Oracle and .NET: Best Practices for Performance

Christian Shay & Alex Keh
Product Managers
Oracle
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Program Agenda

1. Optimization Process
2. Optimizing ODP.NET Performance (Connections, Data Retrieval and Updates, ODP.NET Data Types)
3. Oracle Performance Analyzer and SQL Tuning Advisor
4. Caching
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
General – All ODP.NET Objects

• Close/Dispose all ODP.NET objects explicitly
  – Garbage collector cannot reliably implicitly dispose objects under heavy load
    • May see increasing memory usage
• Can use “Using” statement instead
• Recommended for all ODP.NET objects
Connections

• Use connection pooling
  – Min Pool Size = # connections at steady state or average load
  – Max Pool Size = # connections at maximum capacity
    • Min and Max Pool Size always obeyed over other CP attributes
  – See documentation for connection pooling parameter options

• ODP.NET performance counters
  – Monitor with Windows Performance Monitor
  – More granularity in monitoring – New in ODAC 12c
    • Monitor at app domain, pool, or DB instance level
  – See documentation for details on how to enable
Connection Management
RAC, Data Guard, and GoldenGate

• Run-time connection load balancing
  – Automated load balanced at connection dispense
  – Set “Load Balancing = true”

• Fast Connection Failover
  – Automatic severed connection removal
  – Set “HA Events = true”
Commands
Bind Variables

• Prevents re-parsing of frequently executed statements
  – Works with SQL and PL/SQL statements

• Improves subsequent command executions
  – Literal value changes 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

• Retains previously parsed statement in shared pool
  – Prevents repeated parsing in server

• Caches most recently used statements
  – Works with SQL and PL/SQL statements
  – Best with bind variables

• Self-tuned cache size – on by default
  – No code changes needed
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
DEM OnStrATIoN

Fetch Size and Row Size
Commands
Statement Batching

- Use `OracleDataAdapter.UpdateBatchSize` to batch updates from `DataSet`
- Execute multiple commands in one DB roundtrip
  - Use anonymous PL/SQL
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
REF Cursors

• OracleRefCursor class
• Defers result set retrieval until needed
• Usage:
  – Can create REF cursors as part of an anonymous PL/SQL block
  – Can return REF cursors from stored procedures
  – Can pass REF Cursors to database as input stored procedure parameters

• Retrieve data as needed
  – Control data retrieved via FetchSize
  – Fill a DataSet with just a portion of the REF Cursor result
SecureFiles and LOBs

- **Data retrieval options**
  - Control amount of data returned with `OracleCommand.InitialLOBFetchSize`
  - Retrieve a chunk using `OracleClob` and `OracleBlob` classes Read method
    - Use Search method to find data to be retrieved

- **Update/Insert/Delete SQL statements acting on LOBs**
  - Modify LOB without retrieving the data to the client side
    - Uses LOB locator

- **Use SecureFile data type in Oracle Database 11g and higher**
Oracle Performance Analyzer and SQL Tuning Advisor
SQL Tuning Advisor

• Included with Oracle Developer Tools for Visual Studio
• Use when designing new SQL statements
• Tune ad-hoc SQL statements in Query Window
• Tune bad SQL found by Oracle Performance Analyzer
• Use if SQL is performing poorly under load
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
SQL Tuning Advisor
Oracle Performance Analyzer

• Included with Oracle Developer Tools for Visual Studio
• Detects performance issues in an application’s use of the database under load
• Requirements
  – SYSDBA
  – Oracle Database license for Oracle Diagnostic Pack
• Can be used during testing
• Can be also used on production applications
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
  – Run Oracle Performance Analyzer again until no remaining issues
Performance Analyzer
Caching
Oracle .NET Caching Solutions

• Oracle .NET client-side DB caches
  – Client Result Cache
  – Continuous Query Notification (CQN) – customizable cache
  – TimesTen In-Memory Database

• Automatically updates/alerts client cache upon server changes

• Each serves separate caching requirements

• Server-side caches can be used with .NET
  – DB In-Memory option
  – Server result cache
  – Etc.
Oracle Client Result Cache

• Automatically updating query result set cache

• Benefits
  — Easy to use
    • No code changes required
  — Snapshot consistent
    • Cache refreshes without user intervention
  — More scalability and performance
    • Data retrieval from client, rather than server
    • No additional round trips
Oracle Client Result Cache Updates

• 1. Upon data change, client receives change notification on subsequent round trip (or max lag)
  – Invalidation notifications piggyback on existing client round trips
  – No changes to the cache results yet

• 2. Cache waits for next execution to refresh results
  – Does not initiate an independent round trip
    • No unnecessary DB traffic

• Cache entries do not timeout
  – Uses Least Recent Used algorithm
Client Result Cache
Oracle Continuous Query Notification (CQN)

- Programmatic control over cache notifications and updates
- Also known as Database Change Notification

Benefits over Client Result Cache
  - More control over how cache behavior
    - What if multiple DB usernames access the same results?
    - What if only a subset of the cached data is required?
    - How long should a query be cached?
    - Do I want additional logic executed when the cache is refreshed?

Requires significant customization
  - CQN provides cache infrastructure
Oracle TimesTen In-Memory Database

Memory-Optimized Relational Database

• Fully featured relational database
• Oracle compatible SQL and PL/SQL
• Persistent and durable
  – Transactions with ACID properties
  – Flexible options for durability
• Exceptional performance
  – Instantaneous response time, high throughput, embeddable
• ODP.NET TimesTen provider for TimesTen DB
  – Same ODP.NET APIs
Upcoming .NET Sessions

• Deep-Dive into Oracle Data Provider for .NET, Managed Driver and Entity Framework
  – Thursday – 12:00 PM – 12:45 PM Moscone South – 303

• SQL and PL/SQL Development and Leveraging Oracle Multitenant in Visual Studio
  • Thursday – 1:15 PM – 2:00 PM Moscone South – 303
Additional Oracle .NET Resources

OTN
otn.oracle.com/dotnet

Twitter
twitter.com/OracleDOTNET

YouTube
youtube.com/OracleDOTNETTeam

Email
alex.keh@oracle.com & christian.shay@oracle.com
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