

# The New z/VSE Database Connector (DBCLI)

Ingo Franzki



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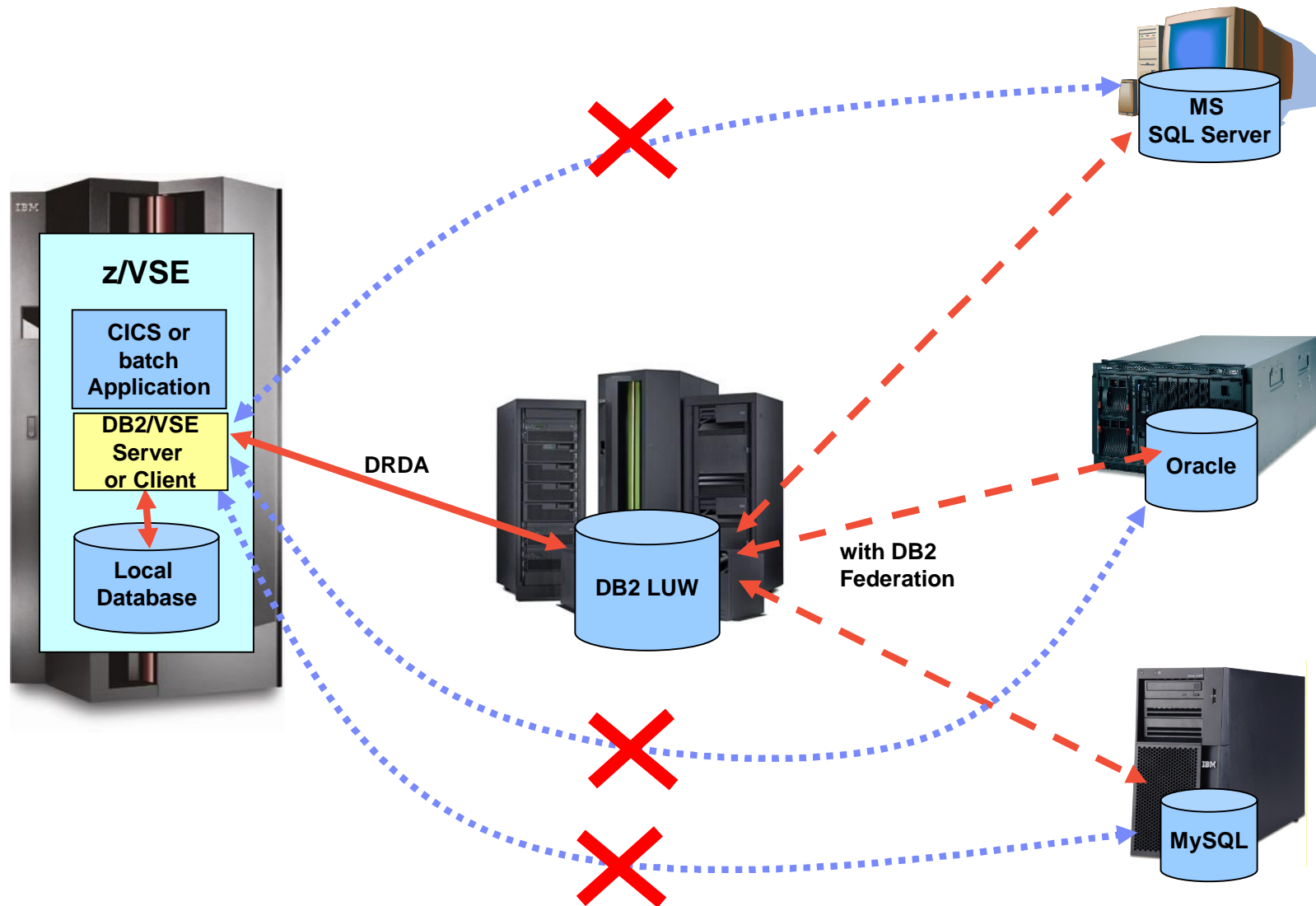
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# z/VSE applications accessing Databases



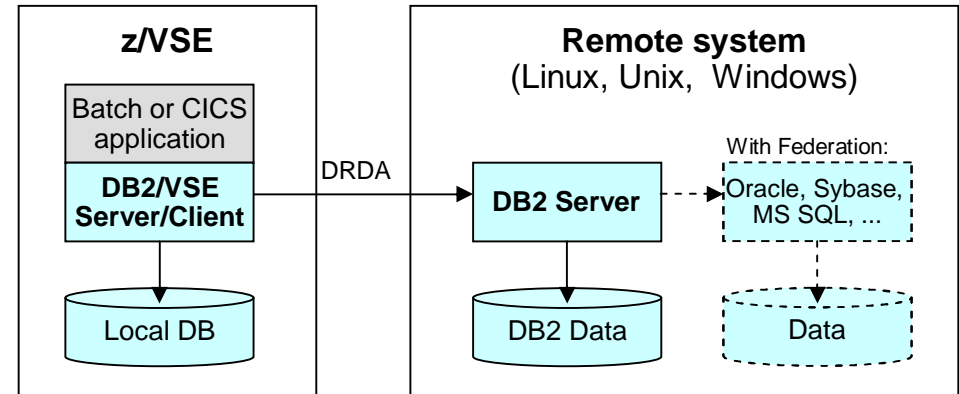
## Options for using Databases with z/VSE applications

### § DB2/VSE or DB2/VM Server

- Local database residing in z/VSE or z/VM
- Lacks support of modern SQL functionality
- Only quite old SQL level supported

### § DB2/VSE Client Edition

- Remote database (on Linux, Windows, Unix)
- Communication via DRDA protocol
- Same old SQL level supported as DB2/VSE Server
- Can not use modern SQL functionality provided by DB2 LUW
- Can only access remote DB2 databases
  - Other databases (e.g. MS SQL Server, Oracle, etc) can only be accessed through IBM InfoSphere Federation Server



### § VSAM Redirector

- Primarily used to keep Databases in sync with VSAM data
- Also allows migration from VSAM to database



### § **New:** z/VSE Database Call Level Interface

- Allows z/VSE applications to access a relational database on any suitable database server
  - IBM DB2, IBM Informix, Oracle, MS SQL Server, MySQL, etc.
- Utilize advanced database functions and use SQL statements provided by modern database products

## z/VSE V5.1 + PTFs: z/VSE Database Call Level Interface (DBCLI)

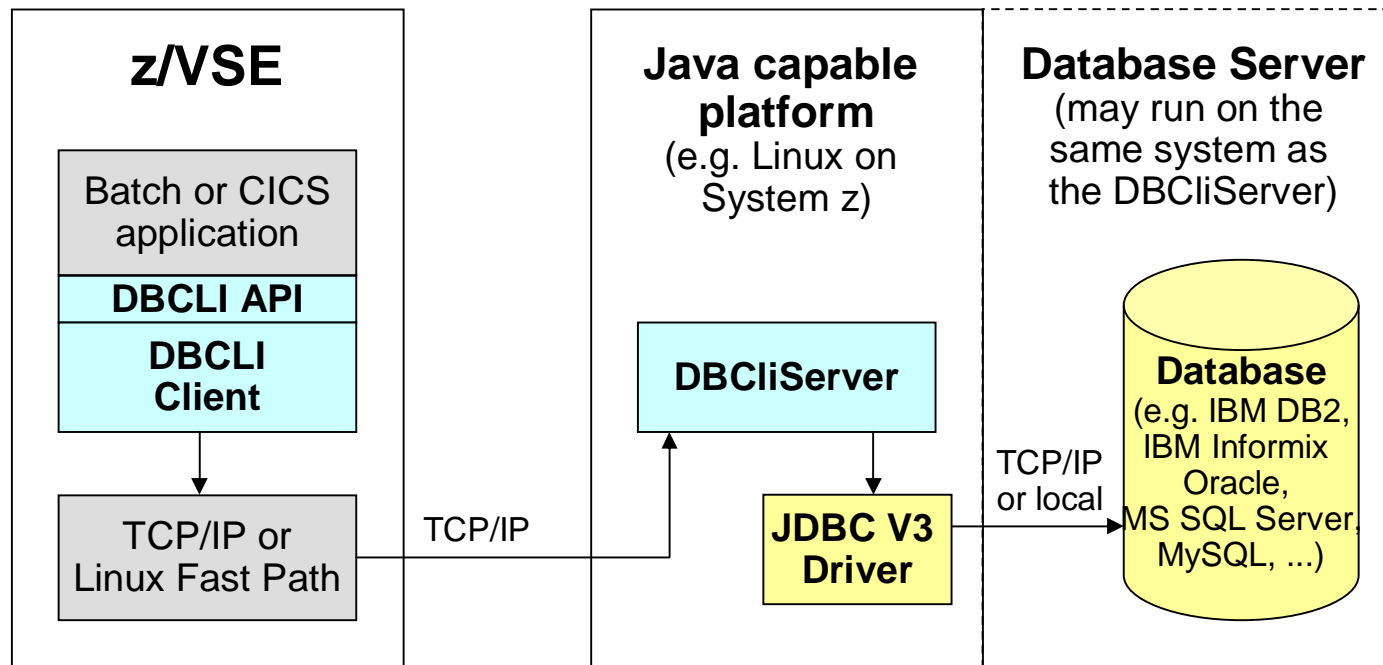
§ Allows z/VSE applications to access a relational database on any suitable database server



– IBM DB2, IBM Informix, Oracle, MS SQL Server, MySQL, etc.

à The database product must provide a JDBC driver that supports JDBC V3.0 or later

à Utilize advanced database functions and use SQL statements provided by modern database products



Requires z/VSE 5.1 plus PTFs (UK78892 and UK78893)



## z/VSE V5.1 + PTFs: z/VSE Database Call Level Interface (DBCLI)

### § The z/VSE Database Call Level Interface provides a programming interface (API)

- Call interface for use with [COBOL](#), [PL/1](#), [Assembler](#), [C](#) and [REXX](#)
- Can be used in [Batch](#) as well as in [CICS TS](#) applications
- Supports LE enabled as well as non-LE environments (Assembler, REXX)

### § It provides callable functions for

- [Initializing](#) and [Terminating](#) the API Environment
- [Connecting](#) and [Disconnecting](#) to/from the DBCLI Server and the Database
- [Executing](#) SQL Statements
- Retrieving [query results](#) through cursors
- Handling of [Logical Units of Work \(Transactions\)](#)
- Retrieving [Database Meta Data](#)

### § **Additional enhancement announced:**

- [Connection Pooling](#)



### § The API is not compatible with DB2/VSE's EXEC DB2 preprocessor interface

- But it provides similar functions
- The API is similar to the ODBC programming interface

### § A COBOL example is provided to show how DBCLI can be used in your applications

## DBCLI Concepts: Using the DBCLI API in your applications

### § Using DBCLI in COBOL:

- The COBOL copybook IESDBCOB contains common declarations

```
CALL 'IESDBCLI' USING FUNCTION ENV-HANDLE parm1 parm2 ... parmN RETCODE.
```

### § Using DBCLI in PL/I

- The PL/I copybook IESDBPL1 contains common declarations

```
CALL IESDBCLI (FUNCTION, ENV_HANDLE, parm1, parm2, ..., parmN, RETCODE);
```

### § Using DBCLI in C

- The C header file IESDBC.h contains common declarations

```
IESDBCLI (function, &env_handle, &parm1, &parm2, ..., &parmN, &retcode);
```

### § Using DBCLI in Assembler

- The Assembler macro IESDBASM contains common declarations

```
CALL IESDBCLI, (FUNCTION, ENV_HANDLE, parm1, parm2, ..., parmN, RETCODE), VL
```

- The following register conventions apply:

- Register 0, 1, 14, and 15 are used by the interface and must be saved prior to invocation
- Register 13 must point to a 72-byte save area provided by the caller

### § Using DBCLI in REXX (Batch)

```
ADDRESS LINKPGM "IESDBCLA FUNCTION ENV_HANDLE parm1 parm2 ... parmN RETCODE"
```

- All parameters must be initialized with a value of the appropriate length before calling the DBCLI API. This is especially true for output parameters.
- Fullword binary variables must be initialized to contain 4 bytes (for example, VARIABLE = D2C(0,4) )
- Since the variable is expected to contain a value in binary representation, you must convert the value from the REXX string representation into the binary representation and vice versa using the REXX functions C2S and D2C





## DBCLI Concepts: Initializing and terminating the environment

When using the API provided by the DBCLI client, you must:

§ **Initialize** the API environment by calling the **INITENV** function before calling any other function

- The INITENV function allocates an **environment handle** that you must pass to all subsequent functions
- You can have only one active environment at a time in your program

§ **Terminate** the API environment (at the end of your program) by calling the **TERMENV** function

- The TERMENV function frees all resources allocated by the DBCLI code
- The TERMENV function will also close any "left over" connections or statements
- After the TERMENV function, the environment handle is no longer valid

§ **You can set and get various attributes on the environment level**

- You do so by calling the **SETENVATTR** or **GETENVATTR** function



## DBCLI Concepts: Connecting to a database

**To access a Database, you must connect to the DBCLI server and the Vendor database**

§ You connect to the DBCLI server (DBCliServer) and the database by calling the **CONNECT** function

§ You must supply the:

- IP address or hostname of DBCliServer
- Alias name of the database or the JDBC URL to which you wish to connect
- User-ID and Password to authenticate with the database

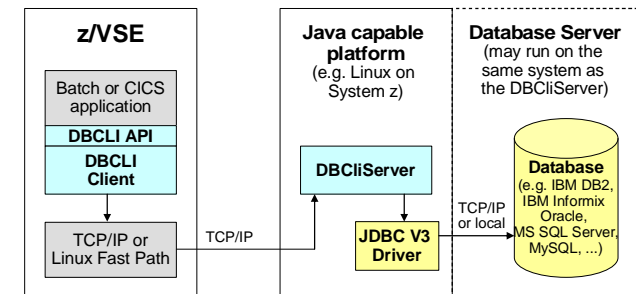
§ The **CONNECT** function allocates a **connection handle** that you must pass to all subsequent functions that require a connection

- You can have multiple connections to the same or different DBCLI servers and databases at a time
- Each connection is represented by its own connection handle

§ When you are finished working with a database, you must disconnect from the database and the DBCLI server (DBCliServer) by calling the **DISCONNECT** function

- The DISCONNECT function frees the connection handle and all left over statements (if any) that you have allocated using this connection

§ **New:** Connection Pooling can be used to speed up the connection establishment



## DBCLI Concepts: Logical Units of Work (Transactions)



**Per default, a connection operates in transaction mode:**

§ Any database updates that you perform are contained in a **logical unit of work**

§ You can **end a logical unit of work** by calling the COMMIT or ROLLBACK functions:

- The **COMMIT** function commits all changes done since the beginning of the logical unit of work and starts a new logical unit of work
- The **ROLLBACK** function rolls back (reverts) all changes since the beginning of the logical unit of work or up to a savepoint

§ Usually, you should **explicitly call the COMMIT function at the end of the program.**

§ If you do not call the COMMIT function, DBCLiServer will **automatically commit** all changes

- **if you gracefully close the connection** by calling the **DISCONNECT** function

§ If the **connection is dropped** (for example, because the program abends), the DBCLI server **rolls back all changes** done since the beginning of the last logical unit of work

§ You can set a connection into **auto-commit mode**

- In auto-commit mode, every SQL statement is treated as **its own logical unit of work** and is **committed automatically** when the statement execution is complete.
  - Therefore, you do not have to call the COMMIT or ROLLBACK functions.
- You set a connection into auto-commit mode by calling the **SETCONNATTR** function to set the **CONNATTR-AUTO-COMMIT** attribute to TRUE

## DBCLI Concepts: Preparing SQL Statements

**In order to execute an SQL statement, you must first prepare the SQL statement**

§ During preparation, the database will **pre-compile the SQL statement** and create an **access plan** for the statement

- The access plan is kept as long as the statement exists
- You can then **execute** the statement **as many times** as you want



§ The **PREPARESTatement** function prepares an SQL statement for execution

- It allocates a **statement handle** that represents the statement
- An application can have multiple prepared statements at a time

§ The **PREPARECALL** function prepares a **stored procedure call** statement for execution

§ SQL statements may contain **parameters** that are **evaluated at execution time**

- Parameters are marked by a **question mark (?)** within the SQL statement
- The parameters are **numbered in order of appearance**, starting with 1

§ After preparing, the application can **bind host variables to the parameters** using the **BINDPARAMETER** function

- When the statement is later **executed**, the **content of the host variables is used** and sent to the database.

## DBCLI Concepts: Preparing SQL Statements

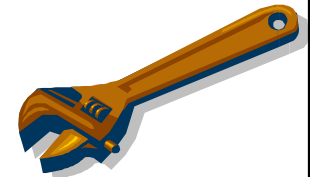
**In order to execute an SQL statement, you must first prepare the SQL statement**

§ During preparation, the database will **pre-compile the SQL statement** and create an **access plan** for the statement

- The access plan is kept as long as the statement exists
- You can then **execute** the statement **as many times** as you want

§ The **PREPARESTATEMENT** function prepares an SQL statement for execution

- It allocates a **statement handle** that represents the statement



**SQL statements may contain parameters that are evaluated at execution time**

§ Parameters are marked by a **question mark (?)** within the SQL statement

```
SELECT * FROM EMPLOYEE WHERE EMPNO>? AND SALARY>?
```

Parameter 1    Parameter 2

§ The parameters are **numbered in order of appearance**, starting with 1

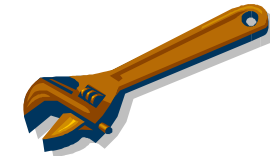
§ When using DB2/VSE preprocessor, above statement would look like:

```
SELECT * FROM EMPLOYEE WHERE EMPNO>:empno AND SALARY>:salary
```

§ The application **binds host variables to the parameters** using the **BINDPARAMETER** function

- When the statement is later executed, the **content of the host variables is used** and sent to the database
- You also specify the **data type** and **length** of the variable with the **BINDPARAMETER** call
- **Indicator variables** are used to determine if the parameter value is **NULL**

## DBCLI Concepts: Executing statements



**To execute a statement, you must call the EXECUTE function**

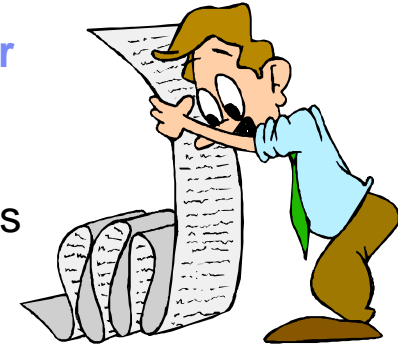
- § If the statement was an SQL **update statement**, you can retrieve the number of rows updated using the **GETUPDATECOUNT** function or the **UPDATE-COUNT** parameter at the EXECUTE function
  
- § If the statement was a SQL **query statement**, you can **use a cursor** to retrieve (fetch) the result rows and columns
  - A statement can provide multiple results (mostly stored procedures)
  - To retrieve the additional results you must call the **GETMORERESULTS** function
  - The GETMORERESULTS function will move to the next available cursor or update count
  
- § If the statement was a stored procedure call, **output parameters** are updated with the data passed back by the stored procedure
  
- § When you no longer need a statement, you must close it by calling the **CLOSESTATEMENT** function:
  - The CLOSESTATEMENT function frees the statement handle and closes all cursors (if any) that may still be open from the last statement execution
  
- § The statement handle is no longer valid after the CLOSESTATEMENT function

## DBCLI Concepts: Result sets and Cursors

The execution on an **SQL query** returns a result in form of a **cursor**

§ A cursor allows you to retrieve (fetch) the result rows and columns

- You can use the **GETNUMCOLUMNS** and **GETCOLUMNINFO** functions to obtain detailed information about the cursor's columns
- The **columns are numbered** in order of appearance, starting at 1



§ To fetch the result rows using the cursor, you must first **bind host variables to the columns** of interest

- You bind host variables to the columns of interest by calling the **BINDCOLUMN** function
- If the **FETCH** function is called later on, the host variables will be updated with the contents of the column in the row that has been fetched

§ Per default, the **FETCH** function processes the cursor **from the beginning to the end**

- You may **reposition with a cursor**
  - Providing the database supports this and you have created the statement using the appropriate type

§ Repositioning can be performed using either the:

- **FETCH** function with operations **FETCH-PREVIOUS**, **FETCH-FIRST**, **FETCH-LAST**, **FETCH-ABSOLUTE** or **FETCH-RELATIVE**.
- **SETPOS** function

## DBCLI Concepts: Database Meta Data

**The DBCLI interface allows you to retrieve meta data from the database**

§ This includes functions to get a **list of tables**, indexes, keys, **columns of a table**, and so on

§ This information is typically stored in system catalog tables in the database.

- You can also execute regular SELECT statements against the system catalog tables, but this requires that you know which database system and vendor you are using
- System catalog tables are vendor- and database-specific

§ The DBCLI interface provides a **set of database independent functions** to retrieve meta data information.

- These functions are prefixed with 'DB'
- The function DBTABLES for example retrieves a list of tables available in the database



§ Please note that some databases may not support all of the meta data functions



## DBCLI Concepts: Connection Pooling (new)



### § Creating database connections is time-consuming

- Because of the overhead of establishing a network connection and initializing access to a database server

### § Connection pooling keeps and reuses existing database connections

- Reducing the time to establish a connection to the database
- This can be especially beneficial for short-lived, CICS DBCLI applications that will be running frequently

### § DBCLI applications can request to use the connection pool by setting environment variable **ENVATTR-USE-CONNPOOL** to **TRUE** prior to calling the **CONNECT** function

- No further applications changes are required
- The use of the connection pool is transparent to DBCLI applications
- Existing DBCLI applications will continue to work unchanged, that is without using the connection pool

### § Connection Pooling is only available under CICS

- The Connection Pool Manager transaction must be active (long running transaction)
- Pooling of SSL connections is not supported

## COBOL Example

```
PROCEDURE DIVISION.  
MAIN-PROGRAM.  
    DISPLAY 'COBSAMPL STARTED'.  
*  
* Perform the INITENV call  
*  
    MOVE 'SOCKET00' TO TCPNAME.  
    MOVE 'EZASOH99' TO ADSNAME.  
    CALL 'IESDBCLI' USING FUNC-INITENV ENV-HANDLE  
        TCPNAME ADSNAME RETCODE.  
    DISPLAY 'RETCODE OF INITENV IS ' RETCODE.  
    IF RETCODE > EOK THEN  
        PERFORM CHECK-ERROR  
    END-IF.
```

← Initialize the environment

## COBOL Example

```
PROCEDURE DIVISION.  
MAIN-PROGRAM.  
    DISPLAY 'COBSAMPL STARTED'.  
*  
* * Connect to the DBCLI server and the database  
*  
    MOVE '9.152.2.70' TO SERVER.  
    MOVE 10 TO SERVER-LEN.  
    MOVE 16178 TO PORT.  
    MOVE 'SAMPLE' TO DBNAME.  
    MOVE 6 TO DBNAME-LEN.  
    MOVE 'dbuserid' TO USERID.  
    MOVE 8 TO USERID-LEN.  
    MOVE 'password' TO PASSWD.  
    MOVE 8 TO PASSWD-LEN.  
    CALL 'IESDBCLI' USING FUNC-CONNECT ENV-HANDLE CON-HANDLE  
        SERVER SERVER-LEN PORT DBNAME DBNAME-LEN  
        USERID USERID-LEN PASSWD PASSWD-LEN  
        RETCODE.  
    DISPLAY 'RETCODE OF CONNECT IS ' RETCODE.  
    IF RETCODE > EOK THEN  
        PERFORM CHECK-ERROR  
    END-IF.
```

IP or hostname of  
DBCLI Server

Database alias name  
User-ID & Password

Connect to the  
DBCLI Server  
and the Database

## COBOL Example

```
PROCEDURE DIVISION.  
MAIN-PROGRAM.  
    DISPLAY 'COBSAMPL STARTED'.  
*  
* * Connect to the DBCLI server and the database  
*  
    MOVE '9.152.2.70' TO SERVER.  
    MOVE 10 TO SERVER-LEN.  
    MOVE 16178 TO PORT.  
    MOVE 'SAMPLE' TO DBNAME.  
    MOVE 6 TO DBNAME-LEN.  
*  
* Prepare an SQL statement for later execution  
*  
    MOVE 'SELECT * FROM EMPLOYEE WHERE EMPNO>? AND SALARY>?'  
      TO SQL.  
    MOVE LENGTH OF SQL TO SQL-LEN.  
    CALL 'IESDBCLI' USING FUNC-PREPARESTATEMENT ENV-HANDLE  
      CON-HANDLE STMT-HANDLE SQL SQL-LEN  
      CURSOR-TYPE-SCROLL-INSENSITIVE CURSOR-CONCUR-READ-ONLY  
      HOLD-CURSORS-OVER-COMMIT RETCODE.  
    DISPLAY 'RETCODE OF PREPARESTATEMENT IS ' RETCODE.  
    IF RETCODE > EOK THEN  
        PERFORM CHECK-ERROR  
    END-IF.
```

SQL Statement  
Containing Parameter  
Markers ('?')

Prepare an  
SQL Statement  
for later execution

## COBOL Example

```
PROCEDURE DIVISION.  
MAIN-PROGRAM.  
    DISPLAY 'COBSAMPL STARTED'.  
*  
* * Connect to the DBCLI server and the database  
*  
    MOVE '9.152.2.70' TO SERVER.  
    MOVE 10 TO SERVER-LEN.  
    MOVE 16178 TO PORT.  
    MOVE 'SAMPLE' TO DBNAME.  
    MOVE 6 TO DBNAME-LEN.  
*  
* Prepare an SQL statement for later execution  
*  
* Bind the EMPNO host variable (Text) to parameter 1.  
* Here we specify the optional codepage parameter to  
* send the text data in the desired codepage.  
*  
    MOVE 1 TO PARM-IDX.  
    MOVE LENGTH OF EMPNO TO EMPNO-LEN.  
    MOVE 'CP1047' TO CODEPAGE.  
    MOVE LENGTH OF CODEPAGE TO CODEPAGE-LEN.  
    CALL 'IESDBCLI' USING FUNC-BINDPARAMETER ENV-HANDLE  
        STMT-HANDLE PARM-IDX NATIVE-TYPE-STRING  
        EMPNO EMPNO-LEN EMPNO-IND  
        CODEPAGE CODEPAGE-LEN RETCODE.  
    DISPLAY 'RETCODE OF BINDPARAMETER IS ' RETCODE.  
    IF RETCODE > EOK THEN  
        PERFORM CHECK-ERROR  
    END-IF.
```

Bind host variable  
“EMPNO”  
to parameter  
number 1  
as STRING

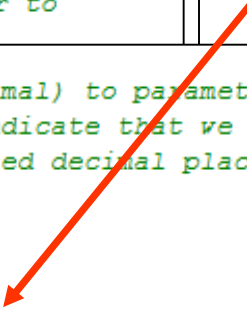
## COBOL Example

```

PROCEDURE DIVISION.
MAIN-PROGRAM.
  DISPLAY 'COBSAMPL STARTED'.
*
*
* * Connect to the DBCLI server and the database
*
  MOVE '9.152.2.70' TO SERVER.
  MOVE 10 TO SERVER-LEN.
  MOVE 16178 TO PORT.
  MOVE 'SAMPLE' TO DBNAME.
  MOVE 6 TO DBNAME-LEN.
*
* Prepare SQL statement for later execution
*
* Bind the EMPNO host variable (Text) to parameter 1.
* Here we specify the optional codepage parameter to
* send the text data in the desired codepage.
*
* Bind the SALARY host variable (packed decimal) to parameter 2.
* Here we specify the decpos parameter to indicate that we
* want to send the numeric data with 2 implied decimal places.
*
  MOVE 2 TO PARM-IDX.
  MOVE LENGTH OF SALARY TO SALARY-LEN.
  MOVE 2 TO DECPOS.
  CALL 'IESDBCLI' USING FUNC-BINDPARAMETER ENV-HANDLE
    STMT-HANDLE PARM-IDX NATIVE-TYPE-PACKED-SIGNED
    SALARY SALARY-LEN SALARY-IND
    DECPOS RETCODE.
  DISPLAY 'RETCODE OF BINDPARAMETER IS ' RETCODE.
  IF RETCODE > EOK THEN
    PERFORM CHECK-ERROR
  END-IF.

```

Bind host variable  
“SALARY”  
to parameter  
number 2  
as PACKED decimal



# COBOL Example

Assign values

```

PROCEDURE DIVISION.
MAIN-PROGRAM.
    DISPLAY 'COBSAMPL STARTED'.
*
*
* * Connect to the DBCLI server and th
*
    MOVE '9.152.2.70' TO SERVER.
    MOVE 10 TO SERVER-LEN.
    MOVE 16178 TO PORT.
    MOVE 'SAMPLE' TO DBNAME.
    MOVE 6 TO DBNAME-LEN.
*
* Prepare SQL statement
*
* Bind the EMPNO host variable
* Here we specify the option
* send the text data in the
*
* Bind the SALARY host variable
* Here we specify the d
* want to send the nume
*
    MOVE 2 TO PARM-IDX
    MOVE LENGTH OF SALARY TO SALARY-LEN.
    MOVE 2 TO DECPOS.
    CALL 'IESDBCLI' USING FUNC-BINDPARAMETER ENV-HANDLE
        STMT-HANDLE PARM-IDX NATIVE-TYPE-PACKED-SIGNED
        SALARY SALARY-LEN SALARY-IND
        DECPOS RETCODE.
    DISPLAY 'RETCODE OF BINDPARAMETER IS ' RETCODE.
    IF RETCODE > EOK THEN
        PERFORM CHECK-ERROR
    END-IF.
*
* Set the host variables values and corresponding indicator
* variables:
*
    MOVE '000030' TO EMPNO.
    MOVE INDICATE-NOTNULL TO EMPNO-IND.
    MOVE 01000.00 TO SALARY.
    MOVE INDICATE-NOTNULL TO SALARY-IND.
*
* Execute the statement. This will use the values of the
* host variables for the parameters.
*
    CALL 'IESDBCLI' USING FUNC-EXECUTE ENV-HANDLE
        STMT-HANDLE RETCODE.
    IF RETCODE > EOK THEN
        PERFORM CHECK-ERROR
    END-IF.
    DISPLAY 'RETCODE OF EXECUTE IS ' RETCODE.
    IF RETCODE > EOK THEN
        PERFORM CHECK-ERROR
    END-IF.
    
```

Execute the statement

## COBOL Example

```

PROCEDURE DIVISION.
MAIN-PROGRAM.
    DISPLAY 'COBSAMPL STARTED'.
*
*
* * Connect to the DBCLI server and th
*
    MOVE '9.152.2.70' TO SERVER.
    MOVE 10 TO SERVER-LEN.
    MOVE 16178 TO PORT.
    MOVE 'SAMPLE' TO DBNAME.
    MOVE 6 TO DBNAME-LEN.
*
* * Prepare SQL statement for
*
* * Bind the EMPNO host variab
* * Here we specify the optio
* * send the text data in the
*
* * Bind the SALARY host
* * Here we specify the d
* * want to send the nume
*
    MOVE 2 TO PARM-IDX
    MOVE LENGTH OF SALARY TO SALARY-LEN.
    MOVE 2 TO DECPOS.
    CALL 'IESDBCLI' USING FUNC-BINDPARAMETER ENV-HANDLE
        STMT-HANDLE PARM-IDX NATIVE-TYPE-PACKED-SIGNED
        SALARY SALARY-LEN SALARY-IND
        DECPOS RETCODE.
    DISPLAY 'RETCODE OF BINDPARAMETER IS ' RETCODE.
    IF RETCODE > EOK THEN
        PERFORM CHECK-ERROR
    END-IF.
*
* * Set the host variables values and coresponding indicator
* * variables:
*
* * Bind host variable FIRSTNAME (text) to the column 2.
* * Here we do not specify the codepage parameter so we
* * receive the text data in the default codepage.
*
    MOVE 2 TO COL-IDX.
    MOVE LENGTH OF FIRSTNAME TO FIRSTNAME-LEN.
    CALL 'IESDBCLI' USING FUNC-BINDCOLUMN ENV-HANDLE
        STMT-HANDLE COL-IDX NATIVE-TYPE-STRING
        FIRSTNAME FIRSTNAME-LEN FIRSTNAME-IND
        RETCODE.
    DISPLAY 'RETCODE OF BINDCOLUMN IS ' RETCODE.
    IF RETCODE > EOK THEN
        PERFORM CHECK-ERROR
    END-IF.

```

Bind host variable  
"FIRSTNAME" to  
result set column  
number 2



# COBOL Example

```

PROCEDURE DIVISION.
MAIN-PROGRAM.
  DISPLAY 'COBSAMPL STARTED'.
*
*
* * Connect to the DBCLI server and th
*
  MOVE '9.152.2.70' TO SERVER.
  MOVE 10 TO SERVER-LEN.
  MOVE 16178 TO PORT.
*
*
* * Bind the EMPNO host variab
* * Here we specify the optio
* * send the text data in the
*
* * Bind the SALARY host
* * Here we specify the d
* * want to send the nume
*
  MOVE 2 TO PARM-IDX
  MOVE LENGTH OF SALARY TO
  MOVE 2 TO DECPOS.
  CALL 'IESDBCLI' USING FUN
  STMT-HANDLE PARM-IDX
  SALARY SALARY-LEN SA
  DECPOS RETCODE.
  DISPLAY 'RETCODE OF BINDE
  IF RETCODE > EOK THEN
    PERFORM CHECK-ERROR
  END-IF.
*
* * Set the host variables values and coresponding indicator
* * variables:
*
* * Bind host variable FIRSTNAME (text) to the column 2.
* He
* re
* * Fetch all available rows and display the data.
* * Since columns may be NULL we check the indicator variables.
* * FETCH without an operation argument means FETCH NEXT.
* E
*
  PERFORM WITH TEST AFTER UNTIL RETCODE > EOK
  CALL 'IESDBCLI' USING FUNC-FETCH ENV-HANDLE
  STMT-HANDLE RETCODE
  DISPLAY 'RETCODE OF FETCH IS ' RETCODE
  IF RETCODE > EOK AND RETCODE NOT = ENOMOREDATA THEN
    PERFORM CHECK-ERROR
  END-IF
  IF RETCODE = EOK THEN
    DISPLAY 'ROW DATA INFO FOR ROW NUMBER ' ROW-NUMBER
    IF EMPNO-IND = INDICATE-NULL THEN
      DISPLAY ' EMPNO IS NULL'
    ELSE
      DISPLAY ' EMPNO IS ' EMPNO
    END-IF
    IF FIRSTNAME-IND = INDICATE-NULL THEN
      DISPLAY ' FIRSTNAME IS NULL'
    ELSE
      DISPLAY ' FIRSTNAME IS ' FIRSTNAME
    END-IF
  END-IF

```

Fetch all rows

## Differences between DBCLI and embedded SQL

### § An application that uses an **embedded SQL interface** requires a **precompiler**

- To convert the SQL statements into code, which is then compiled, bound to the data source, and executed

### § In contrast, a **DBCLI application** does not have to be precompiled or bound

- Instead uses a set of functions to execute SQL statements and related services at run time

### § This difference is important because **precompilers** are specific to the **database product** used

- This **ties your applications** to a specific database product and vendor

### § **DBCLI** enables you to write applications that are **independent of any particular database product or vendor**



### § **Futher differences:**

- DBCLI does **not require the explicit declaration of cursors**, they are **generated as needed** The application can then use the generated cursor to fetch the result rows
- A **COMMIT** or **ROLLBACK** in DBCLI is issued using the **COMMIT** or **ROLLBACK** functions calls rather than by passing it as an SQL statement
- DBCLI manages statement related information on behalf of the application, and provides a **statement handle** to refer to it as an abstract object. This handle **eliminates the need for** the application to use **product specific data structures**
- Similar to the statement handle, the **environment handle** and **connection handle** provide a means to refer to all global variables and connection specific information

## Advantages of using DBCL instead of embedded SQL

### § Ideally suits the **client-server environment** in which the target data source is unknown when the application is built

- It provides a **consistent interface for executing SQL statements**, regardless of which database server the application connects to

### § Lets you write applications that are **independent of any particular database product**

- DBCLI applications do not have to be recompiled or rebound to access different database. Instead they connect to the appropriate database at run time.

### § Lets applications **connect to multiple data sources** from the same application

### § Allocates and controls data structures, and provides a handle for the application to refer to them

- Applications **do not have to control complex global data areas** such as the SQLDA and SQLCA

### § Lets you retrieve **multiple rows and result sets** generated from a call to a stored procedure

### § Provides a **consistent interface to query catalog information** that is contained in various database management system catalog tables

- The result sets that are returned are consistent across database management systems. Application programmers can avoid writing version-specific and server-specific catalog queries

### § Programming interface is very similar to the **accepted industry standard of ODBC/JDBC**

### § Allows application developers to apply their knowledge of industry standards directly to DBCLI

- The interface is intuitive for programmers who are familiar with function libraries but know little about product specific methods of embedding SQL statements into a host language

## Hints & Tips



### § The DBCLI code is **CICS-aware**

- If running under CICS, any memory allocations are performed using EXEC CICS GETMAIN instead of using the GETVIS macro

### § When using the DBCLI API in CICS transactions while CICS operates with storage protection, **all programs using the DBCLI API need to be defined with EXECKEY(CICS)**

- This is also true for those programs that link to these programs
- TASKDATAKEY(CICS) for the transaction definition is NOT required.

### § When using the DBCLI API in CICS transactions, the **EZA "task-related-user-exit" (TRUE) has to be activated** before these transactions can be run

- For details on how to activate this TRUE, refer to "CICS Considerations for the EZA Interfaces" in the z/VSE TCP/IP Support, SC34-2640

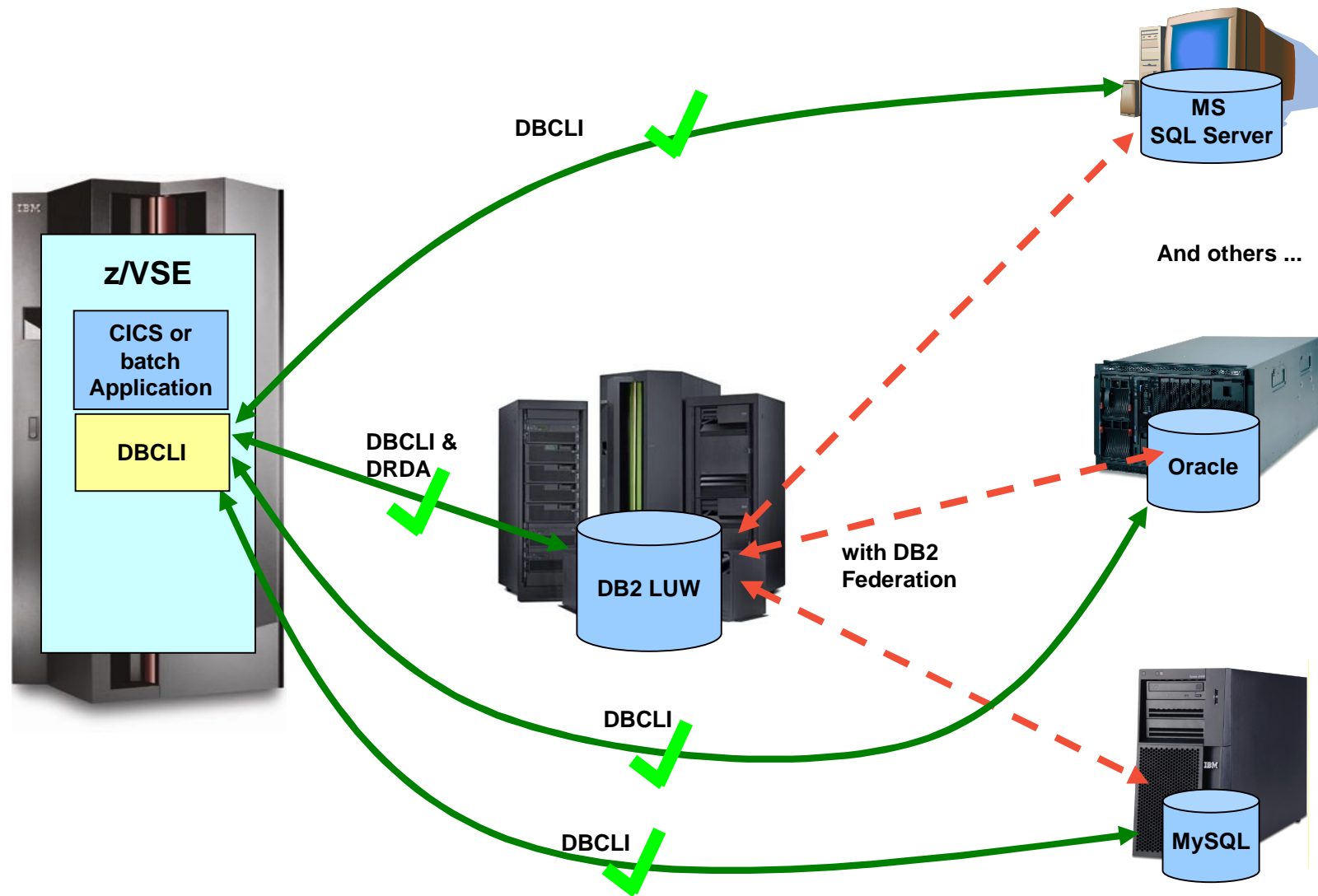
### § Most JDBC drivers will only accept **pure SQL statements**

- They will not accept SQL preprocessor statements that are used for DB2 Server for VSE applications

### § The call to the IESDBCLI function must be a **static CALL** in COBOL

- Do not use the DYNAM compiler option

# z/VSE applications accessing Databases



## Questions ?



THANK YOU