



Introducing LE Callable Services

Thomas Petrolino
IBM Poughkeepsie
tapetro@us.ibm.com

Copyright IBM Corp. 2003, 2010

SHARE in Boston, August 2010



Trademarks

The following are trademarks of the International Business Machines Corporation in the United States and/or other countries.

Language Environment

z/OS

z/VM

* Registered trademarks of IBM Corporation

The following are trademarks or registered trademarks of other companies.

Java and all Java-related trademarks and logos are trademarks of Sun Microsystems, Inc., in the United States and other countries.

Linux is a registered trademark of Linus Torvalds in the United States, other countries, or both.

Microsoft, Windows and Windows NT are registered trademarks of Microsoft Corporation.

UNIX is a registered trademark of The Open Group in the United States and other countries.

SET and Secure Electronic Transaction are trademarks owned by SET Secure Electronic Transaction LLC.

* All other products may be trademarks or registered trademarks of their respective companies.

Notes:

Performance is in Internal Throughput Rate (ITR) ratio based on measurements and projections using standard IBM benchmarks in a controlled environment. The actual throughput that any user will experience will vary depending upon considerations such as the amount of multiprogramming in the user's job stream, the I/O configuration, the storage configuration, and the workload processed. Therefore, no assurance can be given that an individual user will achieve throughput improvements equivalent to the performance ratios stated here.

IBM hardware products are manufactured from new parts, or new and serviceable used parts. Regardless, our warranty terms apply.

All customer examples cited or described in this presentation are presented as illustrations of the manner in which some customers have used IBM products and the results they may have achieved. Actual environmental costs and performance characteristics will vary depending on individual customer configurations and conditions.

This publication was produced in the United States. IBM may not offer the products, services or features discussed in this document in other countries, and the information may be subject to change without notice. Consult your local IBM business contact for information on the product or services available in your area.

All statements regarding IBM's future direction and intent are subject to change or withdrawal without notice, and represent goals and objectives only.

Information about non-IBM products is obtained from the manufacturers of those products or their published announcements. IBM has not tested those products and cannot confirm the performance, compatibility, or any other claims related to non-IBM products. Questions on the capabilities of non-IBM products should be addressed to the suppliers of those products.

Prices subject to change without notice. Contact your IBM representative or Business Partner for the most current pricing in your geography.



Agenda

- Overview
- Math functions
- Outputting messages
- Collecting error information.
- Manipulating date and time information
- Summary
- Appendix



Overview

- Language Environment provides a set of callable services that can be called by programs compiled with a Language Environment conforming compiler.
 - This includes assembler programs which use the CEEENTRY macro.



Overview

- Callable services beginning with CEE are valid on any platform.
- Callable services beginning with CEE3 are valid only on z/OS. (Yeah z/VM too)



Overview...

- Callable services may be called from AMODE 24 programs.
 - Language Environment will automatically switch to AMODE 31.
 - This may cause additional overhead with repeated calls.
 - Run AMODE 31 to avoid unnecessary switching.



Overview...

- Feedback codes are returned by most callable services when requested.
 - Indicate success or failure of service
 - Feedback codes may be omitted when calling a service
 - Language Environment will terminate if result of service is a severity 2 or greater feedback code.



Overview...

- Call syntax COBOL
 - CALL "CEExxxxx" USING parm1, parm2, ...,fc
 - The feedback code may be omitted
 - CALL "CEExxxxx" USING parm1, parm2, ...,OMITTED
 - Include file
 - COPY CEEIGZCT



Overview...

- Call syntax PL/I
 - Call CEExxxxx(parm1, parm2, ...,fc)
 - The feedback code may be omitted
 - Call CEExxxxx(parm1, parm2, ..., *)
 - Include file
 - %INCLUDE CEEIBMAW
 - %INCLUDE CEEIBMCT



Overview...

- Call syntax C/C++
 - CEExxxxx(&parm1,&parm2, ..., &fc)
 - The feedback code may be omitted
 - CEExxxxx(&parm1,&parm2, ...,NULL)
 - Include file
 - #include <leawi.h>
 - #include <ceedcct.h>



Overview...

- Call syntax Assembler
 - CALL CEExxxxx
 - Parms are OS style with R1 pointing to parmlist
LA 1,PARM1
ST 1,PARMLIST
LA 1,PARM2
ST 1,PARMLIST+4

...
LA 1,PARMLIST
 - The feedback code may be omitted
LA 1,0
ST 1,PARMLIST+xx
 - Include file
 - CEEBALCT



Math functions

- Names are of the form
 - CEESxyyy
 - Where x is the precision
 - I Integer 32 bit
 - S Single 32 bit floating point
 - D Double 64 bit floating point
 - Q Extended 128 bit floating point
 - Complex types also available



Math functions...

- Names are of the form
 - CEESxyyy
 - Where yyy is the function name
 - ABS Absolute value
 - COS Cosine
 - EXP Exponential base e
 - LG1 Log base 10
 - SIN Sine
 - SQT Square root
 - Many many more



Math Functions...

- Example CEESSQT (Square Root)

```
WORKING-STORAGE SECTION.  
  01  FC.  
    02  CONDITION-TOKEN-VALUE.  
      COPY  CEEIGZCT.  
        03  CASE-1-CONDITION-ID.  
          04  SEVERITY          PIC S9(4)  BINARY.  
          04  MSG-NO            PIC S9(4)  BINARY.  
        03  CASE-SEV-CTL        PIC X.  
        03  FACILITY-ID         PIC XXX.  
    02  I-S-INFO                PIC S9(9)  BINARY.  
  01  MY-INPUT                  COMP-1.  
  01  RESULT                    COMP-1.  
  01  RESULT2                   PIC ZZZZ.99.
```



Math Functions...

- Example CEESSTQT (Square Root)...

```
PROCEDURE DIVISION.
```

```
    MAIN-PROG.
```

```
        DISPLAY "IN MAIN PROG".
```

```
        MOVE 9 TO MY-INPUT.
```

```
        CALL "CEESSTQT" USING MY-INPUT, FC, RESULT.
```

```
        IF NOT CEE000 OF FC THEN
```

```
            DISPLAY "SQUARE ROOT FAILED."
```

```
        END-IF.
```

```
        MOVE RESULT TO RESULT2.
```

```
        DISPLAY "THE SQUARE ROOT OF 9 IS:      " RESULT2.
```



Math Functions...

- Example CEESSTQT (Square Root)...

...

```
MOVE 144 TO MY-INPUT.
```

```
CALL "CEESSTQT" USING MY-INPUT, FC, RESULT.
```

```
IF NOT CEE000 OF FC THEN
```

```
    DISPLAY "SQUARE ROOT FAILED."
```

```
END-IF.
```

```
MOVE RESULT TO RESULT2.
```

```
DISPLAY "THE SQUARE ROOT OF 144 IS:  " RESULT2.
```

...



Math Functions...

- Example CEESSTQT (Square Root)...

```
...  
MOVE -99 TO MY-INPUT.  
CALL "CEESSTQT" USING MY-INPUT, FC, RESULT.  
IF NOT CEE000 OF FC THEN  
    DISPLAY "SQUARE ROOT FAILED."  
END-IF.  
MOVE RESULT TO RESULT2.  
DISPLAY "THE SQUARE ROOT OF -99 IS:  " RESULT2.  
GOBACK.
```



Math Functions...

- Example CEESST (Square Root)...
Output.

```
IN MAIN PROG
THE SQUARE ROOT OF 9 IS:      3.00
THE SQUARE ROOT OF 144 IS:    12.00
THE SQUARE ROOT OF 2500 IS:   50.00
SQUARE ROOT FAILED.
THE SQUARE ROOT OF -99 IS:    50.00
```



Outputting messages

- Several services are available to output messages.
 - CEEMGET
 - Get a message for a condition token.
 - CEEMOUT
 - Output a message from a string
 - CEEMSG
 - Output a message for a condition token



Outputting messages...

- We can use CEEMSG to output a Language Environment error message associated with the failure.

...

```
MOVE -99 TO MY-INPUT.
```

```
CALL "CEESSSQT" USING MY-INPUT, FC, RESULT.
```

```
IF NOT CEE000 OF FC THEN
```

```
    CALL "CEEMSG" USING FC, MSG-DEST, OMITTED
```

```
    STOP RUN
```

```
END-IF.
```

```
MOVE RESULT TO RESULT2.
```

```
DISPLAY "THE SQUARE ROOT OF -99 IS:  " RESULT2.
```

...



Outputting messages...

- The output now looks like:

IN MAIN PROG

THE SQUARE ROOT OF 9 IS: 3.00

THE SQUARE ROOT OF 144 IS: 12.00

THE SQUARE ROOT OF 2500 IS: 50.00

CEE2010E The argument was less than 0 in
math routine SQRT .



Outputting messages...

- We can use CEEMOUT to output a string.
- String must be a 2 byte prefix string

...

```
01 MY-MSG-STRING.  
  02 MY-STRING-LEN          PIC S9(4) BINARY.  
  02 MY-STRING-TEXT.  
    03 MY-STRING-CHAR      PIC X,  
                                OCCURS 0 TO 256 TIMES  
                                DEPENDING ON MY-STRING-LEN  
                                OF MY-MSG-STRING.
```

...



Outputting messages...

- Must move length first.

```
...
PROCEDURE DIVISION.
MAIN-PROG.
    MOVE 16 TO MY-STRING-LEN
        OF MY-MSG-STRING.
    MOVE "IN MAIN PROGRAM!" TO MY-STRING-TEXT
        OF MY-MSG-STRING.
    CALL "CEEMOUT" USING MY-MSG-STRING, MSG-DEST, FC.
    IF NOT CEE000 OF FC THEN
        CALL "CEEMSG" USING FC, MSG-DEST, OMITTED
        STOP RUN
    END-IF.
...
```



Collecting error information...

- Output looks like.

IN MAIN PROGRAM!

THE SQUARE ROOT OF 9.00 IS: 3.00

THE SQUARE ROOT OF 144.00 IS: 12.00

THE SQUARE ROOT OF 2500.00 IS: 50.00

CEE2010E The argument was less than 0 in
math routine SQRT .



Collecting error information

- CEE3DMP service.
 - Requests a CEEDUMP be taken
 - Provide your own dump title
 - Pass options that control which information is included in the dump
 - Options we use when TERMTHDACT(TRACE)
 - NOENTRY COND TRACE THR(ALL) NOBLOCK
NOSTOR TRCE GENOPTS
 - Options we use when TERMTHDACT(DUMP)
 - NOENTRY COND TRACE THR(ALL) BLOCKS
STOR GENOPTS



Collecting error information...

- CEE3DMP service.
 - Recommended options when you call CEE3DMP.

■ ENCLAVE(ALL)	default
■ THREAD(CURRENT)	default
■ TRACE	default
■ FILES	default
■ VARIABLES	default
■ NOBLOCKS	default
■ NOSTORAGE	default
■ NOCONDITION	not default
■ ENTRY	default
■ GENOPTS	default



Collecting error information...

- CEE3DMP service.
 - Add service to our program.

...

```
01 DUMP-TITLE                PIC X(80) .
```

```
01 DUMP-OPTIONS             PIC X(255) .
```

```
PROCEDURE DIVISION.
```

```
MAIN-PROG.
```

```
    MOVE "SAMPLE DUMP TAKEN BY CEE3DMP." TO DUMP-TITLE.
```

```
    MOVE "NOCOND" TO DUMP-OPTIONS.
```

...



Collecting error information...

- CEE3DMP service.
 - Add service to our program.

...

```
MOVE -99 TO MY-INPUT.
```

```
CALL "CEESSSQT" USING MY-INPUT, FC, RESULT.
```

```
IF NOT CEE000 OF FC THEN
```

```
    CALL "CEEMSG" USING FC, MSG-DEST, OMITTED
```

```
    CALL "CEE3DMP" USING DUMP-TITLE, DUMP-OPTIONS, FC
```

```
    STOP RUN
```

```
END-IF.
```

...



Collecting error information...

- Output looks like.

IN MAIN PROGRAM!

THE SQUARE ROOT OF 9.00 IS: 3.00

THE SQUARE ROOT OF 144.00 IS: 12.00

THE SQUARE ROOT OF 2500.00 IS: 50.00

CEE2010E The argument was less than 0 in
math routine SQRT .



Collecting error information...

- We also have CEEDUMP output

COMMAND INPUT ==>

PREFIX=* DEST=(ALL) OWNER=JMONTI SYSNAME=

NP	DDNAME	StepName	ProcStep	DSID	Owner
	JESMSG LG	JES2		2	JMONTI
	JESJCL	JES2		3	JMONTI
	JESYSMSG	JES2		4	JMONTI
	SYS PRINT	STEP1	COBOL	101	JMONTI
	SYS PRINT	STEP1	LKED	102	JMONTI
	CEEDUMP	STEP1	GO	104	JMONTI
	SYSOUT	STEP1	GO	106	JMONTI



Date and Time information

- Language Environment provides a robust assortment of date and time services.
 - All services based on Lilian time – seconds/days since October 14, 1582
 - Valid through December 31, 9999
 - This timeframe chosen since it is a superset of all supported language time ranges.



Date and Time information...

- Let's add some to our program.

...

```
01 MY-DATE-LILIAN          PIC S9(9) BINARY.
01 MY-SECS-LILIAN          COMP-2.
01 MY-TIME-GREGORIAN       PIC X(17).
01 MY-PIC-STRING.
    02 MY-STRING-LEN       PIC S9(4) BINARY.
    02 MY-STRING-TEXT.
        03 MY-STRING-CHAR  PIC X,
                                OCCURS 0 TO 256 TIMES
                                DEPENDING ON MY-STRING-LEN
                                OF MY-PIC-STRING.
01 MY-TIMESTAMP            PIC X(80).
```



Date and Time information...

- Let's call CEELOCT to get the current local time.

...

```
CALL "CEELOCT" USING MY-DATE-LILIAN, MY-SECS-LILIAN,  
                    MY-TIME-GREGORIAN, FC.
```

```
IF NOT CEE000 OF FC THEN
```

```
    CALL "CEEMSG" USING FC, MSG-DEST, OMITTED
```

```
    CALL "CEE3DMP" USING DUMP-TITLE, DUMP-OPTIONS, FC
```

```
    STOP RUN
```

```
END-IF.
```



Date and Time information...

- Now convert MY-SECS-LILIAN to characters with CEEDATM.

```
...  
MOVE 22 TO MY-STRING-LEN OF MY-PIC-STRING.  
MOVE "MM/DD/YYYY HH:MI:SS AP" TO MY-STRING-TEXT  
                                OF MY-PIC-STRING.  
CALL "CEEDATM" USING MY-SECS-LILIAN,  
                    MY-PIC-STRING,  
                    MY-TIMESTAMP, FC.  
IF NOT CEE000 OF FC THEN  
    CALL "CEEMSG" USING FC, MSG-DEST, OMITTED  
    CALL "CEE3DMP" USING DUMP-TITLE, DUMP-OPTIONS, FC  
    STOP RUN  
END-IF.
```



Date and Time information...

- Now output MY-TIMESTAMP with CEEMOUT.

...

```
MOVE 22 TO MY-STRING-LEN OF MY-MSG-STRING.
```

```
MOVE MY-TIMESTAMP TO MY-STRING-TEXT  
OF MY-MSG-STRING.
```

```
CALL "CEEMOUT" USING MY-MSG-STRING, MSG-DEST, FC.
```

```
IF NOT CEE000 OF FC THEN
```

```
CALL "CEEMSG" USING FC, MSG-DEST, OMITTED
```

```
CALL "CEE3DMP" USING DUMP-TITLE, DUMP-OPTIONS, FC
```

```
STOP RUN
```

```
END-IF.
```



Date and Time information...

- Let's terminate with an ABEND

...

```
MOVE 1234 TO ABDCODE
```

```
MOVE 0 TO TIMING
```

...

```
CALL "CEEMOUT" USING MY-MSG-STRING, MSG-DEST, FC.
```

```
IF NOT CEE000 OF FC THEN
```

```
    CALL "CEEMSG" USING FC, MSG-DEST, OMITTED
```

```
    CALL "CEE3DMP" USING DUMP-TITLE, DUMP-OPTIONS, FC
```

```
    CALL "CEE3ABD" USING ABDCODE , TIMING
```

```
END-IF.
```



Date and Time information...

- Job output now shows U1234 ABEND:

08.35.57 JOB05201 IEA995I SYMPTOM DUMP OUTPUT 360

```
360      USER COMPLETION CODE=1234 REASON CODE=00000000
360      TIME=08.35.57 SEQ=10636 CPU=0000 ASID=0037
360      PSW AT TIME OF ERROR 078D1000 A0CC401A ILC 2 INTC 0D
360      ACTIVE LOAD MODULE      ADDRESS=20C29260 OFFSET=0009ADBA
360      NAME=CEEPLPKA
360      DATA AT PSW 20CC4014 - 00181610 0A0D58D0 D00498EC
360      AR/GR 0: 9856AFDE/84000000 1: 00000000/840004D2
360          2: 00000000/A0EA94D8 3: 00000000/20EA94D0
360          4: 00000000/20C265B8 5: 00000000/20C26140
360          6: 00000000/20E86BE8 7: 00000000/20E890E0
360          8: 00000000/00000002 9: 00000000/20E85448
360          A: 00000000/20EA94D0 B: 00000000/A0CC3EF8
360          C: 00000000/20C27908 D: 00000000/20E893C0
360          E: 00000000/A0CD9884 F: 00000002/00000000
360      END OF SYMPTOM DUMP
```

08.35.57 JOB05201 IEF450I JMONTIGO GO - ABEND=S000 U1234 REASON=00000000 361



Date and Time information...

- Our final output looks like the following along with our CEEDUMP from the CEE3DMP call:

```
02/14/2003 03:36:04 PM
```

```
IN MAIN PROGRAM!
```

```
THE SQUARE ROOT OF      9.00 IS:      3.00
```

```
THE SQUARE ROOT OF   144.00 IS:     12.00
```

```
THE SQUARE ROOT OF 2500.00 IS:     50.00
```

```
CEE2010E The argument was less than 0 in math  
routine SQRT      .
```



Other services

- Many other services are available.
 - Condition handling services
 - National Language services
 - Storage services
 - And more...



Summary

- Details on callable services available in the Language Environment Programming Reference. (SA22-7562-03)
- Callable services available from language environment conforming compilers
- CEE* available on any platform
- CEE3* available only on z/OS, z/VM
- Feedback codes report results of service



Appendix

- Full COBOL example
- Full PL/I example
- Full C example
- Full Assembler example