COBOL Migration is an OS/390 issue!

Migrating to Language Environment and COBOL for MVS & VM

GUIDE session AP150
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Language Products
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April 1997

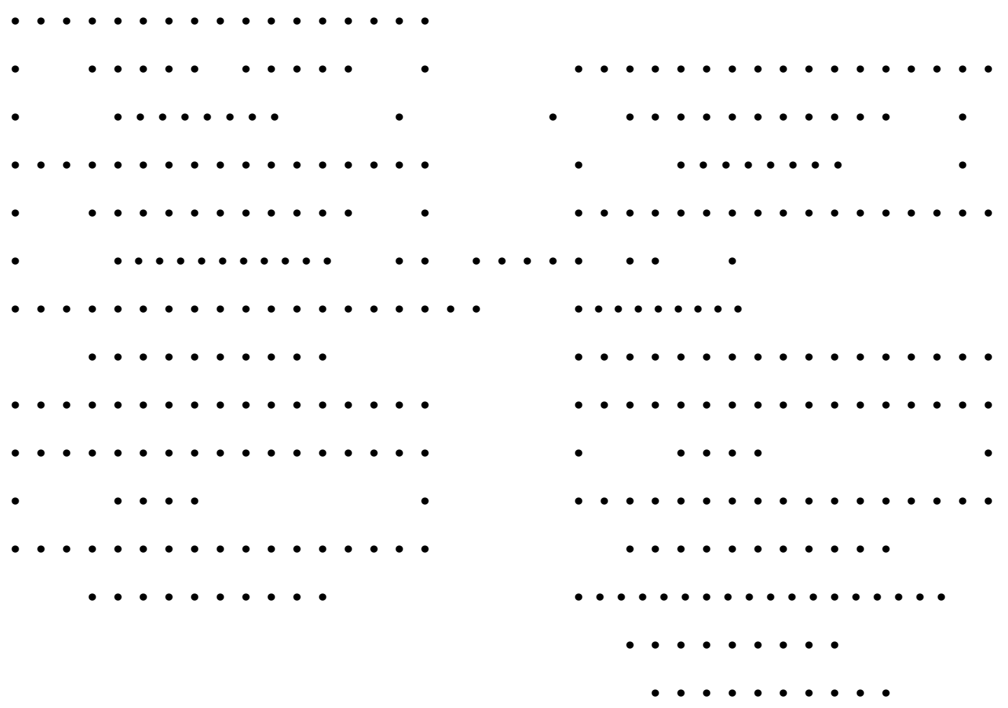
GUIDE Spring 1997

Outline

IBM

- **Product overview**
- **News update from IBM COBOL development**
- **Migration overview**
- **Planning for Migration**
- **Benefits of Migration**
- **Preparation for Migration**
- **Using the new run time**
- **Testing your applications**
- **Moving LE into production**
- **COBOL source conversion**
- **Technical Advantages of Language Environment**

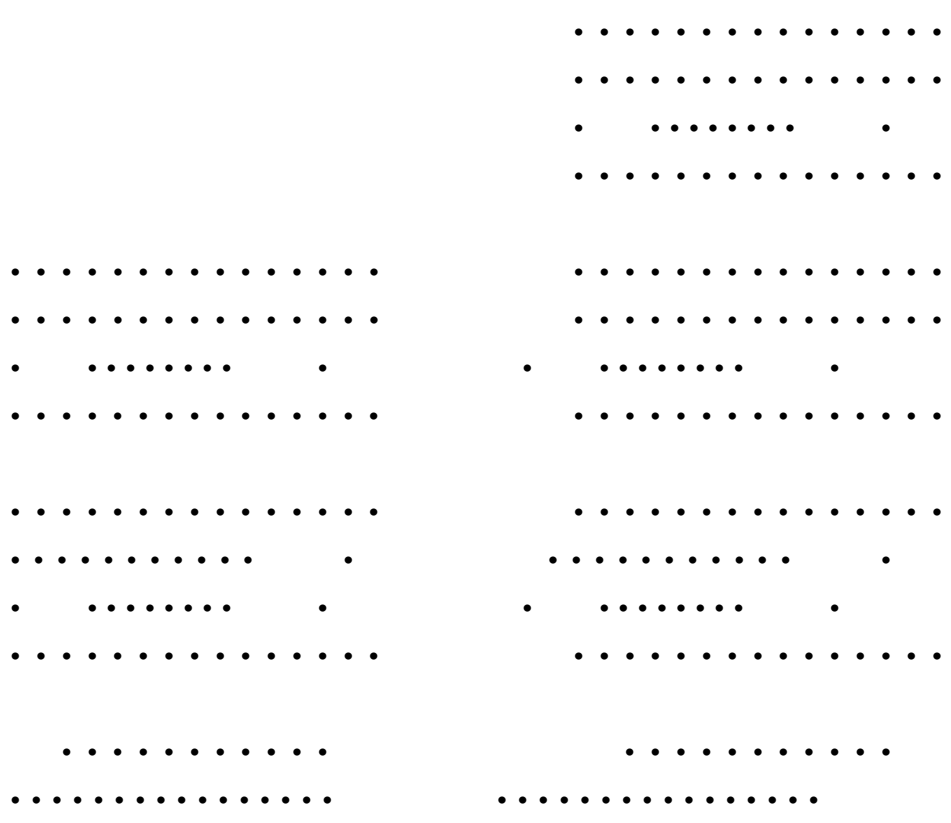
Obsolete/Stabilized products



- OS/VS COBOL compiler and run-time library
  - Service support ended June 1994
- VS COBOL II compiler and run-time library
  - End of service date will be announced March 1997
  - To help customers migrating off VS COBOL II

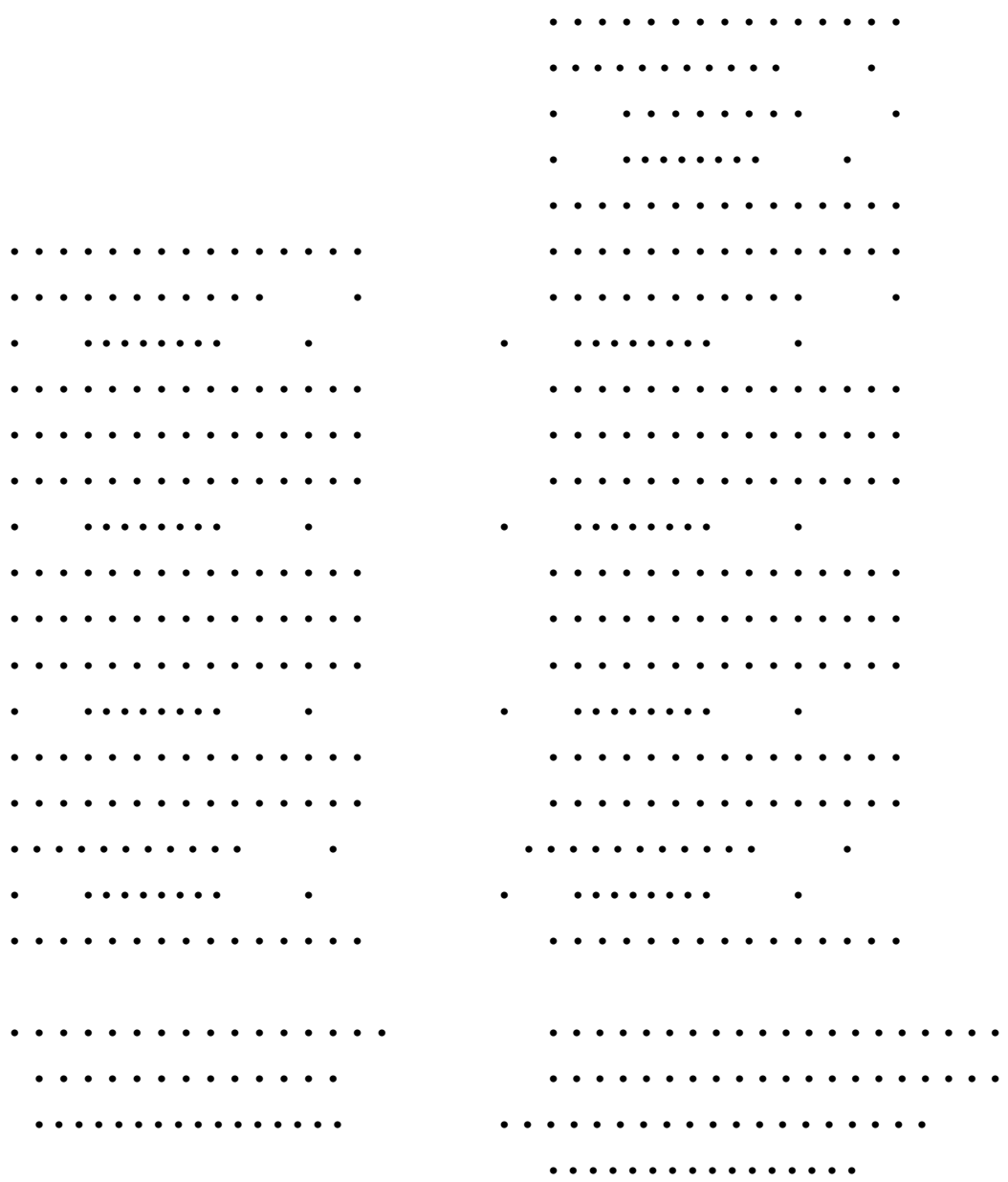
Strategic Products

Obsolete/Stabilized run-time libraries



- Old languages run-time library had same name as compiler
- Had to separate compiler and libraries for Language Environment

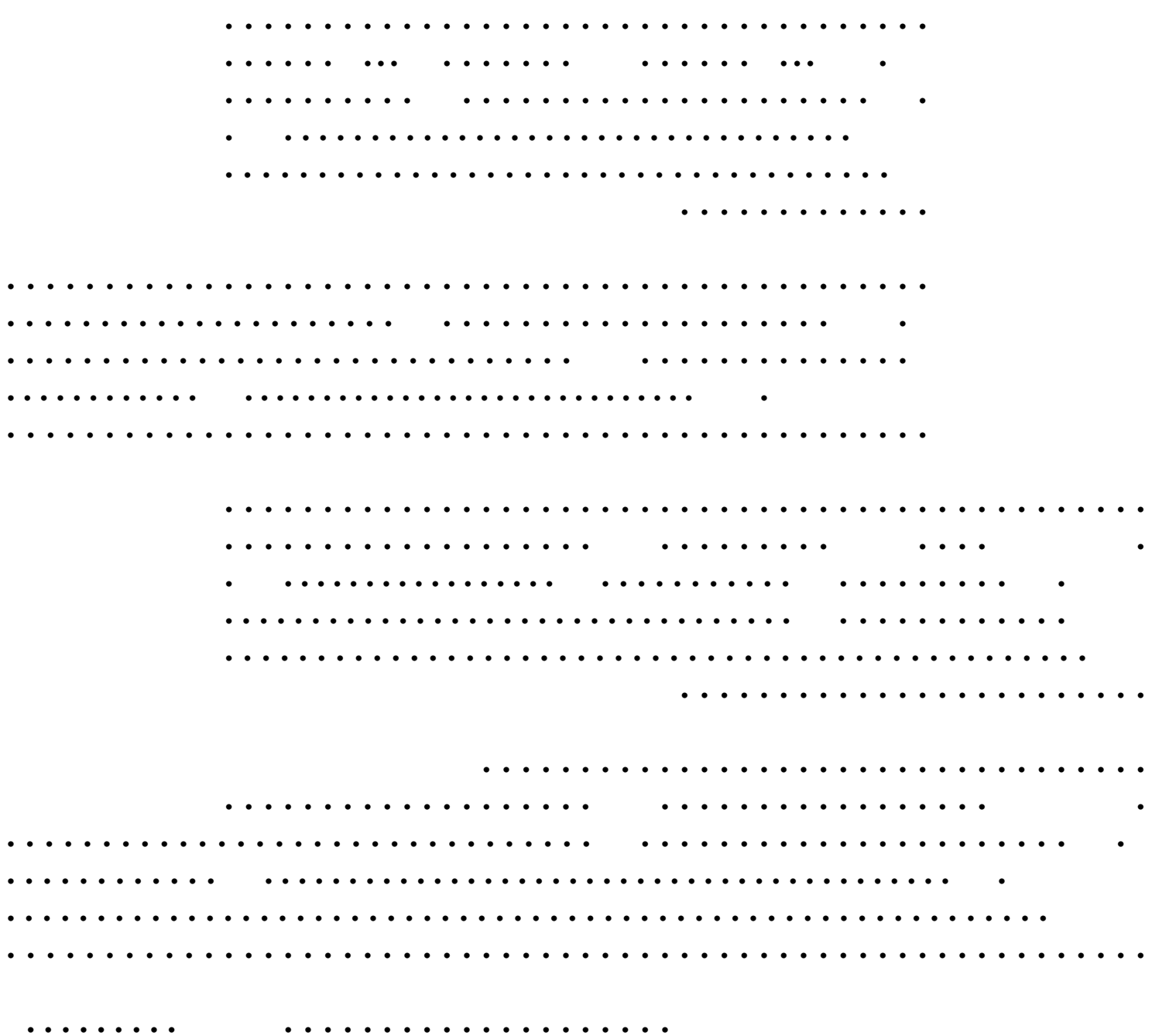
Strategic Run-time libraries



LE R3 End Of Service in 3/97

LE R4 End Of Service in 9/97

Programs supported by LE R5 and later



Service for OS/VS COBOL programs without any extension from IBM!

- **How?**

- **Every COBOL program requires library routines in order to execute.**
  - **Example: ILBOVOC for VSAM OPEN/CLOSE**

- **COBOL programs that are using supported versions of the library routines are supported by IBM service!**
  - **All OS/VS COBOL and VS COBOL II library routines are in LE**

- **Complete your migration without recompiling any programs!**

The name game

IBM

- COBOL compilers for MVS & VM
  - 5688-197:
    - COBOL/370 Release 1
    - IBM COBOL for MVS & VM Release 2
  - coming soon:
    - IBM COBOL for OS/390 & VM
- COBOL run-times for host:
  - VM: Language Environment for OS/390 & VM Release 6 (5688-198)
  - MVS: LE element of OS/390 R2 (5645-001)
- IBM COBOL for workstations:
  - IBM VisualAge for COBOL for OS/2 (5622-793)
    - Includes Windows 95/NT support!
    - Standard Edition: 83H9131
    - Professional Edition: 83H9095
    - VA Test for OS/2: 33H0005
  - IBM COBOL Set for AIX (5765-548)
- IBM COBOL for VSE:
  - Replacements for VS COBOL II and DOS/VS COBOL:
  - COBOL for VSE (5686-068)
  - LE for VSE R4 (5686-094)
  - PL/I for VSE (5686-069)

- VSAM control blocks above the line
  - VSAM buffers already above for XA/ESA systems
  - VS COBOL II Release 4 - APAR PN72097
  - LE/370 Release 3 and 4 - APAR PN72983
  - In base LE Release 5 product
  - Solved a unique(?) customer problem, helps everyone
- COBPACK serviceability APAR for VS COBOL II R4 and LE/370
  - VS COBOL II Release 4 - APAR PN59231
  - In base LE/370 Release 4 product
  - Many customers APPLY maintenance without ACCEPTing it
  - Before this new procedure, rebuilding COBPACK used modules from distribution libraries only
  - Allows rebuilding of COBPACKs without losing temp fixes by using modules from target libraries

- COBOL for MVS & VM Release 2 programs will NOT run on LE R4
  - LE for MVS & VM Release 4 books say they will
  - You must migrate to LE for MVS & VM Release 5 before you can use the COBOL for MVS & VM Release 2 compiler
- COBOL for MVS & VM Release 2 has 15 new reserved words:
  - CLASS-ID END-INVOKE INHERITS INVOKE
  - LOCAL-STORAGE METACLASS METHOD
  - METHOD-ID OBJECT OVERRIDE RECURSIVE
  - REPOSITORY RETURNING SELF SUPER
- APAR PN71388 for COBOL/370 provides an alternate reserved word table for Release 1 that will flag Release 2 reserved words with an informational message.
- COBOL for MVS & VM Release 2 provides an alternate reserved word table for users who don't need the new function, and want compatibility with VS COBOL II reserved words.

Migration overview

IBM

- Plan, plan, plan
- Communicate with management and users
  - Make friends with your system programmer
  - Don't let OS/390 force LE into LNKLST too early!
- Migrate runtime first, then upgrade source
- Use old compiler until new run time in production
- Migrate in test environment first
- Regression test...why?
  - Your code
  - IBM code
  - Third party code
- Migrate tested applications to production environment

Migration overview

IBM

Everything you need to know!

- **Migration publications**
  - **IBM COBOL Compiler and Run-Time Migration Guide (GC26-4764)**
  - **IBM PL/I Compiler and Run-Time Migration Guide (SC26-3118)**
  - **IBM C/C++ for MVS/ESA Compiler and Run-Time Migration (SC09-2002)**
  - **IBM Language Environment for OS/390 & VM Run-Time Migration (SC26-8232)**
  - **Call (800)879-2755 to order IBM publications**
- **Other resources**
  - **COBOL CFORUM (Available though TALKLINK of IBMLINK)**
  - **http://www.software.ibm.com/ad/cobol/cobol.htm**
  - **http://www.software.ibm.com/Year2000**
  - **http://www.s390.ibm.com/os390/bkserv**
- **Missing source?**
  - **http://www.source-recovery.com**
  - **(770)785-9801**

Migration overview

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- **Rex Widmer's fundamental rules for migration**

  1. **The run-time package must be at a product and maintenance level equal to, or later than, any compiled code which is executed under the run-time package.**

  2. **All dynamic run-time package components must be at a product and maintenance level equal to, or later than linked-in run-time components which are executed under the run-time package.**

- **Your migration plan may have long term effects. Example:**

  - **If you have all NORES now and you install LE in LINKLST/LPA**

  - **Every relink will mean a newly migrated application**

  - **NORES behavior to RES behavior without recompile**

  - **Migration could still be going on in 10 years!**

- **I recommend planning to get it all done with the same technical staff available for problems within as short a period as possible**

Planning for migration

IBM

- Are you ready for Language Environment?
  - MVS/ESA V3.1.3 or later (or VM/ESA)
  - If CICS, then must be CICS V3.3 or later
    - no CICS required if you don't use it!
  - NO macro-level CICS applications
    - could take a while to convert, don't need to buy LE until you have converted to Command-level
  - Other products may need to be updated
    - TCP/IP 3.1, BookManager 1.3, OfficeVision/MVS 1.3, Netview 3.1
  - Run-time migration, source conversion

- Are your vendors ready?
  - Vendor Enabled Tools document on MKTTOOLS
    - LEVNDRST PACKAGE
  - If your vendor has not heard the word
    - Ask them to fax their request for info to (914)435-1752
    - Fax us the company name, product name, and phone number
  - Other questions or information about IBM products in general:
    - 1 (800) 426-2255 IBM Direct Marketing
    - 1 (800) 627-8363 IBM S/390 Developers Association

Planning for migration

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1. **Develop a cost/benefit analysis**
   - **Include YEAR 2000, client-server, OO in your benefit**
   - **See ″Technical Advantages of LE″**
2. **Take inventory of your COBOL development tools**
3. **Assess requirements of new software**
   - **Prerequisite product levels**
   - **Compatibility with vendor products**
   - **Compatibility with IBM products**
4. **Take inventory of existing applications**
5. **Assess migration effort for each application**
6. **Schedule training for programmers**

Migration and Year 2000 conversion

- Share the same process, and most of the same steps
  - Planning
  - Inventory
  - Ownership
  - Status
  - (Source conversion/Year2000 changes)
  - Compile, link
  - Unit Test
  - System Test
- Combine and save money and time!

What could go wrong without planning?

- Improper setup
  - One large customer installed LE R3 with default storage options and started running out of storage in IMS region when running a high volume of transactions
    - Even after fixing it in test, failed to move change to production
    - The storage defaults were changed in LE R4
  - One customer noticed a big performance hit when using TRUNC(BIN), problem was solved by using TRUNC(OPT).
    - TRUNC(BIN) should never be the default option
- Incomplete investigation into vendor products
  - One customer thought they were all ready to go to LE Release 3, but when they started testing they found that TCP/IP Version 2 does not run with LE, so they had to start migrating to TCP/IP Version 3 Release 1.
    - TCP/IP Version 2 was trying to dynamically access the C Version 1 library. TCP/IP Version 3 runs with either C Version 1, Version 2, or LE.

What do you get with COBOL for MVS & VM?

- See ″Technical Advantages of LE″
  - In back of handouts

- For OS/VS COBOL users,
  - 31-bit capability
  - Much improved CICS interface
  - Structured programming constructs
  - Hex literals, reference modification
  - Re-entrant programs

What do you get with COBOL for MVS & VM?

- For ALL COBOL users
  - The base for Object-Oriented COBOL
  - The base for Client-Server using COBOL
  - Any future performance improvements
  - New! OPTIMIZE(FULL) feature
  - New! RMODE option for NORENT above the line
  - Condition handling for entire application using COBOL programs
  - All I/O buffers above the line
  - Full data striping support (DFSMS)
  - Improved ILC performance
  - Intrinsic Functions
    - Including date functions that return 4-digit year dates

Take inventory of your applications

- COBOL runtime currently in use
- COBOL runtime options used
  - LIBKEEP? RTEREUS?
- COBOL compiler options used
  - RES? TRUNC? NUMPROC? CMPR2?
- COBOL source level 68, 74, 85, ?
- What, if any, will need to be re-linked?
  - For COBOL-PL/I ILC, start relinking before migration
    - See PL/I migration aid (in PL/I Migration Guide)

Preparation for migration

IBM

- **EDGE Portfolio Analyzer looks at load modules**
  - **EDGE Portfolio Analyzer tool (5633-009)**
  - **Ask IBM to use option 3 ″Software Ordering Information″ in the HONE system**
  - **EDGE tool can tell you what needs to be relinked**
  - **EDGE tool can build Linkage Editor control statements to make relinking easy**

The most difficult migrations

- OS/VS COBOL NORES programs that use assembler with SVC LINK for "CALLing" subprograms
  - SVC LINK creates new enclave, OS/VS under LE must be single enclave in non-CICS
- Any applications that do their own program management with assembler or have assembler programs that use high order bits
- Any applications that have assembler programs that use high order bits of registers
- Shops that use exits on the DCB EXLST for label processing
  - VS COBOL II and COBOL for MVS & VM use them all
- Any shop using modified ILBO* modules
- Applications that set SPIEs or STAEs and trap abends
  - Must migrate to LE condition handling
  - We have some relief for VS COBOL II programs that use SPIE under LE, as long as SPIE is RESET after application code
- OS/VS COBOL ILC with PL/I
  - Must upgrade COBOL before migrating to Language Environment

- Set up LE for COBOL users

  If moving from VS COBOL II runtime:

  - Install CEEBX05A sample user exit
    - Instructions in LE Installation manual
    - Use CEEBX05A in place of CEEBXITA

  For all COBOL users, set default options:

  - ABTERMENC(ABEND)
  - CBLQDA(OFF)
  - TERMTHDACT(ABEND)

- For COBOL ILC, start relinking now

- For OS/VS COBOL with ESTAE exits, start source conversion

- For mixed-language shop, no COBOL ILC:

  For a COBOL-only migration

  - Install PL/I and C ahead of LE in concatenation

Recommended options for all languages:

- ABTERMENC(ABEND) Default is RETCODE
- ALL31(OFF) (ON) if all migrated or on CICS
- CBLOPTS(ON)
- CBLQDA(OFF) Default is ON
- CHECK(ON) maps to SSRANGE of VS COBOL II
- NODEBUG USE FOR DEBUGGING
- RPTOPTS(OFF)
- RPTSTG(OFF)
- RTEREUS(OFF) RTEREUS can have nasty side affects!
- STORAGE(NONE,NONE,NONE,8K)
  - if no uninitialized variables
- STORAGE(00,NONE,NONE,8K)
  - will zero out WORKING-STORAGE variables (X'00')
- NOTEST
- TERMTHDACT(DUMP) Default is TRACE
  - or TERMTHDACT(UADUMP) For SYSUDUMPs

TRAP(ON)

- TRAP(OFF) is only for diagnosis purposes

Testing your applications

IBM

- Test every vendor product and package first
- Test a cross section of your applications
  - You shouldn't have to test every application
  - Test the difficult applications
  - Definitely test the critical applications
  - Test error conditions too: next foil
- Test in CICS, IMS/DC, DB2
- Try to re-create actual production use
- Use an entire system if possible
- Use Omegamon to zap LE into LINKLST for testing

Testing your applications

IBM

- Test missing DD statements for the following:
  - DISPLAY and ACCEPT
  - QSAM file - OPENed for OUTPUT and for INPUT
  - VSAM file - OPENed for OUTPUT, for INPUT, and for I-O
- Test PARM= string/ PROCEDURE DIVISION USING:
  - Containing no '/' characters
  - Containing a date - 08/16/95
- CALL 'user-abend-subroutine'
  - Your own
  - ILBOABN0
  - IGZEABN - believe it or not!

Testing your applications

IBM

- Test behavior of QSAM input and output files when an I/O error is encountered and no FILE STATUS checking is performed
- Test behavior of outputting more records than can be accommodated by the file allocation for a QSAM file with no FILE STATUS checking
- Test fixed file attribute conflicts between file label, DD statement, and FD for OPEN OUTPUT
- Test behavior of ADDing +1 to a USAGE DISPLAY signed and unsigned field containing blanks
- Test behavior of ADDing +1 to a PICTURE S999 COMPUTATIONAL data item that contains +999
- Test behavior of DIVISION by zero, for all data types, with no ON OVERFLOW clause
- Test behavior of MOVEing a USAGE DISPLAY signed and unsigned to a similar field if the sending field contains blanks

- A suite of testcases covering this list of scenarios can be constructed with perhaps 15 or 20 source programs.

- In many cases, a single relatively simple test program can be used for several of the scenarios:
  - This can be done via JCL changes
    - Omitting a DD statement
    - Coding a conflicting DCB parameter on the DD
    - Coding a very small amount of primary file SPACE and no secondary SPACE

Moving LE into production

IBM

- Install target depends on what languages are used
  - LINKLST or LPA only when everything runs under LE
- STEPLIB for old applications that will not run under LE
  - Complete the migration or re-write later
- STEPLIB provides maximum control with worst performance
  - Customer feedback says STEPLIB noticeably slower
- One IMS region at a time
- One CICS region at a time

Moving LE into production

IBM

- Possible scenarios for controlled migration
  - Batch1:
    - Newly migrated applications STEPLIB to LE
    - Deferred applications STEPLIB to old runtime
    - At a given point change from old runtime to new in LPA/LINKLST
    - Start deleting STEPLIB for migrated applications
  - Batch2:
    - Change all applications to STEPLIB to current runtime
    - Install LE in LPA/LINKLST
    - Deferred applications STEPLIB to old runtime
    - Delete STEPLIB to migrate each application

Moving LE into production

IBM

- Scenario for controlled migration
  - Online (either IMS/DC or CICS):
    - Create new region that uses LE
    - Move transaction by transaction from old region to new
    - When all transactions moved, delete the old region
  - Online (TSO):
    - Use TSOLIB command to set up dynamic steplib concatenation

      (must be TSO/E 2.5 or later)
    - Under ISPF add LE to the ISPLLIB concatenation
    - If you can control the logon proc, put a STEPLIB there

COBOL source conversion

IBM

- OldBOL to NewBOL
  - OS/VS COBOL had LOTS of undocumented extensions
- 85 Standard or 9X Standard COBOL?
  - We couldn't wait until 199X for OO COBOL!
  - We will also support the new standard when approved

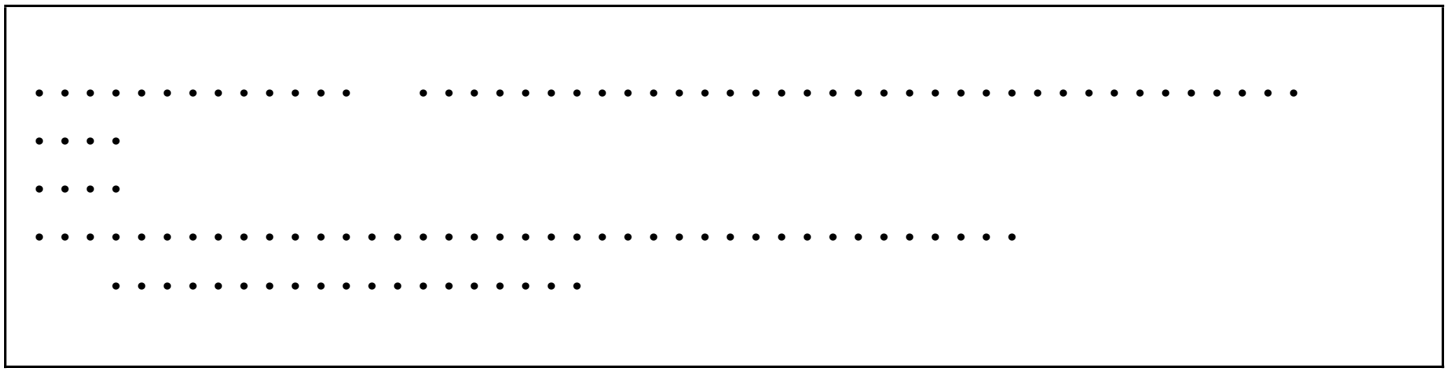
Use tools!

- IBM COBOL Conversion Aid is bigger and better
  - Known as CCCA - 5785-ABJ
  - Over 80 user requirements added in Release 2

- **NUMPROC(MIG)**
  - **Should be default for most shops**
  - **Closest to OS/VS COBOL sign processing**

- **TRUNC(OPT)**
  - **Should be default for most shops**
  - **We have changed our recommendation for CICS and DB2**
  - **OS/VS COBOL NOTRUNC actually did truncate in some cases**
  - **TRUNC(BIN) only for specific programs**

- **OPT(FULL)**
  - **Don't use for programs with flags in WORKING-STORAGE unless you add references to them**
  - **The following example shows how to code a PROCEDURE DIVISION reference that will keep BEG-MARKER from being deleted, but will not add any executable code to the object program:**
    - **The IF can never be true so the optimizer deletes the whole statement!**



COBOL for MVS 34 VM compiler options

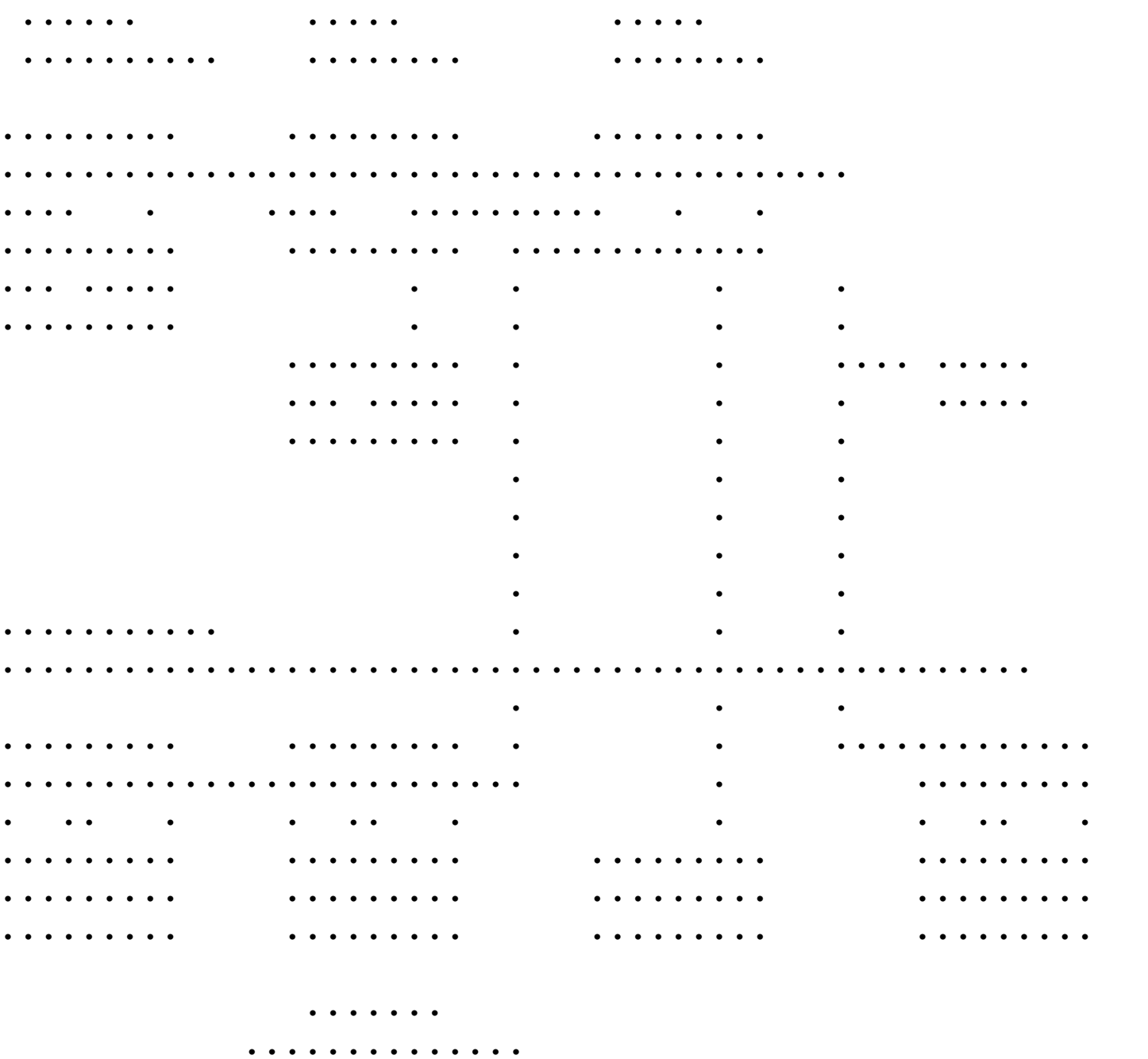
IBM

- If currently OS/VS COBOL using TRUNC as default or VS COBOL II using TRUNC(STD) as default:
  - Use TRUNC(STD) as the default under COBOL/370 or COBOL for MVS & VM.
  - They are identical!
- If currently OS/VS COBOL using NOTRUNC as default:
  - Use TRUNC(OPT) as the default under COBOL/370 or COBOL for MVS & VM.
  - They are very similar.
- If currently VS COBOL II Release 2 using NOTRUNC as default:
  - Use TRUNC(OPT) as the default under COBOL/370 or COBOL for MVS & VM.
  - They are identical!
- TRUNC(BIN) should NOT be used as a default option
  - It is TOO SLOW!
- TRUNC(BIN) should be used only for select programs that require guaranteed non-truncation of binary data.
  - This is particularly true if there is a possibility that data being moved into BINARY data items can have a value larger than that defined by the PICTURE clause for the BINARY item.
  - Example is PIC 9(7).9(2) that will have values bigger than 9,999,999.99
  - With TRUNC(BIN) it can hold up to 16,777,215.99

How to upgrade one program, such as a date routine, to COBOL for MVS & VM in an OS/VS COBOL applicaton

- A little about AMODE/RMODE
  - OS/VS programs are all RMODE=24 AMODE=24
  - COBOL for MVS & VM programs can be RMODE=24 or RMODE=ANY
  - COBOL for MVS & VM programs are all AMODE=31
- Are you ready for the 16meg line?
- Keep all data below the line until all source migrated
  - If RENT, then DATA(24)
  - If NORENT, RMODE(24) or RMODE(AUTO)
- I recommend migrating bottom subroutines first
- Old COBOL calling new COBOL is safer than new calling old
- Dynamic call is safer than static, mode switching
  - Can't enter an OS/VS COBOL program with AMODE=31!
  - Get IKF995I ILBONTR AMODE ERROR.

Example: new calling old. All calls DYNAMIC



- Extremely short on-line transactions may have dramatic difference in performance.
  - Especially when coming from NORES environment
  - You may have to redesign if this is a problem
- Installation customization macros require SYS1.MACLIB
- Do not use default options without verifying that they are correct for your shop!
  - Too many options, and too many different requirements from customers
  - No way to have "One set fits all"
- Keep your language products up to date on service as much as possible
  - IBM only tests with recent levels and
  - Down-level language migrations are harder
    - Example: VS COBOL II Release 4 base = VS COBOL II Release 3.2 at latest maintenance level
    - Example: VS COBOL II programs that CALL OS/VS COBOL programs under CICS diagnosed under VS COBOL II 3.2 with latest maint. Also diagnosed under VS COBOL II R4 and all LE releases.
- Keep control of your language products usage
  - Do not allow programmers to chose what release, what maintenance level, or you will end up with a nightmare of products

Official disclaimer

IBM

How long you can safely continue to run your OS/VS COBOL applications without a newer library is difficult to predict.

As long as nothing in your environment changes, you can run your OS/VS COBOL programs forever. However, if you change any other software in your environment, you could break any or all of your existing OS/VS COBOL applications.

A perfect example of this was DFSMS/MVS V1R3. The VSAM component changed in such a way that a bug in OS/VS COBOL library routine ILBOVOC was revealed. This bug is fixed in Language Environment for MVS & VM R5 but it still exists in OS/VS COBOL, and a future release of VSAM could again break all OS/VS COBOL programs in your shop.

PERFORMANCE:

- Inter-language CALLs are faster under LE between COBOL and other languages, with about 80% less overhead for each call.
- COBOL-assembler-COBOL calls 80% less overhead than VS COBOL II.
- All COBOL calls are faster under LE than under VS COBOL II.

  (In some cases, DYNAMIC CALL is faster than under OS/VS COBOL!)
- COBOL for MVS & VM compiler changes for object program performance: (Improvements over VS COBOL II, only available under LE)
  - OPTIMIZE(FULL) option
  - Static initialization of WORKING-STORAGE variables at compile time for NORENT programs
  - Optimized parameter list generated code (for USING phrase)
  - Improved performance of variable-length MOVEs
  - Optimized code generated for main entry point
  - Dynamic CALL literal performance improved

NEW FUNCTION:

- Support for OpenEdition MVS services, including support for some of the C language functions defined in the POSIX standard
- ANSI 1985 Intrinsic Functions available in COBOL for MVS & VM
- YEAR 2000 support
  - LE callable services that interpret 2-digit year dates as 4-digit year dates. This solves the year 2000 problem prior to changing the database to 4-digit year dates. It also makes it easy to write an application to change the database.
  - COBOL for MVS & VM Intrinsic Functions return 4-digit year dates

    (no 4-digit year dates available on OS/VS COBOL or VS COBOL II)
- High-precision math routines available to any language

  (LE callable services are only available to LE-conforming languages or LE-conforming assembler)

NEW FUNCTION:

- **LE Condition Handling (abend intercept, "0C7 catcher", etc)**

  Allows application-level condition handling so that each routine can be written without dealing with error conditions. This allows routines to be written for success and performance rather than written to address errors in individual statements. The error- handling routines can be written in the High Level Language of choice, thus helping you move away from assembler.

  (Before LE the error-handling code had to be in the same language as the application, or in assembler language. Also, in COBOL you could only have statement-specific condition handling, which means each new program had to have its own condition handling and the associated performance overhead.)

NEW FUNCTION:

- **Object-Oriented COBOL on MVS requires LE**
- **Client-server using COBOL on MVS requires LE**
- **SOM support on MVS requires LE**
- **C++ for MVS requires LE**
- **DB2 V4 Stored Procedures function requires LE**
- **CICS V4 Autoinstall Exit written in COBOL requires LE**

PLATFORM OF THE FUTURE:

- **Any future performance improvements or language enhancements such as DSOM support or XOPEN COBOL will only be available under LE.**

- **LE will be a basic part of MVS, VM and VSE through OS/390 and BOS/390, and will be mirrored on OS/2 and AIX as well. LE is already built in to the OS/400 operating system.**

- **More support of the POSIX standard and possible exploitation of the XPG4 OPEN standard would allow users access to a UNIX-like environment within MVS using C and possibly COBOL.**

SYSTEM EXPLOITATION:

- QSAM buffers can now be above the line for full exploitation of DFSMS and data striping.
- COBOL EXTERNAL data can now be above the 16 MEG line for COBOL for MVS & VM

  (Had to be below the line in VS COBOL II)
- CBLPSHPOP run-time option allows choice of performance versus error handling. (Under VS COBOL II the user had no choice and always took the performance hit of PUSH HANDLE and POP HANDLE for CALLs)
- New COBOL for MVS & VM compiler options:
  - RMODE option allows NORENT programs to run above the line
  - OPT(FULL) automatically optimizes out unused data items
- New LE support in R3:
  - Allows COBOL for MVS & VM programs compiled with NORENT and RMODE(ANY) to run above the 16 MEG line. (Only RENT was supported above the line under VS COBOL II)

USEABILITY:

- All language error messages now in latest CD-ROM collection kit

  (Previous to LE, messages in 3 different manuals)

- CBLQDA run-time option prevents dynamic allocation of QSAM files

  (Only available as a User Mod under VS COBOL II)

- COBOL for MVS & VM removes restrictions for APPLY WRITE-ONLY

  (Under OS/VS COBOL, had to use FROM on WRITE. Also, the subfields of the records could not be referred to in procedure statements.)

- Storage tuning via run-time options (no link-edited assembler, which was the only way to tune storage usage under VS COBOL II)