

SQL Server -

The Common Language Runtime (CLR) Integration

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www.chnsqlug.co.cc



www.sql-articles.com



The Developer Experience

Microsoft® Visual
Basic®, C#, ...

Microsoft®
Visual
Studio®
.NET Project

Assembly:
"TaxLib.dll"

deploy

Runtime
hosted inside
SQL

SQL Data Definition:
create assembly ...
create function ...
create procedure ...
create trigger ...
create type ...

SQL Queries:
`select
sum(tax(sal,state))
from Emp where county
= 'King'`

Microsoft®
SQL Server™

Existing system

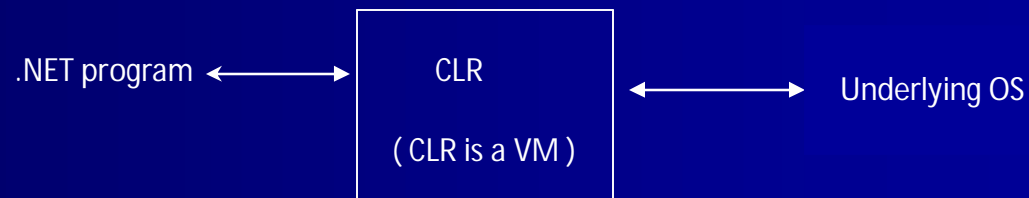
- Transact-SQL is specifically designed for direct data access
- Transact-SQL does not support arrays, collections, for-each loops etc.
- Use Microsoft® Visual C++® to write code, an extended stored procedure, which runs within the database
- Use other languages and middleware, such as ADO and ADO.NET

Limitations

- Struggle to deliver good performance for computationally heavy tasks
- Expensive for large volume of data - Data Marshalling between the external code and sql server process space.

SQL CLR System

- CLR – Heart of .NET F/W – Execution envt for all .NET code
- Specialized CLR - a process virtual machine* that was specifically for SQL
- SQL Server 2005 hosts the runtime environment (CLR) in the database engine's process space.
- The CLR requests memory from SQL Server, not directly from Windows
- CPU-intensive CLR memory garbage collection is controlled by SQL Server.
- CLR application domains are created and managed by SQL Server.



* http://en.wikipedia.org/wiki/Virtual_machine

SQL CLR System

SQL CLR Sandbox



Windows CLR Sandbox



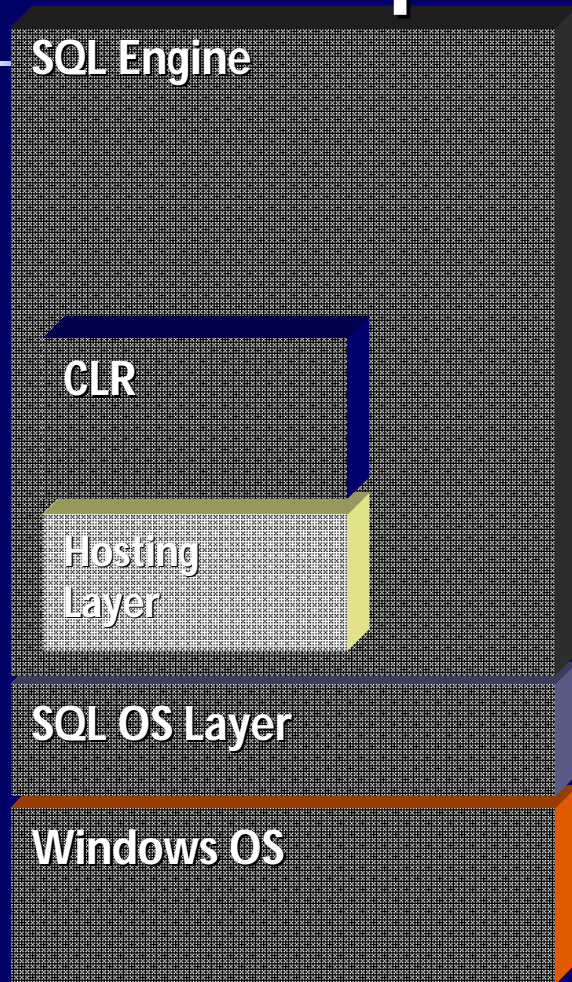
- Oracle allows the Java code in DB ; VM is running outside DB process.
- SQL CLR is tightly coupled ; SQL DB processes/actions will be given higher priority than .NET apps running in SQLCLR ; SQL will clear unused .NET app memory and allow the db to operate normally.

CLR Integration

- Even in supported assemblies, some APIs are not available in SQL
 - `Environment.Exit()`, `Console`, etc.
 - No thread creation
- Eliminate functionality N/A to database
 - `System.Windows.Forms`
 - `System.Drawing`
 - `System.Web`, ...

CLR Integration

Deep Integration with DB



- CLR Hosting layer provides coordination
 - Assembly Loading
 - Memory management
 - Security Model
 - Reliability
 - Threads & Fibers
 - Deadlock detection
 - Execution context

CLR Integration

- Run managed code within a database by using in-process assemblies
- Create managed stored procedures, triggers, user-defined functions, user-defined types, and aggregates
- Integration benefits:
 - Enhanced programming model
 - Enhanced safety and security
 - Common development environment
 - Performance and scalability

CLR Integration

Assembly Security - PERMISSION_SET

■ **SAFE**

- May not access external resources: registry, file system, or network
- May access data using the current context but not via SQLClient or any other data provider
- No thread processing

■ **EXTERNAL_ACCESS**

- May access external resources: registry, file system, network, environment variables

■ **UNSAFE**

- May access external resources
- Can use SQLClient and other data providers
- Can use thread constructs
- (No restrictions; similar to extended stored procedures)

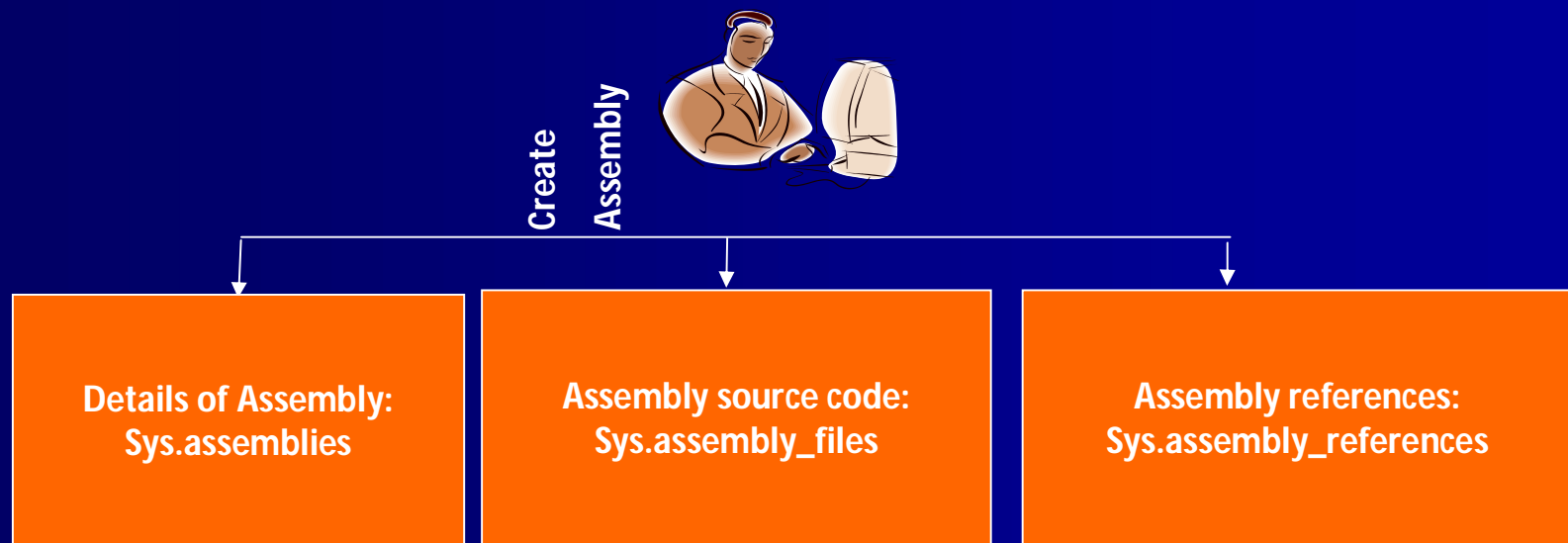
CLR Integration

SQL Server Projects in VS 2005

- Project for creating managed database objects
- Automatically includes necessary references
 - System
 - System.Data.dll
- Includes templates for each object type
 - Stored procedure
 - Trigger
 - User-defined function
 - User-defined type
 - Aggregate
- Allows immediate deployment and debugging

CLR Integration

Meta Data of Assemblies



Other meta data information

- **SYS.OBJECTS**
- **SYS.ASSEMBLY_MODULES**
- **SYS.ASSEMBLY_TYPES**

SQLCLR Guidance

Mid Tier vs. Data Tier

- SQLCLR is not the replacement for T-SQL Statements
- Integrating the CLR into SQL Server is not a step to eliminating T-SQL.
- SQLCLR support does not mean move all business logic to server
- Candidates for moving to server
 - Centralized data validation
 - Process large amount of data while needing a small portion of it for application use

DEMO

Resources

- <http://consultingblogs.emc.com/simonmunro/archive/2008/11/12/digging-in-the-sql-clr-litterbox.aspx>
- <http://codebetter.com/blogs/rodpaddock/archive/2007/09/13/accessing-external-assemblies-from-sql-server-clr-stored-procedures.aspx>
- <http://www.developer.com/net/net/article.php/3528601/An-Intro-to-CLR-Integration-in-SQL-Server-2005.htm>
- <http://blogs.msdn.com/sqllive/default.aspx>

Questions?

