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What about .NET?
Interoperability with i5/OS and DB2

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Agenda

1. The latest on DB2 Web Query

2. RPG and COBOL now, where next for i5/OS development?

3. JAVA, J2EE, Web Services and SOA

4. Brighten up the front end: V7.0 of HATS, WebFacing and WDHT

5. Getting into the Web: JSF, EGL and PHP for i5/OS

6. **What about .NET? Interoperability with i5/OS and DB2**

.NET

- .NET is a Microsoft environment for running code
  - code runs inside .NET execution runtime
  - .NET runtime provides memory management, garbage collection, versioning, etc.

.NET Framework Components

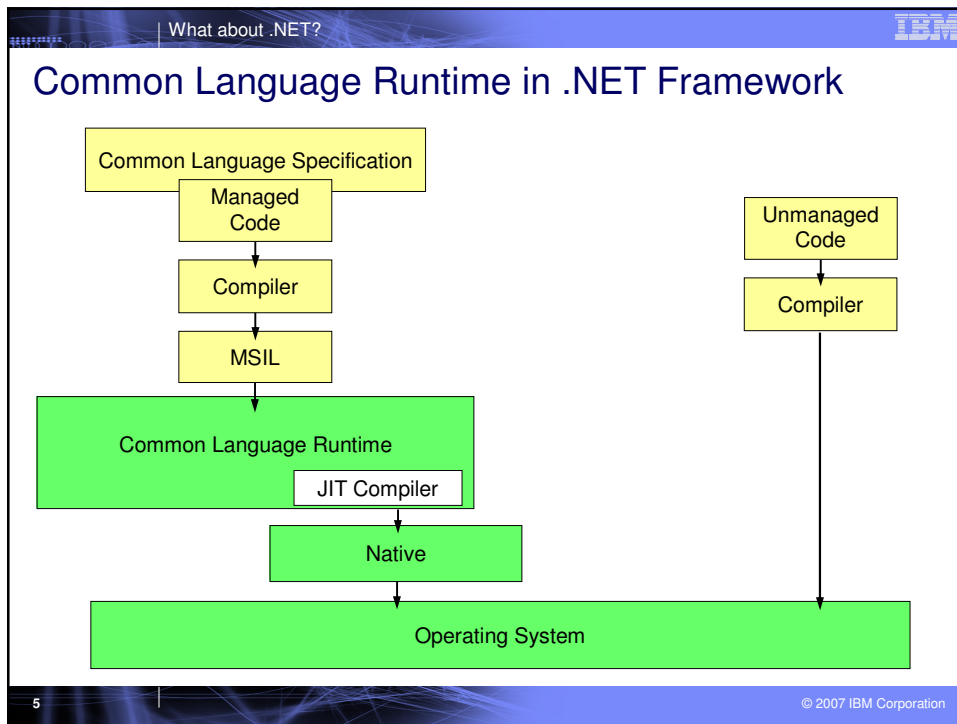| Web Services	Web Forms	Windows Forms

Data, Database, and XML Classes
(ADO.NET, SQL, XSLT, XPath, XML, etc.)

Base Framework Classes
(IO, data types, threading, security, etc.)

Common Language Runtime (CLR)
(garbage collection, exceptions, type checking, JIT, etc.)
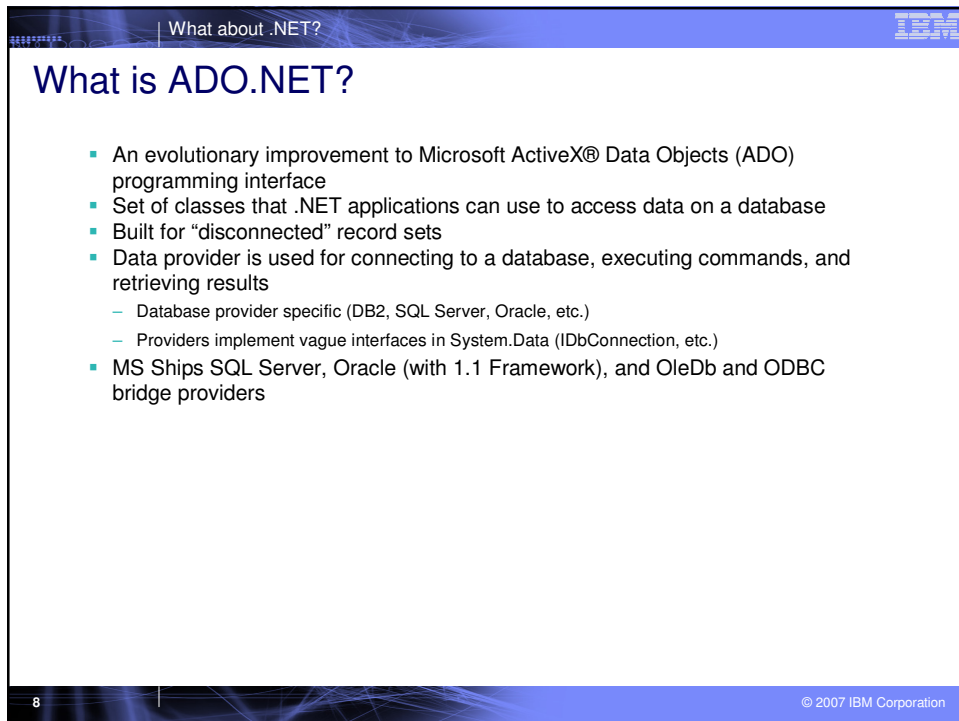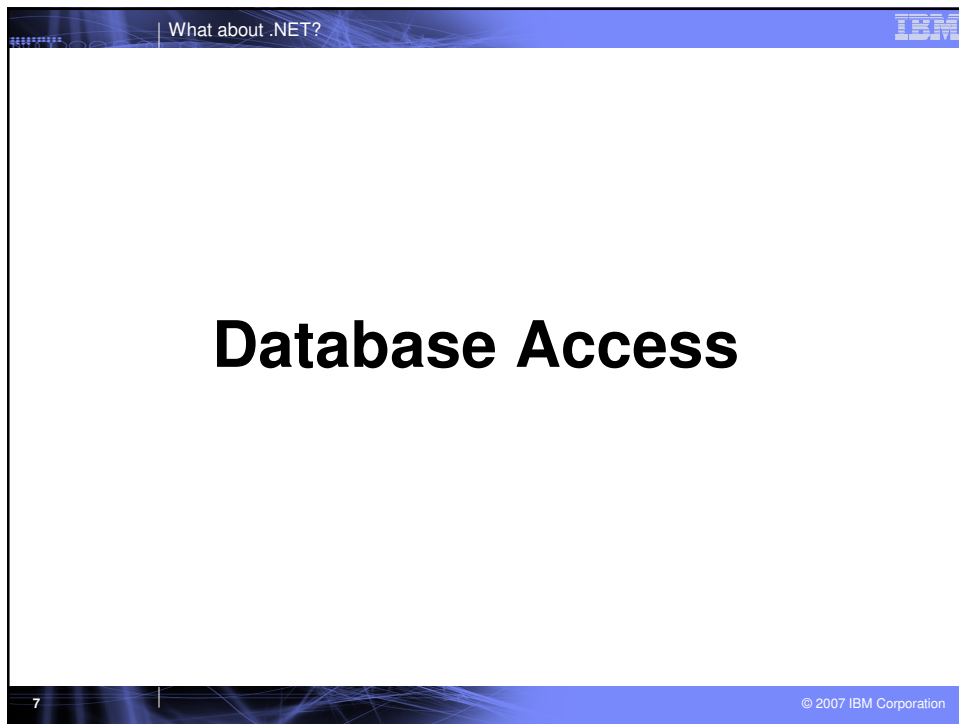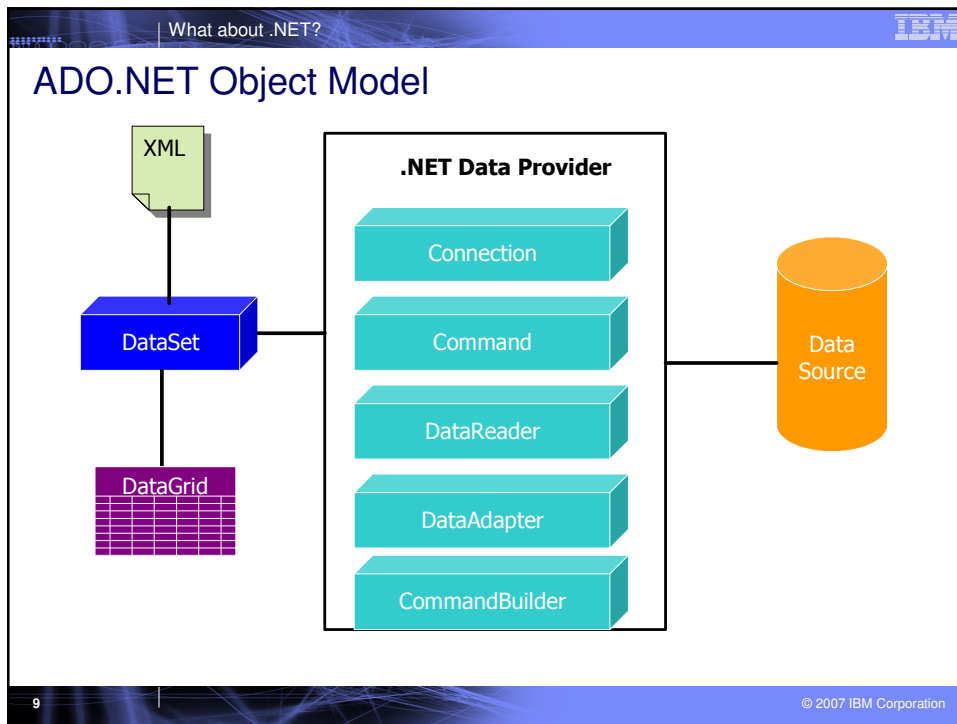
Operating System

Common Language Runtime in .NET Framework

Common Language Specification

Managed Code

Compiler

MSIL

Common Language Runtime

JIT Compiler

Native

Operating System

Unmanaged Code

Compiler

.NET versus J2EE

- **Multiple languages (>25?)**
- **Easily call existing native code/components**
- **1 Intermediary Language (IL)**
- **Windows only (Microsoft)**
  - **Mono™ open source project for Linux, Solaris, Mac OS X, Windows, and Unix**
- **Dynamic web: ASP.NET**
- **Database access: ADO.NET**

- **1 language**
- **JNI/System calls for native components**
- **1 IL**
- **Multiple platforms (JVM)**

- **Dynamic web: JSPs**
- **Database access: JDBC SQL/J**

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Database Access

What is ADO.NET?

- An evolutionary improvement to Microsoft ActiveX® Data Objects (ADO) programming interface
- Set of classes that .NET applications can use to access data on a database
- Built for "disconnected" record sets
- Data provider is used for connecting to a database, executing commands, and retrieving results
  - Database provider specific (DB2, SQL Server, Oracle, etc.)
  - Providers implement vague interfaces in System.Data (IDbConnection, etc.)
- MS Ships SQL Server, Oracle (with 1.1 Framework), and OleDb and ODBC bridge providers

ADO.NET Object Model

XML

DataSet

DataGrid

.NET Data Provider

Connection

Command

DataReader

DataAdapter

CommandBuilder

Data Source

DB2 for i5/OS ADO .NET providers

- IBM DB2 for i5/OS .NET Provider
    - .NET V1.0 + V1.1. SOD for V2.0
- IBM DB2 for LUW .NET provider
- Microsoft .NET provider (part of Host Integration Server 2006)
- Microsoft.Data.Odbc bridge to iSeries Access
- System.Data.OleDb bridge to iSeries Access

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DB2 UDB for iSeries .NET Provider notes

- iSeries Access .NET provider
  - Details available at:
    http://www-1.ibm.com/servers/eserver/iseries/access/
- Install requires the .NET framework be on PC
  - Windows Server 2003 installs .NET framework by default
- Same basic requirements as iSeries Access ODBC and OLE DB to use
  - Database host server must be up and running (see next chart)
- Limited support on pre-V5R2 servers

Planning statement for .NET data provider
February 2007: The .NET data provider in iSeries Access
for Windows plans to support ADO .NET 2.0 base classes
and factories in the next release.

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DB2 UDB for iSeries .NET Provider

OS/400
DB2 iSeries .NET Provider
Network
QZDASOINIT server job
SQL Runtime
SQL
OPTIMIZER
DB2 UDB
Data Storage and Management
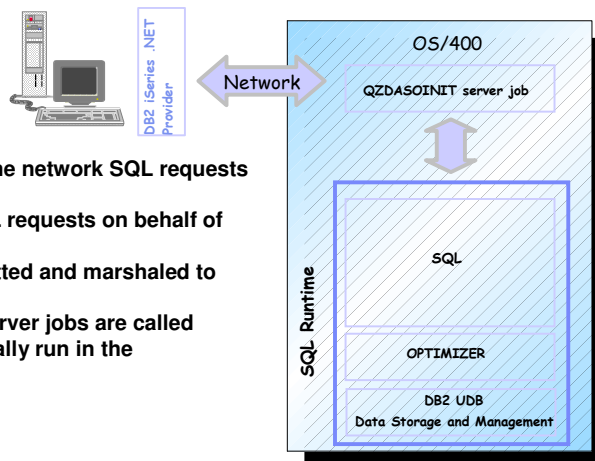
- **.Net client sends over the network SQL requests to iSeries server job**
- **Server job runs the SQL requests on behalf of the client**
- **The results are reformatted and marshaled to the client**
- **The iSeries database server jobs are called QZDASOINIT, and typically run in the QUSRWRK subsystem**

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.NET Framework Integration with DB2 UDB

- IBM DB2 Development Add-Ins for Visual Studio.Net
  - available as part of DB2 UDB and DB2 Connect 8.1.3 (Fix Pack 3) and later
- The key features include:
  - Managed provider for coding server-side objects using the ADO.Net programming model
  - Solution explorer for building DB2 server-side objects
  - Server explorer for gaining access to DB2 server-side objects from any tier of an application
  - SQL editor for using the Visual Studio .NET editor to edit and view DB2 scripts
  - Output views for showing the results of compiling or testing DB2 script files and server objects
- DB2 UDB for iSeries support
  - The managed provider does support iSeries
    - DB2 Connect connection to iSeries is required
  - The Visual Studio .Net Add-Ins in Fix Pack 3 do not support iSeries

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# DB2 .NET Data Provider Access to iSeries
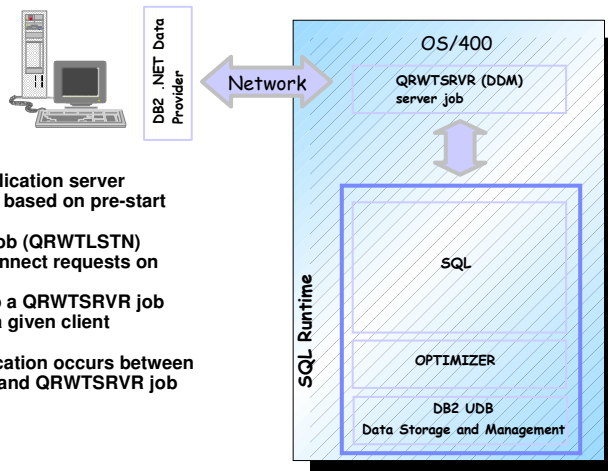
- **iSeries DRDA application server implementation is based on pre-start server jobs**
- **A DRDA listener job (QRWTLSTN) listens for TCP connect requests on port 446.**
- **Listener wakes up a QRWTSRVR job and assigns it to a given client connection**
- **Further communication occurs between client application and QRWTSRVR job**

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Choosing the .NET Provider for i5/OS

- DB2 UDB for iSeries .NET provider is the best choice to access iSeries
  - optimized for iSeries access - best overall performance
  - supports a range of iSeries specific properties
- DB2 UDB (LUW) .NET Managed Provider
  - Considered when access to different DB2 platform is required
  - Requires a DRDA (DB2 Connect) connection to iSeries
  - not as efficient as DB2 UDB for iSeries .NET provider
- ODBC .NET Data Provider and OLE DB .NET Data Provider
  - Less efficient than DB2 UDB for iSeries .NET provider
  - Consider only when access to heterogeneous databases is required or when accessing an older version of OS/400

Redbook

- Introduction to DB2 UDB for iSeries
- Introduction to the Microsoft .NET ADO .NET object hierarchy
- IBM DB2 UDB for iSeries .NET provider
- IBM DB2 for LUW .NET provider
- Selecting the .NET provider
- ASP .NET scenario (Web forms)
- Sample programs
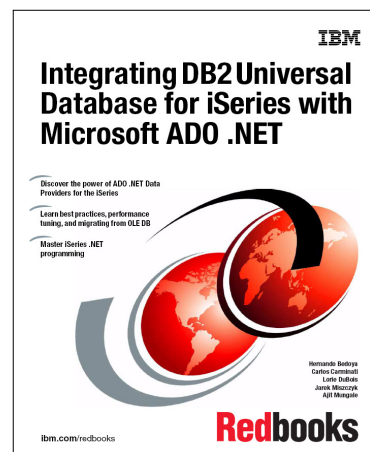
Integrating DB2 Universal Database for iSeries with Microsoft ADO .NET

Application Access

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iSeries Access for Windows Programmer'sToolkit

- Rich family of APIs for Windows applications:
  - ODBC, OLE Db, ADO .NET, ODBC
  - Remote program call, data queue access, DDM file access etc.
  - Unmanaged code (apart from ADO .NET)

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Case Study

Accessing an RPG application from .NET as a Web Service

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The RPG Application

```
C      *entry      PLIST
C                  parm              name       25
C                  parm              gender      1
C                  parm              age         3 1
C                  parm              dest       12
C                  parm              durn        2 0
C                  parm              quoteno     6 0
C                  parm              cost        7 2
C                  parm              enddate    10
C*
C* Get the base quotation for young UK females from the reference table
C* and apply multipliers
C*
C/exec sql
C+ select basequote into :cost
C+ from wfdemo/qqref
C/end-exec
C*
C** Men are more trouble
C . . .
```

Service: supply quotations for holiday insurance to Travel Agencies

RPG application is parameter driven and uses rules and database tables to calculate quotation

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The steps

1. Use WDSc wizard(s) to generate the Web Service and associated WSDL file
2. Test the service using the WDSc test client
3. Map the WSDL file into Visual Studio .NET as a Web Reference
4. Write a VB .NET client
5. Write a short routine to set and get the parameters via the reference
6. Done!

Generate the Web Service in

WebSphere Development Studio Client V7.0

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Generate PCML for the program

PCML: Program Call Markup Language

An XML based description of the call parameters

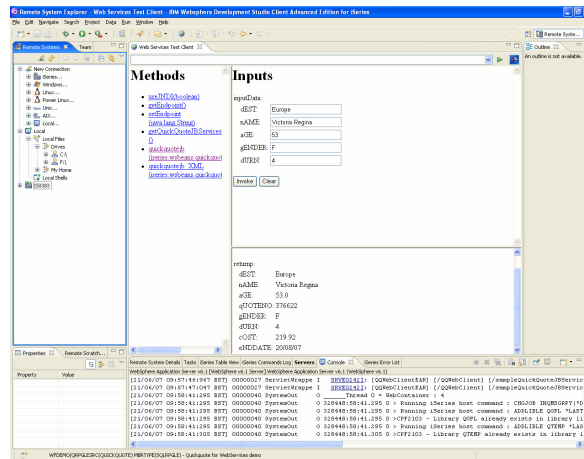
The Web Services Wizard

Use the Web Service wizard to create the service and a test client

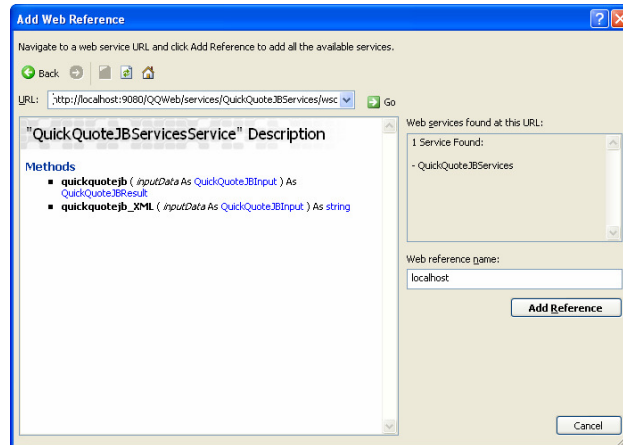Define the interface from the generated PCML

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Test the service with the generated client

The generated service and client are deployed to
WebSphere Application Server

Generate the Service Consumer in

Microsoft Visual Studio .NET

Add a Web Reference to a Visual Studio Project

The reference is created from the WSDL file generated in WDSc

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.NET classes are automatically generated

In the class view we see that the original QuickQuoteJBInput and QuickQuoteJBResult Java classes from WDSc have reappeared as .NET classes

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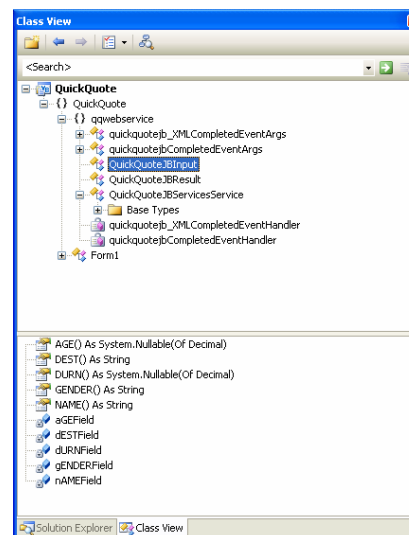
Write a subroutine to invoke the service

```
Private Sub getQuote(ByVal name As String, ByVal gender As String, _
        ByVal age As Double, ByVal destination As String, _
        ByVal duration As Integer, ByRef quoteNo As Integer, _
        ByRef cost As Double, ByRef enddate As String)
        ' Instantiate Web service and parameter classes
        Dim WS As New QuickQuote.qqwebservice.QuickQuoteJBServicesService
        Dim WSInput As New QuickQuote.qqwebservice.QuickQuoteJBInput
        Dim WSResult As New QuickQuote.qqwebservice.QuickQuoteJBResult

        ' Set up the input parameters to the Web Service
        WSInput.age = age
        WSInput.dest = destination
        WSInput.durn = duration
        WSInput.gender = gender
        WSInput.name = name

        ' Call the Web Service
        Try
            WSResult = WS.quickquotejb(WSInput)
        Catch ex As Exception
            MessageBox.Show("A problem occurred on the Web Service call", _
                "Application Server Error", MessageBoxButtons.OK, _
                MessageBoxIcon.Error)
        End Try

        ' Extract the result parameters
        quoteNo = WSResult.quoteno
        cost = WSResult.cost
        enddate = WSResult.enddate
End Sub
```

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The simple Visual Basic .NET Front End

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e (logo) business	OS/400
IBM	System i

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