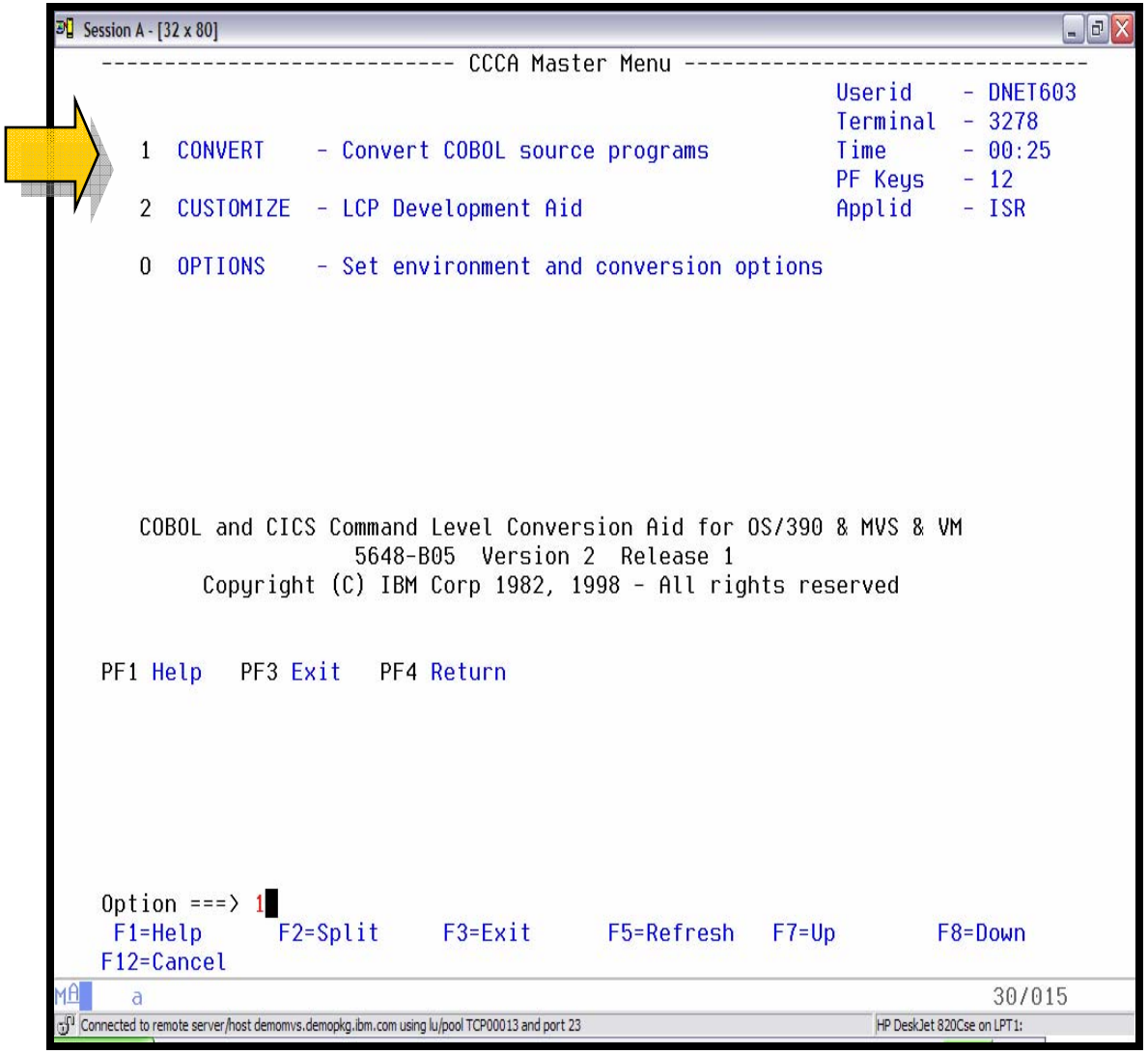
- Main Menu

From the Debug Tool utilities, COBOL Modernization Utility is selected.



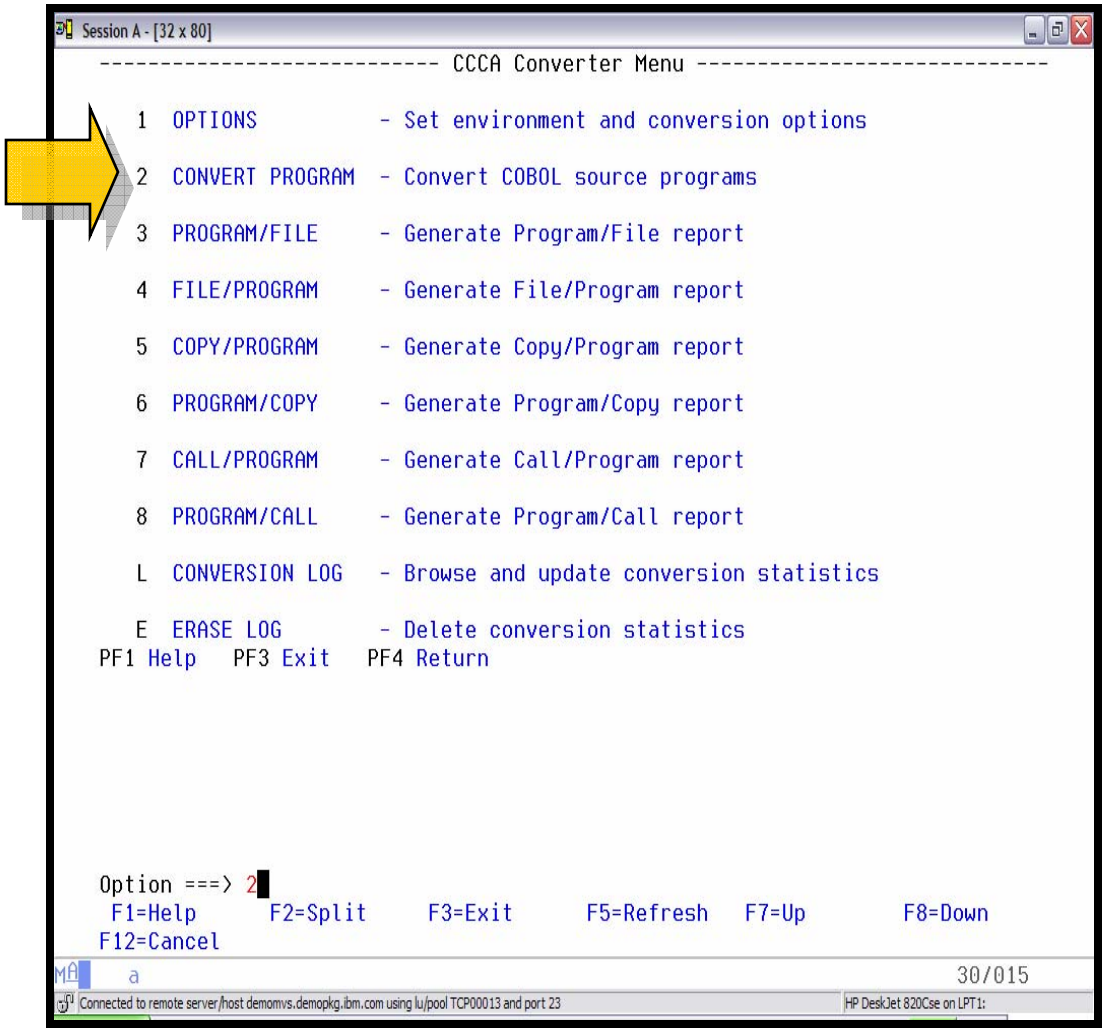
COBOL Modernization Utility ISPF Interface:

- Main Menu
  - From this menu:
    - The default options can be set
    - Language extensions can be defined
    - Code can be reviewed and converted



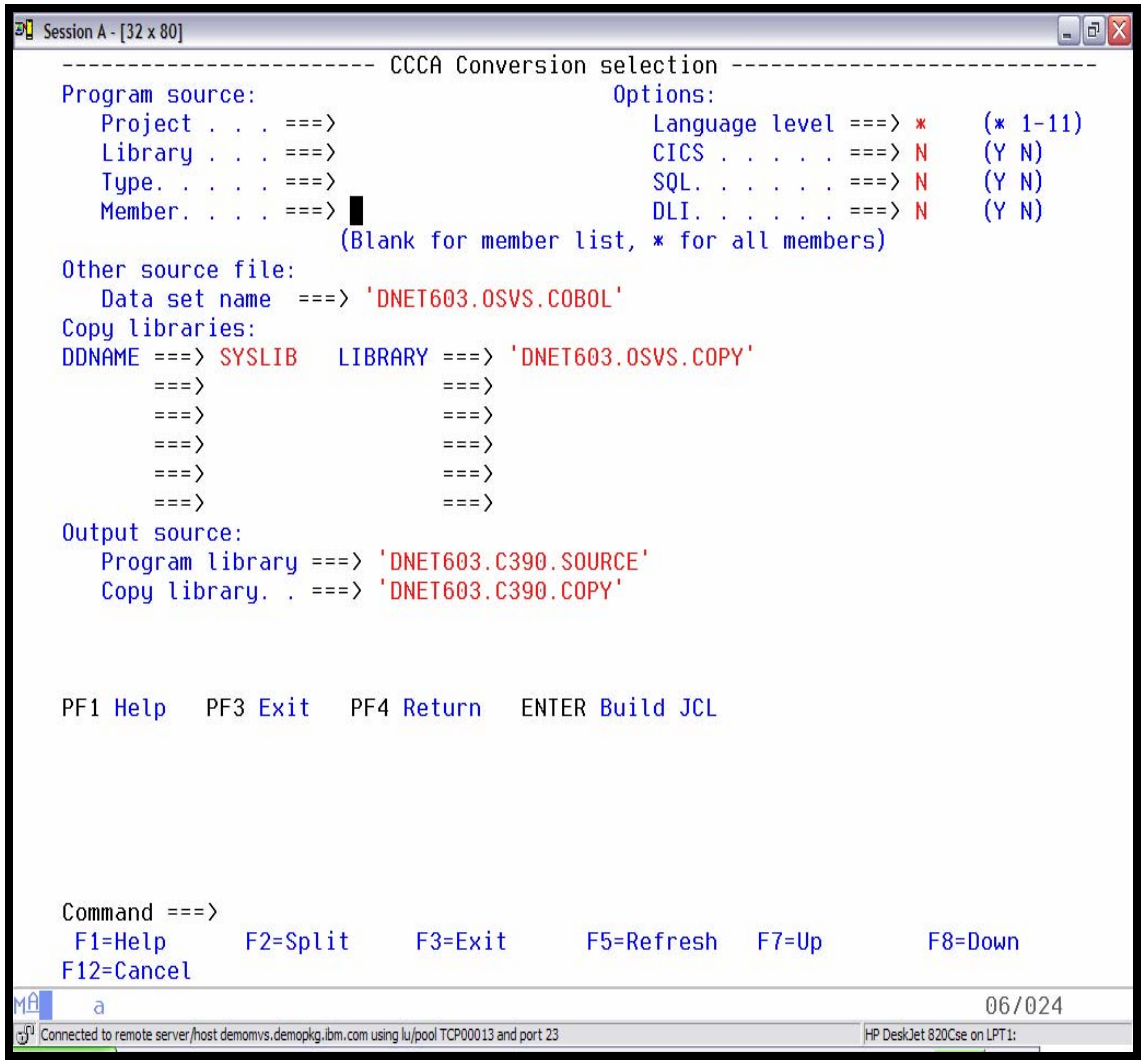
COBOL Modernization Utility ISPF Interface:

- Convert Menu
  - From this menu code can be converted
  - When code is converted a project conversion report log is generated automatically
  - Individual reports are generated for each converted source file

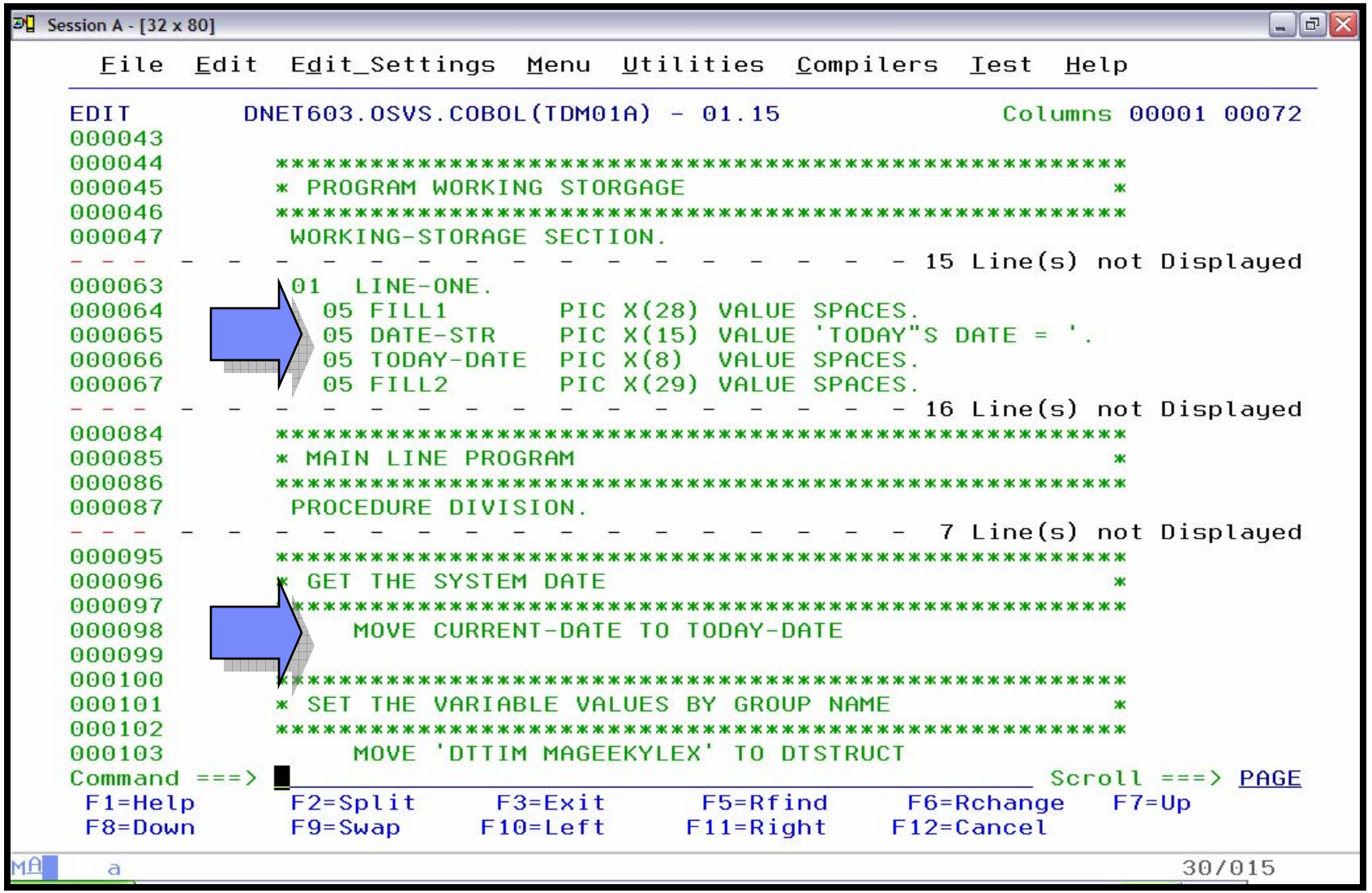


COBOL Modernization Utility ISPF Interface:

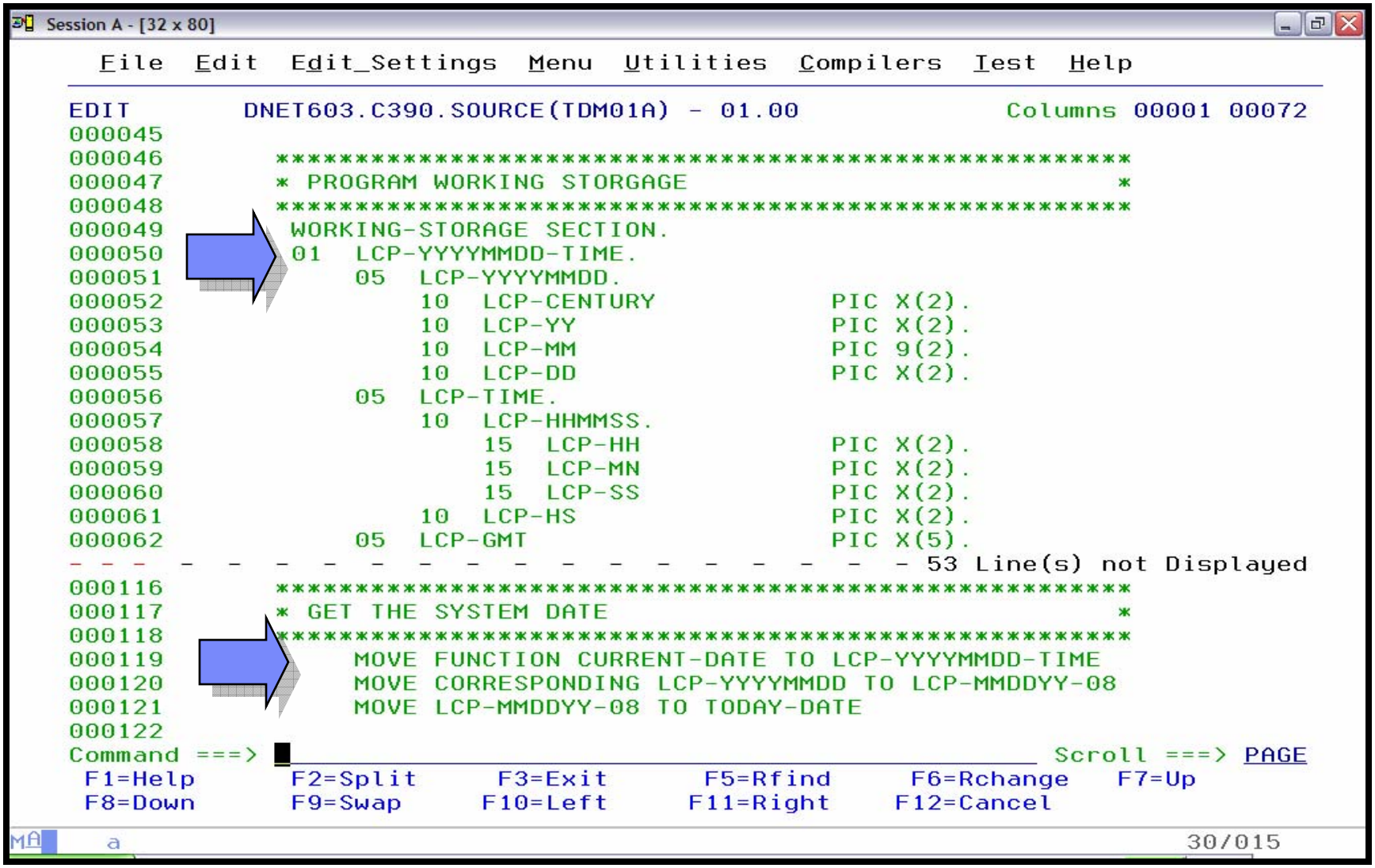
- Conversion
  - Define the “to be converted” COBOL source and copybook libraries
  - Define the output converted COBOL source and copybook libraries
  - Select the options of converting language sensitive runtimes (CICS, SQL, etc)



COBOL 74 Code (OS/VS COBOL):



COBOL 85 Converted (LE Conforming):



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- ***Test and Promote***
  - ***Test all converted modules and migrate to production***

DTUAF Coverage Utility Overview:

- *Code coverage utility for z/OS applications to support Regression and Unit testing and Sarbanes-Oxley compliance*
- *Part of the IBM Debug Tool Utilities and Advanced Functions*
- *Supports IBM Compilers:*
  - *COBOL, C, C++, PL/I, assembler*
- *Supports all z/OS application runtime Environments*
  - *CICS, TSO, JES/Batch, IMS Including IMS/TM, DB2 Including Stored Procedures*
- *Focus support for QA regression testing in as seamless and scaleable*
- *Enables Sarbanes-Oxley z/OS compliance*
- *Order Debug Tool Utilities and Advanced Functions PID*
  - ***5655-R45***

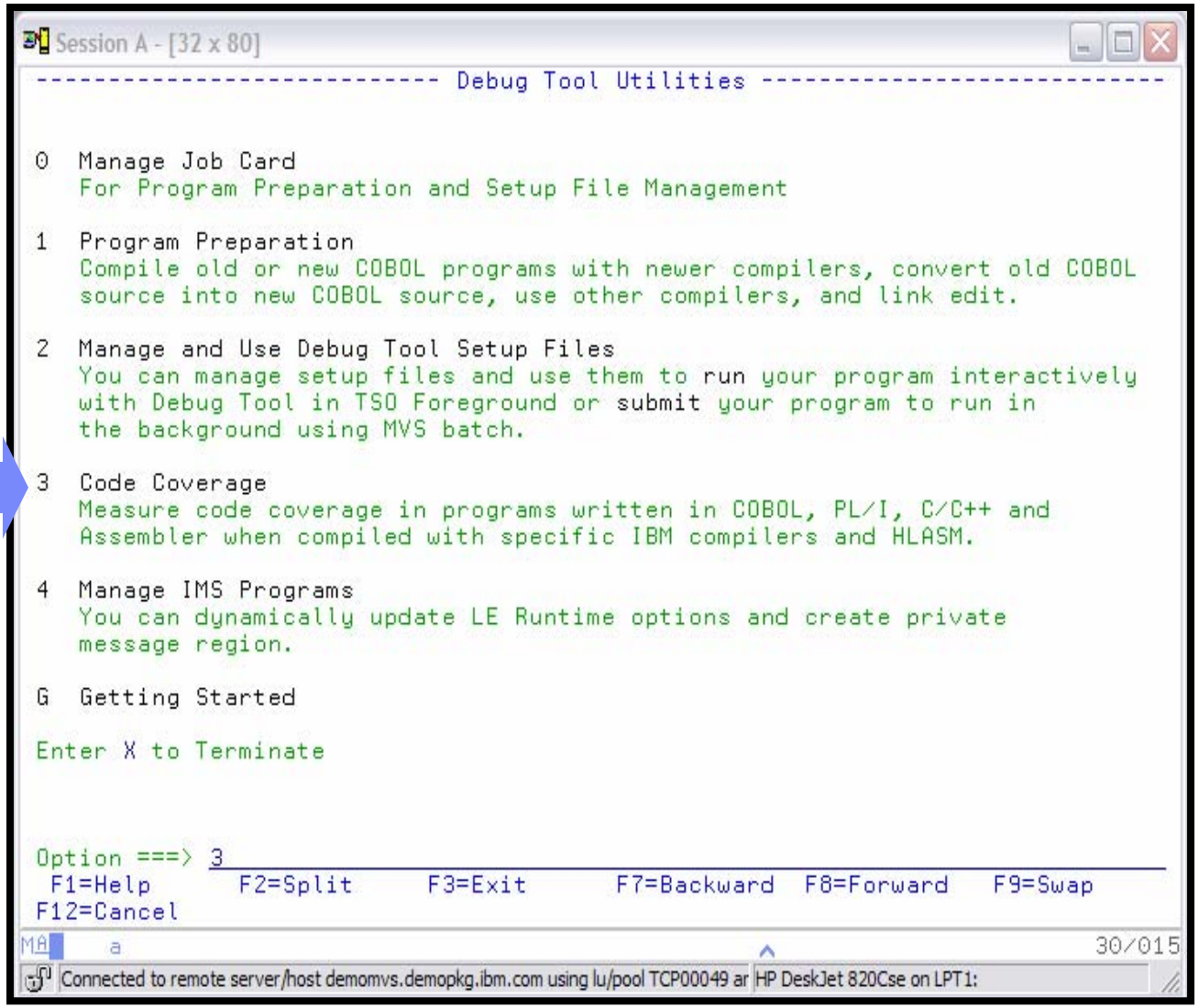
- *Debug Tool Code Coverage Utility Features:*
  - **Does not require any updates to the test case runtimes (does not require updates to present regression test cases)**
  - **Supports any number of testers running multiple executions**
  - **Accumulates coverage statistics accorss multiple runs by multiple testers**
  - **Reports:**
    - *Reports statement coverage*
    - *Reports statement frequency*
    - *Reports branch execution*
    - *Provides 1403 reports for coverage*
    - *Provides Browser HTML reports for coverage*
    - *Generates XML report output for migration*
- Information available at: www.ibm.com/software/awdtools/deployment

DTUAF Coverage Utility Delivered Function:

- *Sarbanes-Oxley Compliance*
  - *Automates the creation of a documented audit trail of all testing (both unit and QA testing) for all program changes migrated into production*
- *Regression Testing Validation*
  - *Verification that a regression test run has exercised all changed programs and changed lines of code*
- *Regression Testing Optimization*
  - *Identification of redundant regression test cases along with identification of missing regression test cases*
- *Test Management Monitoring of Testing Effort*
  - *Background monitoring and measurement of the testing team effort*
- *Unit Test Validation*
  - *Verification that the level of Unit Testing has exercised all changed lines of code*
- *Application Understanding*
  - *Runtime understanding of how one or more programs **work***

Coverage Utility:

- DTUAF Coverage Utility:
  - A the setup and JCL generation functions are accessed from the Debug Tool DTSU main menu



Coverage Utility:

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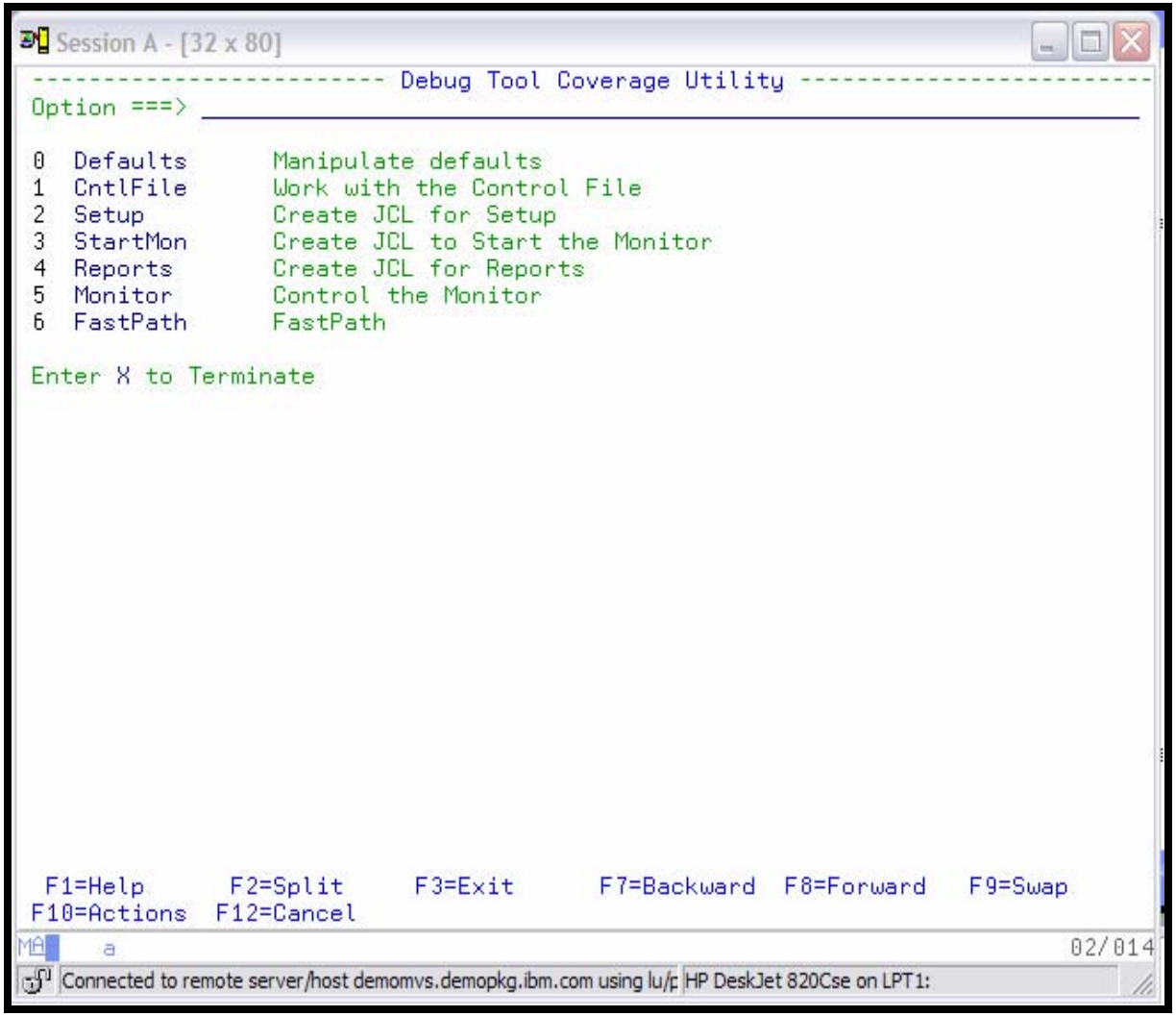


Debug Tool Coverage Reports:

- **Summary Report:**
  - Report showing a "easy to read" matrix of all programs, number of statements executed and not executed, and summary statistics
- **Annotated Listing:**
  - Report generation of the compiler listing adding "flags-tags" to each source statement showing if the statement executed or if the program branch was taken.
- **XML:**
  - An XML generation of the coverage statistics collected that can be migrated to alternate platforms and managed for the Coverage Utility's user's unique analysis

Coverage Summary Report:

```
1 *********  DTCU SUMMARY:                    PROGRAM AREA DATA                    ********
0                DATE: 12/05/2004
                 TIME: 09:32:07
        TEST CASE ID:
0 |<--                       PROGRAM IDENTIFICATION                        -->|
  |                             |                                             | STATEMENTS:             | BRANCHES:              |
  | PA LOAD MOD PROCEDURE       | LISTING NAME                                |  TOTAL    EXEC    %     |  CPATH   TAKEN    %     |
```

PA	LOAD MOD	PROCEDURE	LISTING NAME	STATEMENTS: TOTAL	EXEC	%	BRANCHES: CPATH	TAKEN	%
1	COB01	PROG	DNET603.CODE.COBOLST(COB01A)	6	6	100.0	0	0	100.0
2		PROGA		5	4	80.0	6	5	83.3
3		PROCA		1	0	0.0	0	0	100.0
4		LOOP1		3	3	100.0	2	1	50.0
5		LOOP2		2	2	100.0	2	1	50.0
6	COB01	PROGB	DNET603.CODE.COBOLST(COB01B)	6	5	83.3	6	4	66.7
7		PROCB		1	1	100.0	0	0	100.0
8		LOOP1		3	3	100.0	2	1	50.0
9	COB01	PROGC	DNET603.CODE.COBOLST(COB01C)	5	5	100.0	6	6	100.0
10		PROCC		3	2	66.7	2	1	50.0
11		LOOP1		4	3	75.0	4	2	50.0
12		LOOP2		2	2	100.0	2	1	50.0
13	COB01	PROGD	DNET603.CODE.COBOLST(COB01D)	4	0	0.0	4	0	0.0
14		PROCD		1	0	0.0	0	0	100.0
15		LOOP1		1	0	0.0	0	0	100.0
Summary for all PAs:				47	36	76.6	36	22	61.1

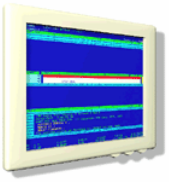
Coverage Annotation Listing Report:

```
1                    DTCU Annotation Symbols
-
  Each  instruction line of the listing has a character to the
  right of the statement number to indicate what happened
  during the test run:
0 &   A conditional branch instruction that has executed both ways
  >   A conditional branch instruction that has branched but not
      fallen through
  V   A conditional branch instruction that has fallen through but
      not branched
  :   Non-branch instruction that has executed
  ^   Instruction that has not executed
  @   Data area in the assembler listing
  %   An unconditional branch instruction that has executed in the
      assembler listing

 000036
 000037               * THE FOLLOWING ALWAYS PERFORMED
 000038
 000039                PROG.
 000040               * ACCESS BY TOP LEVEL QUALIFIER
 000041 :                  MOVE 'ILCHIMVS' TO TASTRUCT                29          >0001<
 000042
 000043               * ACCESS BY MID LEVEL QUALIFIERS
 000044 :                  MOVE 'ILSPR' TO LOC-ID                     30          >0001<
 000045 :                  MOVE 'AIX' TO OP-SYS                       33          >0001<
 000046
 000047               * ACCESS BY LOW LEVEL QUALIFIERS
 000048 :                  MOVE 'KY' TO STATE                         31          >0001<
 000049 :                  MOVE 'LEX' TO CITY                         32          >0001<
 000050 :                  MOVE 'VM ' TO OP-SYS                       33          >0001<
 000051                    .
 000052
 000053                PROGA.
 000054 &                  PERFORM  LOOP1 UNTIL TAPARM1 = 0           70 24       >0001<
 000055
 000056 >                  IF TAPARM2 = 0   THEN                      25          >0001<
 000057               *   PROCA NOT EXECUTED
 000058 ^    1                 PERFORM PROCA.                         66          >0000<
```

Debug Tool Utilities Advanced Functions Interactive Facility

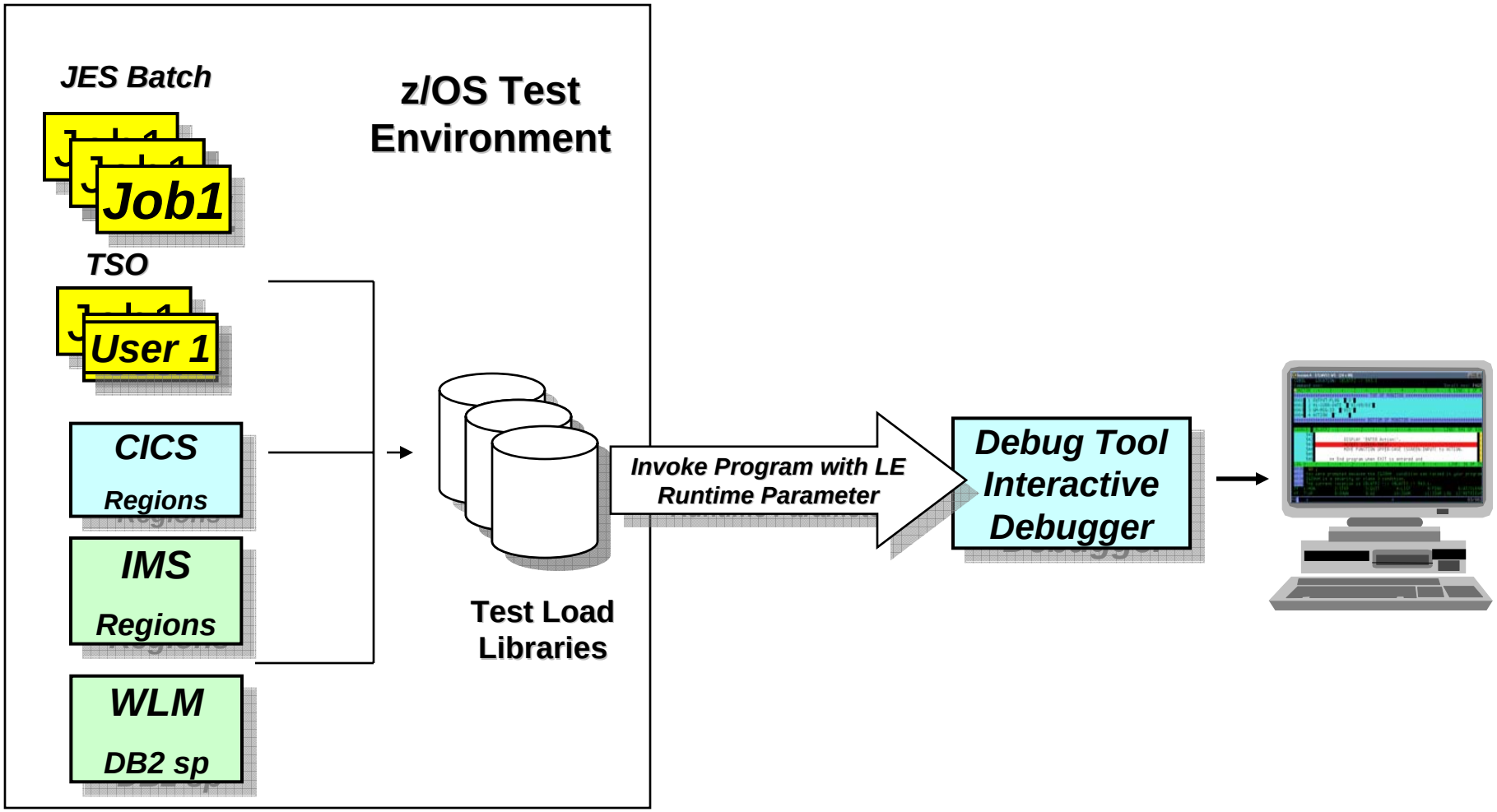
DTUAF Interactive Debugger Overview:



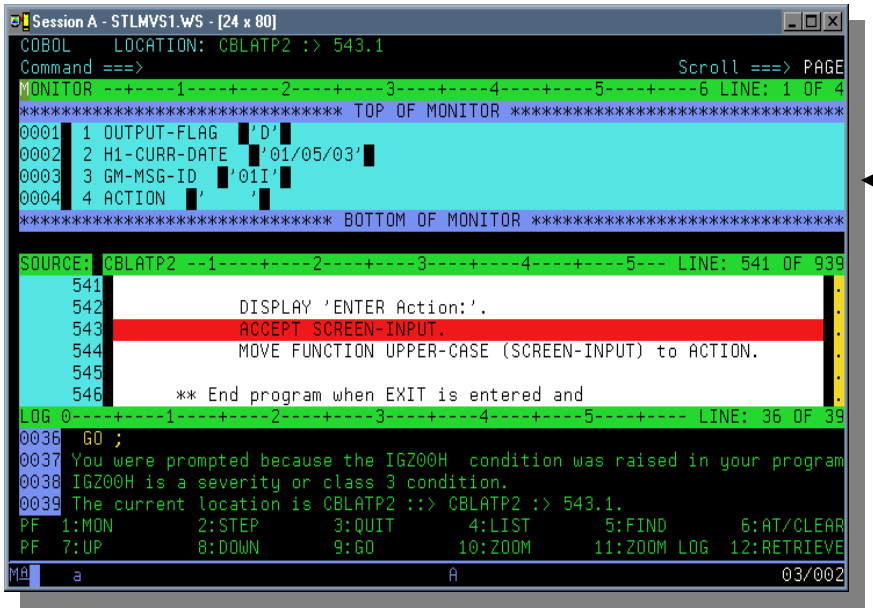
- *Interactive Source Debugger for z/OS compiled and assembled programs*
- *Base Feature of Debug Tool Utilities and Advanced Functions*
- *Common User Interfaces Across All z/OS Subsystems*
- *Consistent Across Languages*
  - ***COBOL (all versions), C/C++, PL/I, assembler***
- *All z/OS Subsystems Supported:*
  - ***CICS, TSO, JES/Batch, IMS Including IMS/TM, DB2 Including Stored Procedures, Unix System Services (USS), MQSeries***
- *Order Debug Tool Utilities and Advanced Functions PID*
  - ***5655-R45***

- *Interactive Debug Features:*
  - **Source-level Debugging**
  - **Step Mode Debugging**
  - **Multiple Breakpoints - Conditional**
  - **3270 and Workstation GUI Interfaces**
  - **Customizable 3270 Interface**
  - **Programmable Command Script Support for Background Execution**
  - **Interactive "Playback" support for all programs**
  - **"Automonitor" support for COBOL, PL/I, and assembler programs**
  - **Object level "disassembly" debug support**
  - **Support for terminal and background CICS and IMS TM transactions**
  - **Command logging Of Debug Session**
  - **Dynamic Program Source Logic Patching**
  - **Frequency Sampler**
- ***Information available at:***
  www.ibm.com/software/awdtools/deployment

DTUAF Interactive Debugger:



DTUAF 3270 VTAM Interface:



- **Full-screen mode**
  - 3270 interface
  - Work with Debug Tool from a VTAM terminal
  - Debug Tool uses a terminal that you specify… your CICS or TSO terminal can be used