

ORACLE®

[illegible]

Alex Keh and Christian Shay
Principal Product Managers, Oracle

Program Agenda

- Optimization Process
- Optimizing ODP.NET Performance
 - Connection Pooling
 - Data Retrieval and Updates
 - ODP.NET Data Types
 - Miscellaneous
- Optimizing Oracle Database Performance from Visual Studio
 - SQL Tuning Advisor
 - Oracle Performance Analyzer



Optimization Process

Oracle .NET Application Performance – Optimization Steps

- .NET data access tuning
 - Use ODP.NET best practices
- SQL tuning
 - Use SQL Tuning Advisor in Visual Studio
- Database tuning under real world conditions
 - Oracle Performance Analyzer in Visual Studio detects issues you have missed
 - May need to modify application based on findings
 - Can be used during testing phase or production

Optimizing ODP.NET Performance

Connection Recommendations

- Connection pooling (CP)
 - Creating many connections quickly is resource intensive
 - Make sure to have enough connections in CP
 - Better to have too many connections than too few
 - OS-authenticated CP available with ODP.NET 11g version
- Keep number of connections at steady state
 - Should never destroy or create large numbers of connections
- Close/Dispose connections (and all objects) explicitly
 - Do not necessarily rely on the garbage collector
 - Recommendation applies to all ODP.NET objects

CP Sizing and Monitoring

- Min Pool Size = # connections at steady state or average load
- Max Pool Size = # connections at maximum capacity
 - Min and Max Pool Size always obeyed ahead of other CP parameters
- Incr Pool Size = connection growth rate from steady state
- Decr Pool Size = connection decrease rate from steady state
 - Pool size checked every 3 minutes
- Monitor ODP.NET CP performance counters and/or tracing
 - Available with ODP.NET 11.1.0.6.20 or higher

General ODP.NET CP Management

- Connection Lifetime = 0 (off by default)
 - No change recommended from performance standpoint
- Validate Connection = false (default) in most cases
 - Extra round trip for every connection request
 - Your own exception handler will be faster
- CheckConStatus = 1 (on by default)
 - Checks connection validity and rollbacks transactions before placing back in the pool
 - Available in config file and Registry only
 - Can turn off if developer writes own exception handlers.

ODP.NET CP Management for Clusters and Standbys

- RAC automatic connection load balancing
 - Load Balancing = true
- RAC and Data Guard automatic “bad” connection removal
 - HA Events = true

Commands – Bind Variables

- #1 Recommendation: use bind variables
 - Prevents re-parsing of frequently executed statements
 - Works with SQL and PL/SQL statements
- Improves subsequent command executions
 - Literal value changes in commands forces a re-parse and re-optimization
 - Literal values should become bind variables
- Executed statements stored in Oracle shared pool
 - Re-parsing and re-optimization uses CPU and requires shared pool locks

Commands – Statement Caching

- #2 Recommendation: use statement caching
 - Retains parsed statement in shared pool
 - Cursor stays open on the client side for faster re-use
 - No additional lookup needed on server
 - Metadata remains on the client
- Caches most recently used statements
 - Works with SQL and PL/SQL statements
- Best used with bind variables
- With ODP.NET 10.2.0.2.20, on by default
 - Caches the last ten executed statements
 - Developer can choose which statements to cache
- Self-tuned cache size (default) with ODP.NET 11.1.0.7.20



ORACLE[®]

D E M O N S T R A T I O N

Statement Caching

Self-Tuning – New in ODP.NET 11.1.0.7.20

- Problem: Sizing statement cache at design time
 - Cache too small – lots of reparsing
 - Cache too big – excessive memory usage
 - Optimal size can change over time
- Solution: Let ODP.NET automatically optimize at runtime
- Statement cache size dynamically changes
 - Automatically optimized in real-time
 - Increases cache if not caching frequently executed statements
 - Decreases cache if using excessive memory

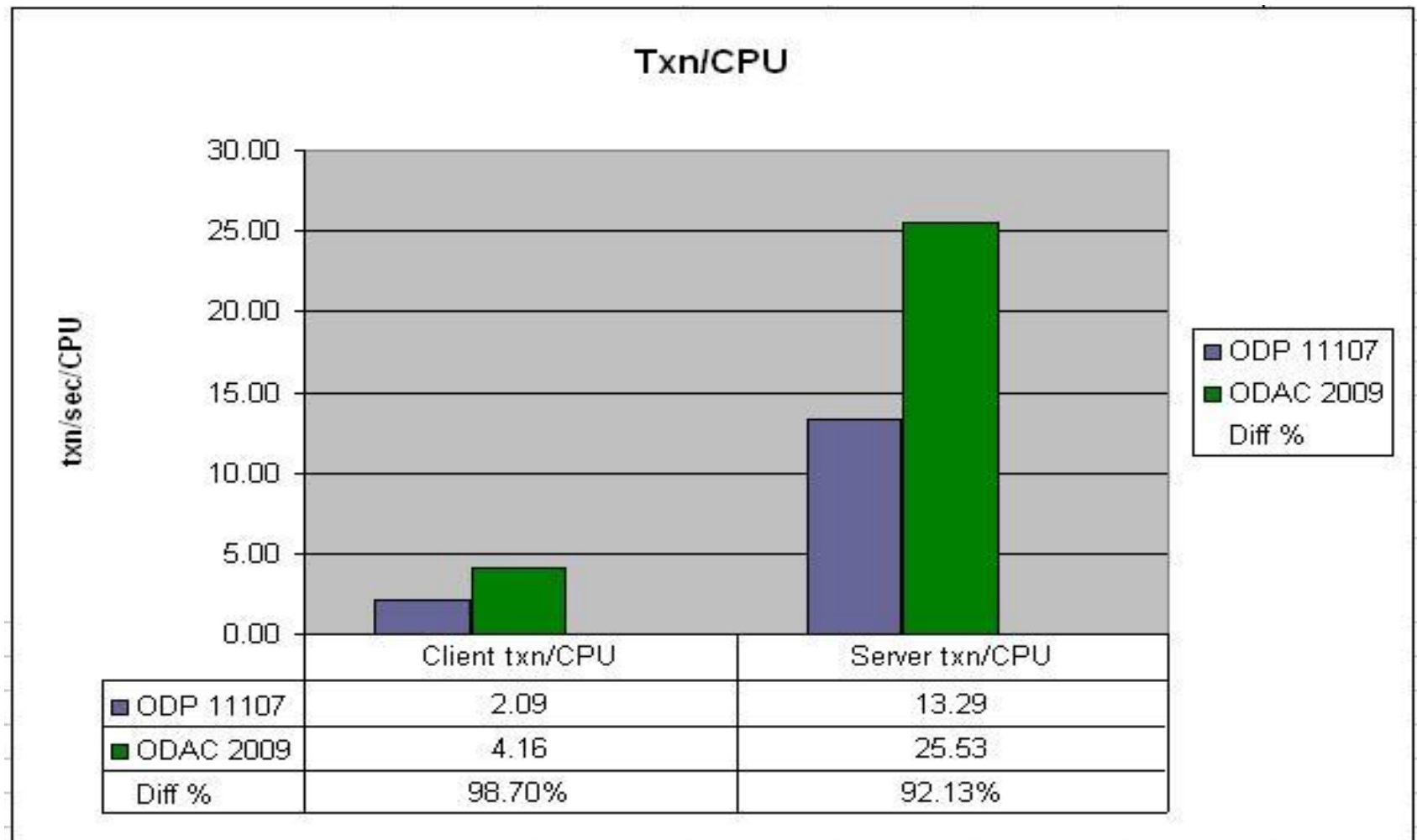
Self-Tuning – New in ODP.NET 11.1.0.7.20

- **Benefits**
 - Faster performance
 - Less network traffic
 - Lower client and server memory usage
- **Beneficiaries**
 - Apps without a tuned statement cache size
 - Apps that require a changing statement cache size at runtime
- **Self Tuning is enabled by default**
 - No code changes required
 - Just upgrade to ODP.NET 11.1.0.7.20 or higher

How Much Faster?

- Performance comparison
 - Compared ODP.NET 11.1.0.7.0 versus ODP.NET 11.1.0.7.20
 - Using same Oracle DB 11.1.0.7 Server
 - 80 concurrent users with 40K query executions each
 - 60 unique queries
 - Application reads data into DataSet
- Client and server machine specs
 - Quad 3.2GHz Intel Xeon with 4GM RAM
 - Windows Server 2003 Standard Edition
- No tuning done – out of the box settings

Add It Up: More Transactions Per Second Per CPU



Self-Tuning Performance Comparison Conclusions

- Results
 - Faster completion (24%)
 - More throughput (60%)
 - Better response time (38%)
 - Less network traffic (21%)
 - Less CPU on both client (19%) and server (17%)
 - More transactions per second per CPU on client (99%) and server (92%)
- All gains were out of box
 - No tuning done

Commands – Data Retrieval

- Control how much data is retrieved per DB roundtrip
 - Too much data retrieved – excessive client-side memory used
 - Too little data retrieved – additional round trips
- Use `OracleCommand.RowSize` and `OracleDataReader.FetchSize` to control result size
 - RowSize populated after statement execution
 - Set dynamically at run-time
 - FetchSize can be set as multiple of RowSize



ORACLE[®]

D E M O N S T R A T I O N

Fetch Size and Row Size

Commands – Mass Data Movement with Arrays

- PL/SQL associative arrays
 - Pass large amounts of data between .NET and DB of the same data type
- Use parameter array binding
 - Useful if executing the same statement multiple times
 - Bind variables are the same, variable values can be different
 - One execution for each element in the bound array
- Remember: PL/SQL associative arrays and parameter array binding are two different concepts

Commands – Statement Batching

- Execute multiple commands in one DB roundtrip
- Use anonymous PL/SQL
 - Useful for disparate or similar statements
- Use `OracleDataAdapter.UpdateBatchSize` to batch updates from `DataSet`

Promotable Transactions – New in ODP.NET

11.1.0.7.20

- Problem: At design time, unknown if a transaction will be distributed or local at run time
 - Must use distributed transactions even if local transactions are used some of the time
 - Local transactions are less resource intensive
 - Preferred over distributed transactions
- Solution: Promote local transactions to distributed as needed at run time
- Benefits
 - Better application performance
 - Lower resource usage

Promotable Transactions – New in ODP.NET

11.1.0.7.20

- Enabled by default
 - No code changes required
 - Just upgrade to ODP.NET 11.1.0.7.20 or higher
- Requirements
 - First connection to Oracle Database 11g (11.1) or higher
 - Subsequent connections can be to any other version or database
 - Requires Oracle Services for MTS 11.1.0.7.20 or higher
 - Requires .NET Framework 2.0 or higher

ODP.NET Data Types

- Avoid unnecessary data type conversions
- .NET vs. ODP.NET Types
 - OracleDataReader Type Accessors
 - OracleParameter.DbType vs. OracleParameter.OracleDbType
- Option to store Oracle data types in DataSet
 - OracleDataAdapter.ReturnProviderSpecificTypes = true
 - Available in ADO.NET 2.0

REF Cursors

- Retrieve data as needed
 - Control data retrieved via FetchSize
 - Fill a DataSet with just a portion of the REF Cursor result
 - Explicit control over what REF Cursor data is retrieved and how
- Defers result set retrieval until needed
- Pass REF Cursors back as input stored procedure parameters
- OracleRefCursor class

SecureFiles and LOBs

- Data retrieval options
 - Defer retrieval (default) with LOB locator
 - Retrieve data immediately using `OracleCommand.InitialLOBFetchSize`
 - Retrieve a portion using `Read` method
 - Use `Search` method to find data to be retrieved
- Update/Insert/Delete
 - Modify LOB without retrieving the data to the client side
 - Uses LOB locator
- Use `SecureFile` data type in Oracle Database 11g
 - Numerous benefits over traditional LOBs

Additional Optimizations

- Oracle Database Change Notification
 - Maintain consistent client cache while disconnected from server
 - Programmatically control caching and updating
- Oracle Client Result Cache
 - Transparent client cache
 - Requires Oracle Database 11g server and client or higher
 - Use `/*+ result_cache */` hint
 - Only necessary with Oracle Database 11.1
 - Not needed with Oracle Database 11.2

Deployment: Instant Client (IC)

- IC available with OUI and xcopy
- No functionality difference between IC and standard client
- IC Benefits
 - Control over install process
 - Xcopy
 - Fine grain control over installation process
 - Great for large scale deployments or ISV packaging
 - OUI – great for small scale deployments
 - Smaller install size compared to standard install
 - Xcopy install – smallest footprint
 - OUI install – small footprint
 - Fastest client deployment – Xcopy install

[illegible]

Performance Tuning in Visual Studio – SQL Tuning Advisor

- Tunes ad-hoc SQL Statements in Query Window
- Tunes bad SQL found by Oracle Performance Analyzer
- Use this at dev time when designing SQL Statements
- Use when testing if SQL is performing poorly under load

Performance Tuning in Visual Studio – SQL Tuning Advisor

- Requirements
 - ADVISOR Privilege
 - Oracle Database license for Oracle Diagnostic Pack
 - Oracle Database license for the Oracle Tuning Pack
- How to run:
 - Oracle Query Window “Tune SQL” button
 - Oracle Performance Monitor – Tune SQL button
- Implement Findings Button
 - Automatically fix the problem for certain finding types
- View Report Button
 - View more details about how to fix a problem

Performance Tuning in Visual Studio – Oracle Performance Analyzer

- Detects performance issues in an application's use of the database under load
- Use it when you have a running app with a load
- Requirements
 - SYSDBA
 - Oracle Database license for Oracle Diagnostic Pack
- Can be use during testing
- Can be also used on production applications

AWR and ADDM

- Built into the Oracle Database 10g
- Automatic Workload Repository (AWR)
 - Evolution of statspack
 - Built-in repository
 - Captures performance statistics at regular intervals
- Automatic Database Diagnostic Monitor (ADDM)
 - Methodically analyses captured AWR stats
 - Generates recommendations
- Reports provide invaluable input for diagnosing performance issues

AWR and ADDM

- AWR Snapshots
 - A collection of database statistics and performance metrics gathered at a single point in time.
 - Two snapshots make up one analysis time period
 - Oracle Database automatically takes periodic snapshots
- ADDM Tasks:
 - An analysis of Oracle database performance over a period of time
 - Requires two AWR Snapshots to define that time period

AWR and ADDM in Visual Studio

- AWR Snapshots
 - New AWR Snapshot Dialog
 - AWR Snapshots Node in Server Explorer
- ADDM Tasks
 - New ADDM Task Dialog
 - ADDM Tasks Node in Server Explorer
 - ADDM Task results are displayed in Oracle Performance Analyzer

Oracle Performance Analyzer

The screenshot shows the Oracle Performance Analyzer application window. The title bar includes tabs for 'ORACLE://SYS...905[ANALYSIS]', 'Program.cs', 'ORACLE://HR.(...LOYEES[Design]', and 'Start Page'. The main window is divided into two main sections: 'Analyze Performance' and 'Performance Analysis'.

Analyze Performance Section:

- Text: "This tool allows you to analyze the database performance for your application. Please start your application before starting the database analysis."
- Connection name: SYS.(Local Database)
- Run For (hrs:min): 00:14
- Start button
- Analysis Status: Completed.

Performance Analysis Section:

- Left sidebar (Tree View):
 - Performance Analysis
 - Findings
 - CPU Usage
 - Top SQL by DB Time
 - Recommendation1
 - Action1 (highlighted)
 - Recommendation2
 - Action1

- Right pane:
- Name: Action1
- Description: Run SQL Tuning Advisor on the SQL statement with SQL_ID "2sgj803gsfssk".
- Tune SQL button
- SQL / Tune SQL tabs (Tune SQL is selected)
- Table with 4 columns: Type, Findings, Recommendations, and Rating (partially visible).

Type	Findings	Recommendations	Rating
STATISTICS	Table "HR"."DE...	Consider collecting optimizer statistics for thi...	The
STATISTICS	Table "HR"."EM...	Consider collecting optimizer statistics for thi...	The
- Buttons: Implement Recommendation, Preview SQL, View Report

Performance Tuning in Visual Studio – Oracle Performance Analyzer

- Simple to use
 - Run your application
 - Enter amount of time to analyze
 - Press Start to start timer
 - Sufficient “database time” required to get results
 - View findings and actions
 - Implement recommended actions
- Automatically creates two snapshots and an ADDM task and displays results
 - Pro: Easy to use interface, simple for beginners
 - Con: If Insufficient database time, must wait entire time period again
 - Con: Visual Studio must be open throughout entire time period

Performance Tuning in Visual Studio – Oracle Performance Analyzer

- “Manual” Method, instead of using Timer
 - Run your application
 - Create a Snapshot, via “New AWR Snapshot” dialog
 - Wait desired time period
 - Create second snapshot
 - Create ADDM Task, via “New ADDM Task” dialog
 - View Results. If insufficient database time, wait a while and create one more snapshot and another ADDM task

Performance Tuning in Visual Studio – Oracle Performance Analyzer

- Manual Method Pros
 - Can close Visual Studio during time period
 - If insufficient database time in first attempt, you can simply extend the time period by creating one more snapshot, without having to wait entire duration again
 - Can use database created AWR Snapshots if desired
 - Can elect to monitor all statistics when creating the snapshots

Performance Tuning in Visual Studio – Oracle Performance Analyzer

- Finds many possible problems:
 - Top SQL in use of Database Time
 - CPU usage
 - Excessive parsing
 - I/O bottlenecks
 - Virtual memory paging
- Recommended Actions:
 - Tune SQL
 - May need to modify application
 - View Report button for more details



ORACLE®

D E M O N S T R A T I O N

Performance Tuning

Appendix



More Oracle .NET Resources

- .NET Technology Center
 - <http://www.oracle.com/technetwork/topics/dotnet/>
- For more questions
 - alex.keh@oracle.com
 - christian.shay@oracle.com


Oracle Products Available Online



Oracle Store

SHOP NOW

**Buy Oracle license and support
online today at
oracle.com/store**



The preceding is intended to outline our general product direction. It is intended for information purposes only, and may not be incorporated into any contract. It is not a commitment to deliver any material, code, or functionality, and should not be relied upon in making purchasing decisions. The development, release, and timing of any features or functionality described for Oracle's products remains at the sole discretion of Oracle.

SOFTWARE. HARDWARE. COMPLETE.

ORACLE®