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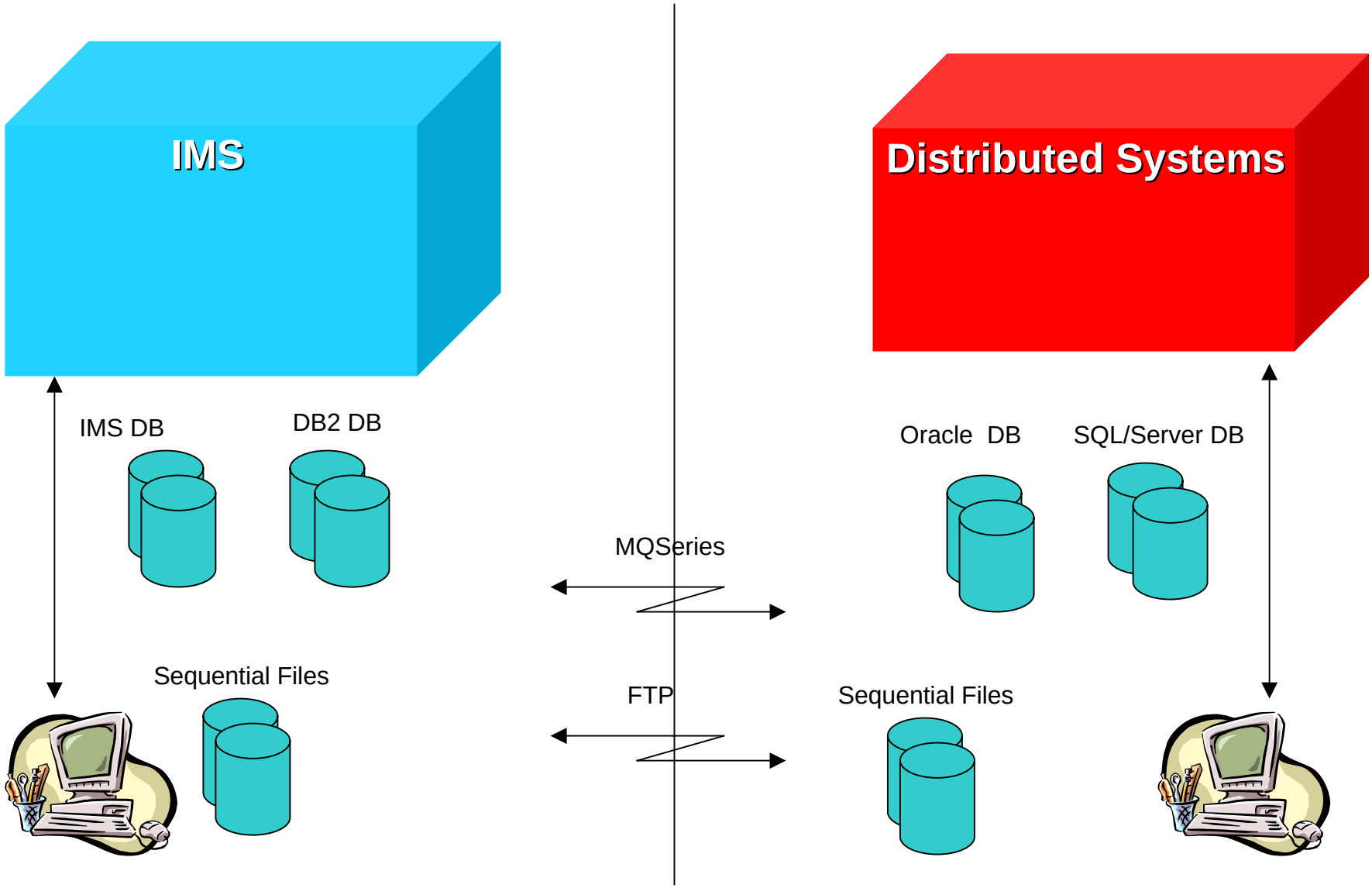
IMS Open Database at Caterpillar

The Challenge

- Coordinate the tracking of manufacturing materials between applications based in IMS and applications based on Distributed Platforms.
  - A full function, 40 year old, legacy IMS application, tracking materials in many factories and warehouses around the world
  - Many distributed applications, both purchased and in-house developed, tracking materials in a single or small group of factories.
  - Legacy FTP of files to communicate between the systems
  - Manual data entry to update systems and process exceptions

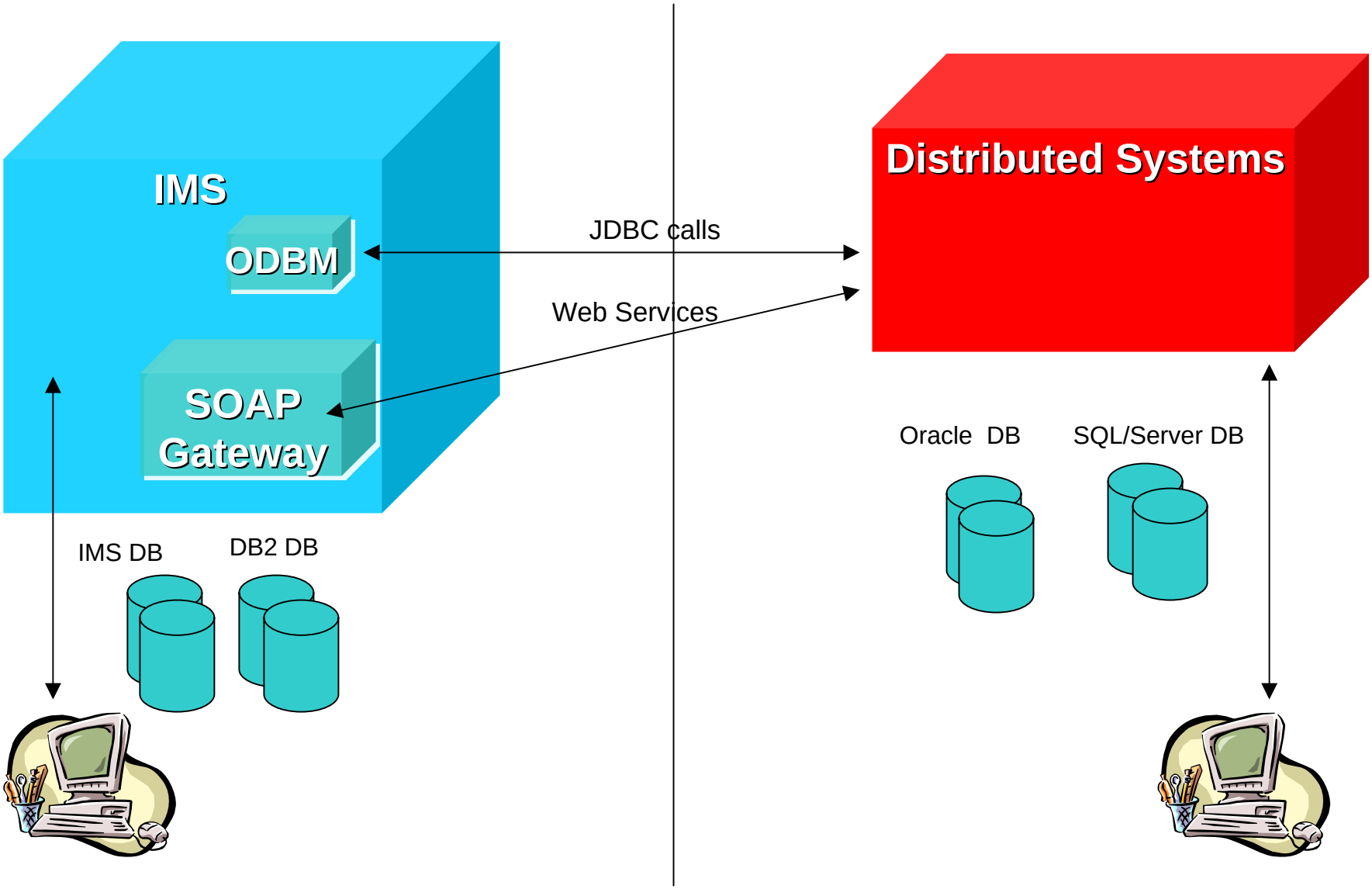
Old Configuration



The Solution(s)

- A Service Oriented Architecture
  - Implement the IMS SOAP Gateway on z/OS with Web Security.
  - Expose IMS Transactions as Web Services
  - Implement both asynchronous and synchronous Callout from IMS programs.
  - Implement IMS V11 With ODBM.
  - Use RDz and the DLIMODEL utility as the tooling to implement the solutions

New Solution



IMS Transaction as a Web Service

- Most IMS Transactions can be exposed as a Web Service with no change to the IMS program.
- The tooling for doing this is provided by Rational Application Developer for z/OS (RDz) and the IMS SOAP Gateway. IMS Versions 10 and 11 provide 2 limited licenses of RDz.

New Solution

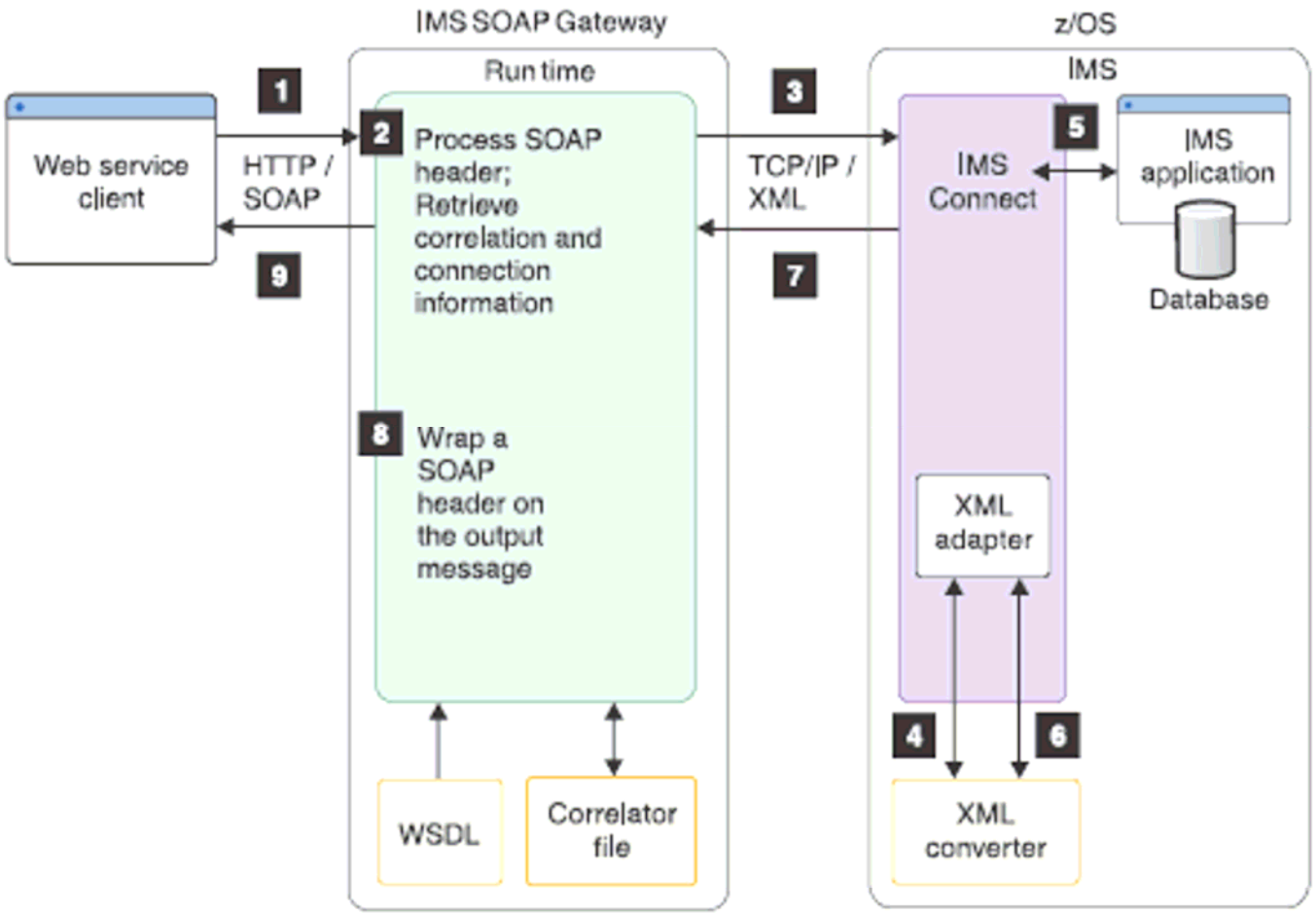


Figure 1. IMS SOAP Gateway runtime environment for the IMS applications as Web service providers scenario

IMS Transaction as a Web Service

IMS Transaction
Program

```
01 I-AREA.
  05 I-LENGTH   PIC S999 COMP SYNC.
  05 I-ZZ       PIC S999 COMP SYNC VALUE +0.
  05  TRANCODE  PIC X(8).
  05  A         PIC S9(8).
  05  B         PIC S9(8).

01 O-AREA.
  05 O-LENGTH   PIC S999 COMP SYNC VALUE +12.
  05 O-ZZ       PIC S999 COMP SYNC.
  05 C          PIC S9(8).
```

IMS Transaction as a Web Service

Web Service WSDL File

```
<complexType name="IAREA">
        <sequence>
          <element form="qualified" name="a">
            <simpleType>
              <restriction base="int">
                <minInclusive value="-99999999"/>
                <maxInclusive value="99999999"/>
              </restriction>
            </simpleType>
          </element>
          <element form="qualified" name="b">
            <simpleType>
              <restriction base="int">
                <minInclusive value="-99999999"/>
                <maxInclusive value="99999999"/>
              </restriction>
            </simpleType>
          </element>
        </sequence>
      </complexType>
```

IMS Transaction as a Web Service

Web Service WSDL File

```
<complexType name="OAREA">
        <sequence>
          <element form="qualified" name="c">
            <simpleType>
              <restriction base="int">
                <minInclusive value="-99999999"/>
                <maxInclusive value="99999999"/>
              </restriction>
            </simpleType>
          </element>
        </sequence>
      </complexType>
```

IMS Transaction as a Web Service Consumer

- IMS Supports both Asynchronous and Synchronous "Callout" to Web Services

- The tooling for doing this is also provided by Rational Application Developer for z/OS (RDz) and the IMS SOAP Gateway. IMS Versions 10 and 11 provide 2 limited licenses of RDz.

IMS Transaction as a Web Service Consumer (CALLOUT)

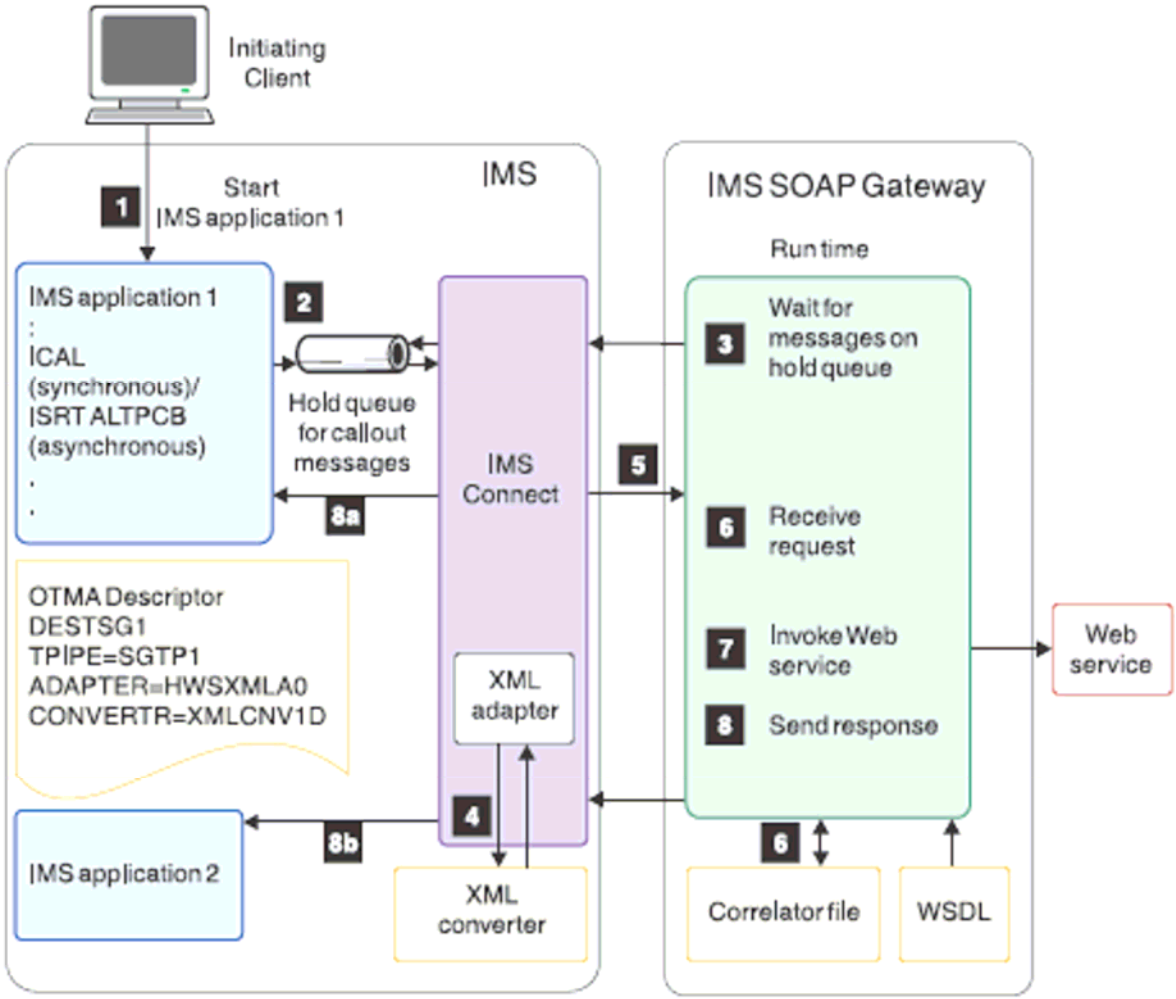


Figure 2. IMS SOAP Gateway runtime environment for the IMS applications as Web service consumers scenario (asynchronous callout)

IMS Transaction as a Web Service Consumer (ASYNC)

COBOL Copylib

```
01  INPUT-AREA.
  05  I-LENGTH  PIC S999 COMP SYNC VALUE +12.
  05  I-ZZ      PIC S999 COMP SYNC.
  05  INPUT1    PIC 9(08).
  05  INPUT2    PIC 9(08).
01  OUTPUT-AREA.
  05  O-LENGTH  PIC S999 COMP SYNC VALUE +12.
  05  O-ZZ      PIC S999 COMP SYNC.
  05  TRANCODE  PIC X(08).
  05  FILLER1   PIC X(01).
  05  OUTPUT2   PIC 9(08).
```

IMS Call

CALL 'CBLTDLI' USING ‘ISRT’ ALTIO-PCB INPUT-AREA.

OTMA Descriptor

```
D KR01ASYN TYPE=IMSCON TMEMBER=TIMSTOC1 TPIPE=KR01ASYN
D KR01ASYN ADAPTER=HWSXMLA0 CONVERTR=BCPASYND
```

IMS Transaction as a Web Service Consumer (ASYNC)

SOAP Gateway Correlator File

```
Adapter Type                          : IBM XML Adapter
Converter Name                        : BCPASYND
Connection Bundle Name                : timssxc
Socket Timeout                        : 0
Execution Timeout                     : 0
Lterm Name                            :
Transaction Code                      : KR01SPL1
Callout Connection Bundle Name        : timssxcout
Callout WSDL                          : BCPASYNCMIN.wsdl
Callout Web Services Timeout          : 7500
Correlator Service Name               : Service1
Correlator Operation Name             : Compare
```

IMS Transaction as a Web Service Consumer (ASYNC)

Connection Bundle

```
Connection Bundle Name                    : timssxc
Host Name                                 : tcpipsyt.cis.cat.com
Port Number                               : 10115
Datastore                                 : TIMS
IMS User ID                               : z1jgims1
IMS User ID Password                      : ********
Group Name                                :
Callout SSL Truststore Name               :
Callout SSL Truststore Password           :
Callout SSL User Authentication Name      :
Callout SSL User Authentication Password  :
Callout SSL Keystore Name                 :
Callout SSL Keystore Password             :
Callout TPipes                            : KR01ASYN, NPS39001
```

IMS Transaction as a Web Service Consumer (ASYNC)

Web Service WSDL File

```
<s:element name="Compare">
<s:complexType>
<s:sequence>
  <s:element minOccurs="0" maxOccurs="1" name="o" type="tns:BCPMath" />
  </s:sequence>
  </s:complexType>
  </s:element>
<s:complexType name="BCPMath">
<s:sequence>
  <s:element minOccurs="1" maxOccurs="1" name="a" type="s:int" />
  <s:element minOccurs="1" maxOccurs="1" name="b" type="s:int" />
  </s:sequence>
  </s:complexType>
<s:element name="CompareResponse">
<s:complexType>
<s:sequence>
  <s:element minOccurs="1" maxOccurs="1" name="CompareResult" type="s:int" />
  </s:sequence>
  </s:complexType>
  </s:element>
  </s:schema>
```

IMS Transaction as a Web Service Consumer (SYNC)

COBOL Copylib

```
01  CALLOUT-REQUEST.
  05  INPUT1     PIC 9(08).
  05  INPUT2     PIC 9(08).
01  CALLOUT-RESPONSE.
  05  OUTPUT2    PIC 9(08).
```

IMS Call

MOVE 'SENDRECV' TO AIBSFUNC
MOVE ‘KR01MNOX’ TO AIBRSNM1
MOVE +16 TO AIBOALEN
MOVE +8 TO AIBOAUSE
MOVE +10000 TO AIBRSFLD
CALL 'AIBTDLI' USING ‘ICAL’ AIB CALLOUT-REQUEST CALLOUT-RESPONSE.

OTMA Descriptor

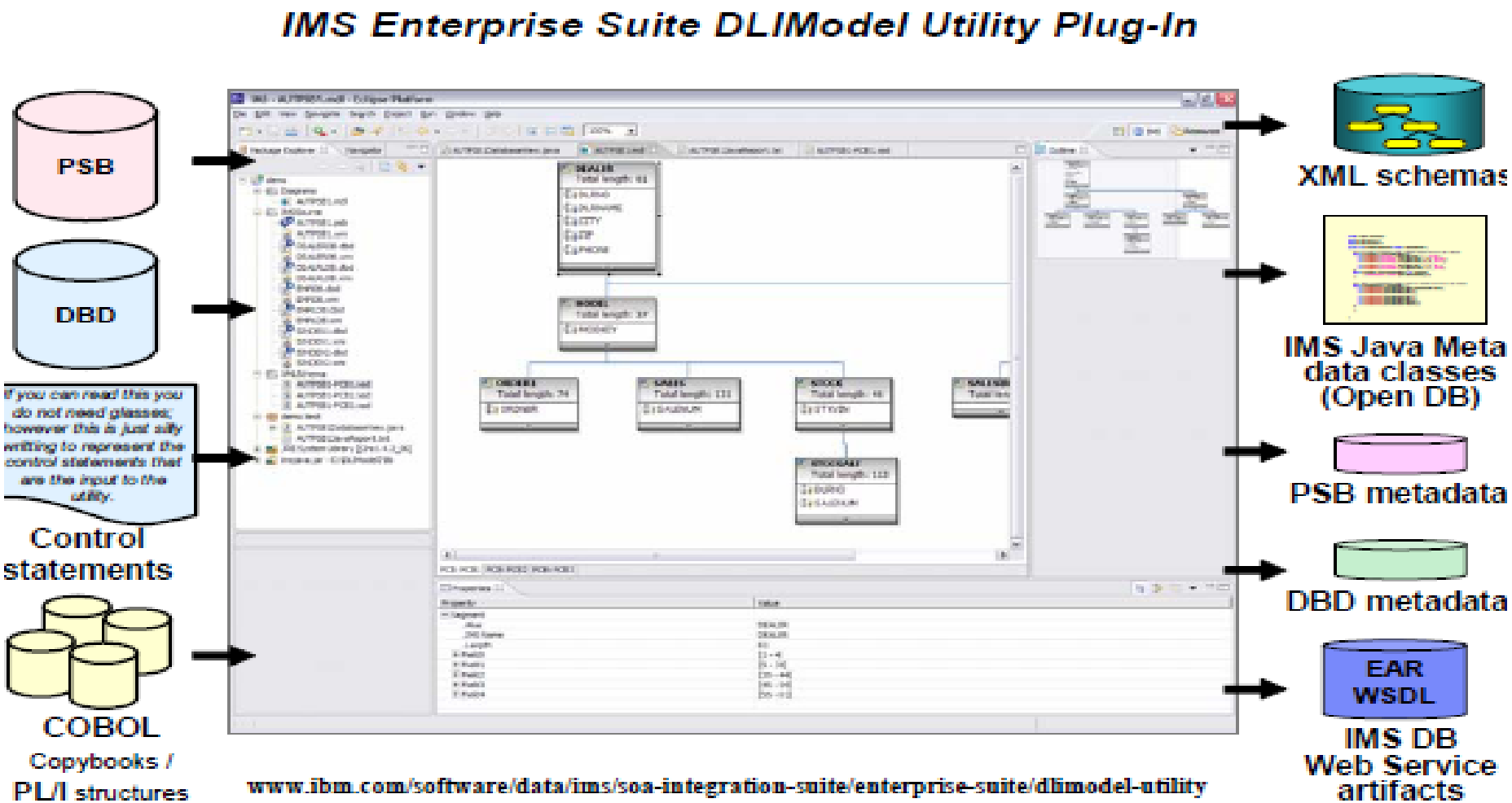
```
D KR01MNOX TYPE=IMSCON TMEMBER=TIMSTOC1 TPIPE=KR01MNOX
D KR01MNOX ADAPTER=HWSXMLA0 CONVERTR=KR01MNOD
```

IMS V11 with Open DataBase Manager (ODBM)

- ODBM provides a way for distributed java applications to make database calls directly to IMS, in much the the same way that they have accessed DB2 tables in the past.

- The tooling for doing this is provided by the IMS DLIMODEL Utility, running under Eclipse, and optionally the Rational Application Developer for z/OS (RDz). IMS Versions 10 and 11 provide 2 limited licenses of RDz.

IMS V11 – ODBM

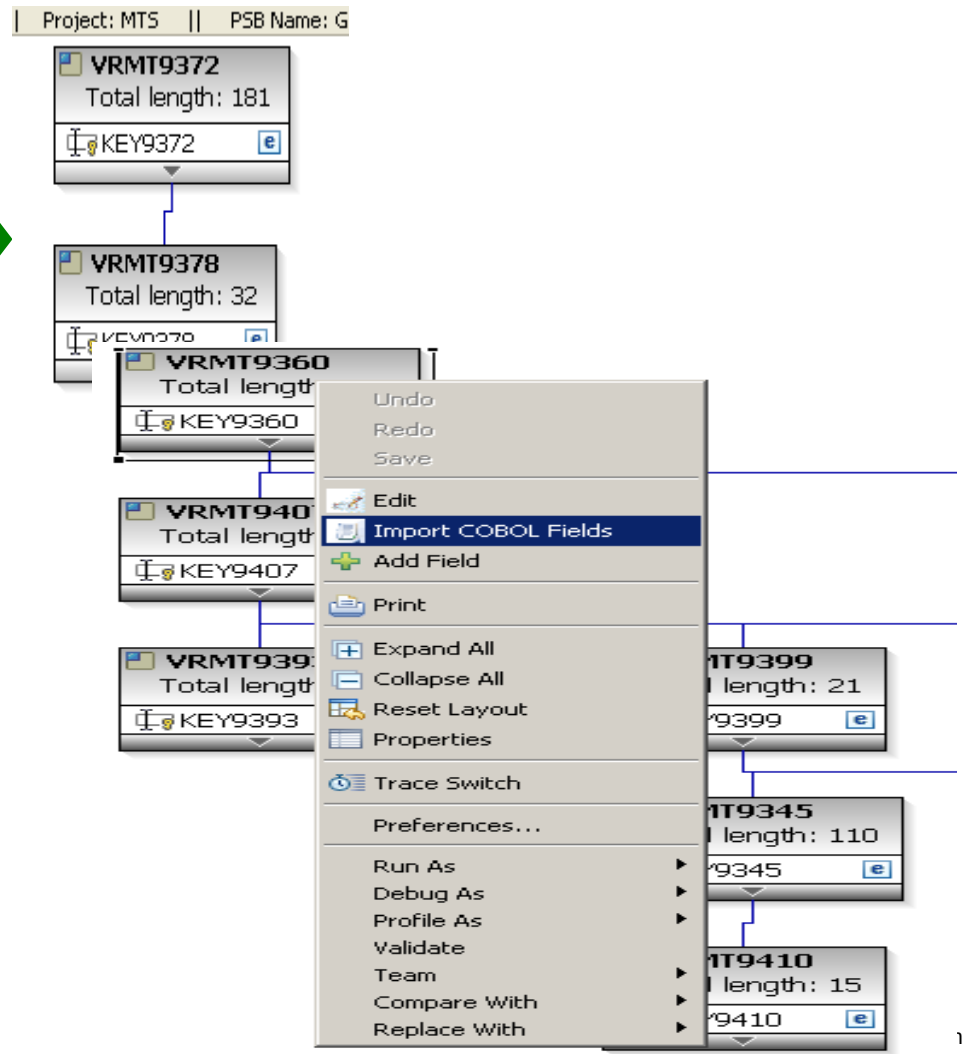


IMS V11 – DL/I Model Utility PSBs – DBDs

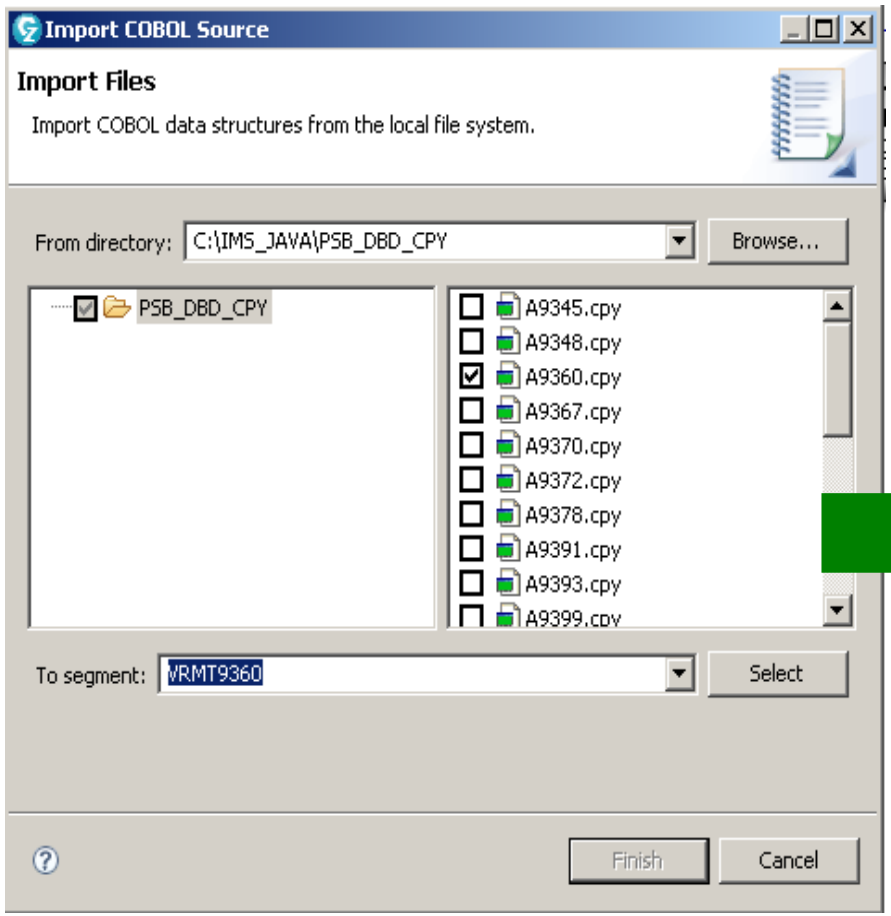
```
PRINT   NOGEN
PCB9NA0 PCB     TYPE=DB,DBDNAME=VRC19NA0,PROCOPT=GOT,KEYLEN=200
     SENSEG  NAME=VRMT9360,PARENT=0
     SENSEG  NAME=VRMT9407,PARENT=VRMT9360
     SENSEG  NAME=VRMT9393,PARENT=VRMT9407
     SENSEG  NAME=VRMT9399,PARENT=VRMT9407
     SENSEG  NAME=VRMT9345,PARENT=VRMT9399
```

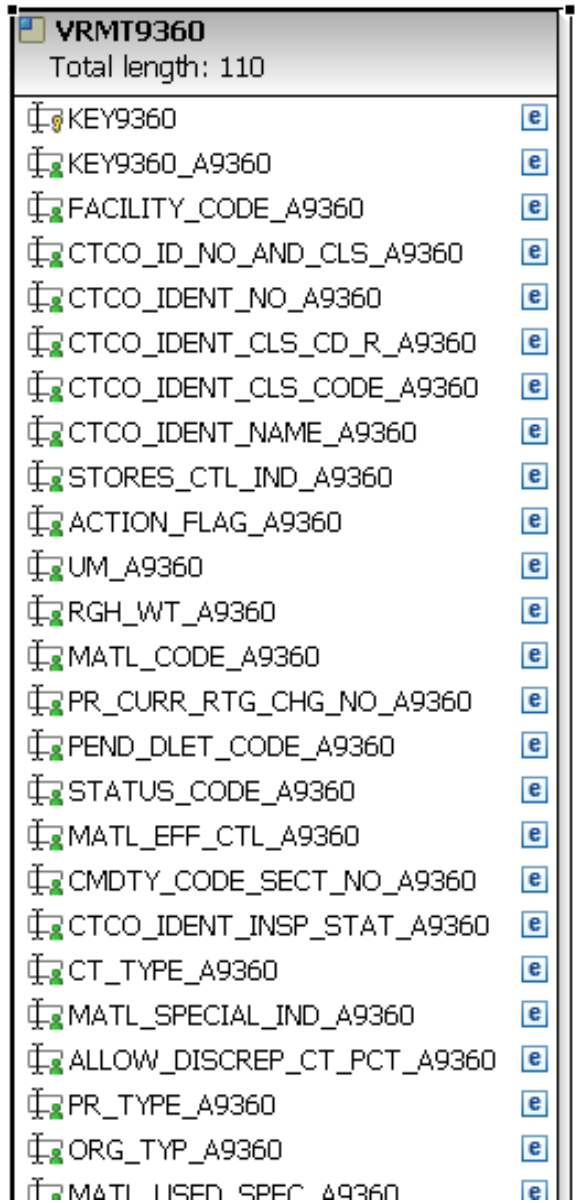
```
PRINT   NOGEN
     DBD     NAME=VRLW9NA0,                          C
           ACCESS=(HDAM,OSAM),
           RMNAME=(DFSHDC40,10,17850,1024)
*                    *----------> 150 CYLS.
*
DSG1   DATASET
DD1=VRW19NA0,DEVICE=3380,SIZE=6144,SCAN=0,FRSPC=(0,10)
     SEGM    NAME=VRMT9360,BYTES=110,                C
           COMPRTN=COMPRSS1
      FIELD  NAME=(KEY9360,SEQ,U),BYTES=13,START=1
     SEGM    NAME=VRMT9407,PARENT=VRMT9360,BYTES=13
      FIELD  NAME=(KEY9407,SEQ,U),BYTES=6,START=1
     SEGM    NAME=VRMT9393,PARENT=VRMT9407,BYTES=73,         C
           COMPRTN=COMPRSS1
      FIELD  NAME=(KEY9393,SEQ,M),BYTES=1,START=1
      FIELD  NAME=(KEY9429,SEQ,U),BYTES=15,START=1
     DBDGEN
     FINISH
     END
```

DL/I Model utility



IMS V11 – DL/I Model Utility Copybooks





IMS V11 – ODBM – Data Mapping

Copybook format	DLIType info data type	Java data types
PIC X(25)	CHAR	java.lang.String
PIC S9 (1-4 figures) COMP	SMALLINT (2 Bytes)	short
PIC S9 (5-9 figures) COMP-4	INTEGER (4 Bytes)	int
PIC S9 (10-18 figures) BINARY	BIGINT (8 Bytes)	long
COMP-1	FLOAT	float
COMP-2	DOUBLE	double
PIC S9(06)V99 COMP-3	PACKEDDECIMAL	java.math.BigDecimal
PIC S9(06)V99	ZONEDECIMAL	java.math.BigDecimal
PIC 9(06).99	ZONEDECIMAL	java.math.BigDecimal
PIC 9 DISPLAY	ZONEDECIMAL	java.math.BigDecimal

IMS V11 – ODBM – Generated Metadata Class

```
package Z1MXODBM;
. . .
public class Z1MXODBMDatabaseView extends DLIDatabaseView {
// The following describes Segment: MX1701 ("MX1701") in PCB: MX1701 ("MX1701")
    static DLITypeInfo[] MX1701MX1701Array= {
        new DLITypeInfo("PARMKEY", DLITypeInfo.CHAR, 1, 37, "PARMKEY", DLITypeInfo.UNIQUE_KEY),
        new DLITypeInfo("PARAMETER_KEY_MX1701", DLITypeInfo.CHAR, 1, 37),
        new DLITypeInfo("RCD_TYPE_MX1701", DLITypeInfo.CHAR, 1, 3),
        new DLITypeInfo("SEGMENT_KEY_MX1701", DLITypeInfo.CHAR, 4, 34),
        new DLITypeInfo("VARI_DATA_MX1701", DLITypeInfo.CHAR, 38, 339)
    };
    static DLISegment MX1701MX1701Segment= new DLISegment
        ("MX1701","MX1701",MX1701MX1701Array,376);
    // An array of DLISegmentInfo objects follows to describe the view for PCB: MX1701 ("MX1701")
    static DLISegmentInfo[] MX1701array = {
        new DLISegmentInfo(MX1701MX1701Segment,DLIDatabaseView.ROOT)
    };
// Constructor
    public Z1MXODBMDatabaseView() {
        super("2.0.3","Z1MXODBM", "MX1701", "MX1701", MX1701array, "G");
    } // end Z1MXODBMDatabaseView constructor
} // end Z1MXODBMDatabaseView class definition
```

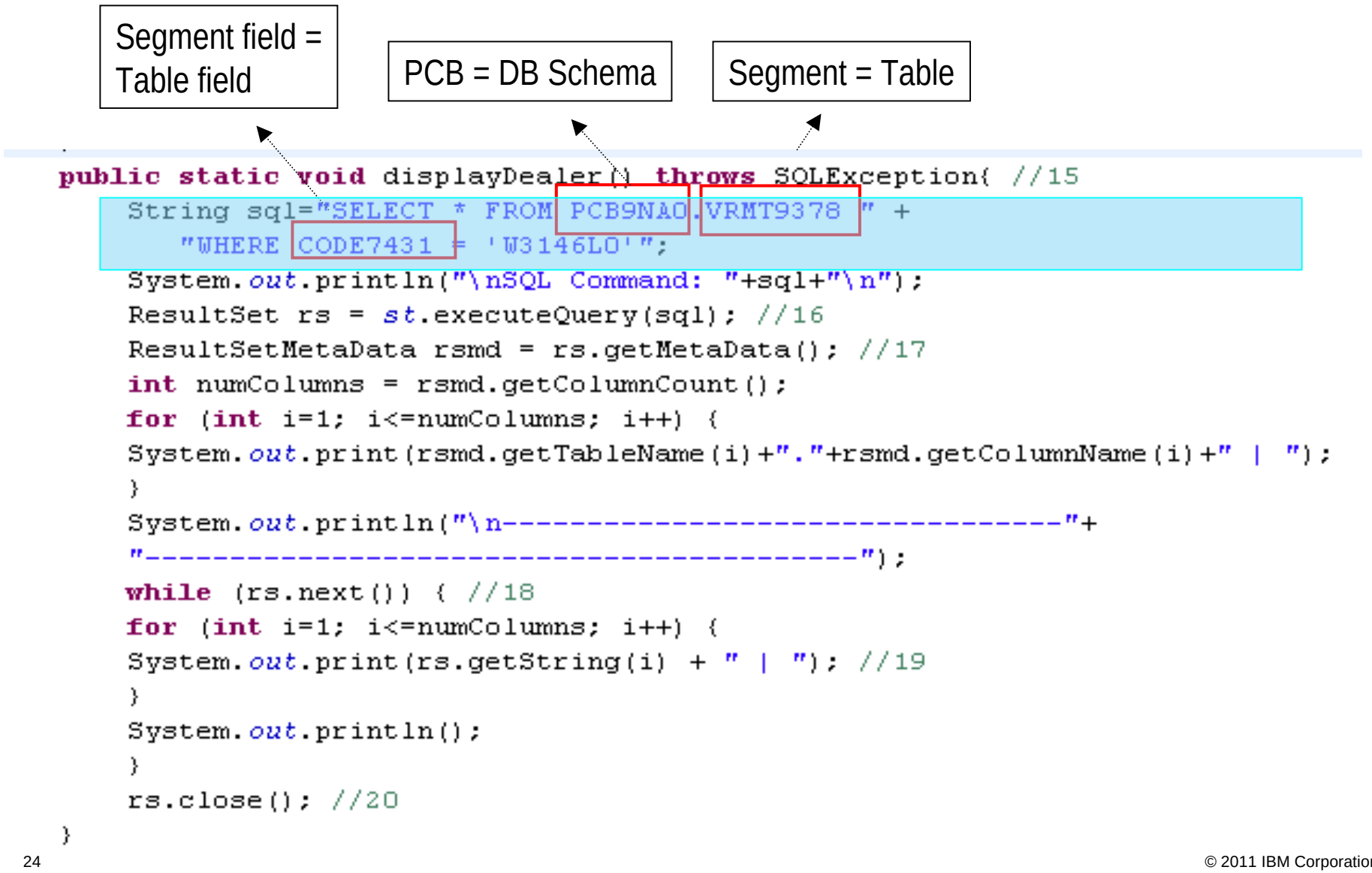
IMS V11 – ODBM – Required files for Client

- The jar file produced from the DLIModel Utility for the PSB containing the Database Views.

- The IMS Universal DL/I driver. It is part of IMS V11(FMID JMK1106). The JDBC and DL/I drivers are shipped in a single jar file, **imsudb.jar**.
  - This jar file is part of IMS and is an OMVS file usually mounted as /usr/lpp/ims/ims11/imsjava/ . Be sure to FTP the IMSUDB.jar file as binary.

- Both of these files must be added to the build path so that they are available to the Java Client program.

IMS V11 – ODBM JDBC Call




```
public static void displayDealer() throws SQLException{ //15
    String sql="SELECT * FROM PCB9NA0.VRMT9378 " +
       "WHERE CODE7431 = 'W3146LO'";
    System.out.println("\nSQL Command: "+sql+"\n");
    ResultSet rs = st.executeQuery(sql); //16
    ResultSetMetaData rsmd = rs.getMetaData(); //17
    int numColumns = rsmd.getColumnCount();
    for (int i=1; i<=numColumns; i++) {
    System.out.print(rsmd.getTableName(i)+"."+rsmd.getColumnName(i)+" | ");
    }
    System.out.println("\n---------------------------------"+
    "----------------------------------------");
    while (rs.next()) { //18
    for (int i=1; i<=numColumns; i++) {
    System.out.print(rs.getString(i) + " | "); //19
    }
    System.out.println();
    }
    rs.close(); //20
}
```

IMS Open Database at Caterpillar

IBM Redbook – "IMS Open Database" – SG24-7856-00.

Questions???

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