Data Delivery in a Service-Oriented World: The BEA AquaLogic Data Services Platform

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Agenda

Why data services?
Building declarative data services
Query processing in ALDSP
Updating data in ALDSP
Work in progress at BEA
Brief demo (optional)
Summary and Q&A
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Evolution of Database Systems

Files

CODASYL/IMS

Early DBMS Technologies
- Records and pointers
- Large, carefully tuned data access programs that have dependencies on physical access paths, indexes, etc.

Manual Coding
- Byte or record streams
- Majority of application development effort goes toward building and maintaining data access logic

Relational

Relational DB Systems
- Declarative approach
- Tables and views bring data independence
- Details left to system
- Designed to simplify data-centric application development
Relational Application Development

```
stmt = dbconn.prepareStatement(
    "select E.name, E.salary, D.no
    from Employee E, Department D
    where E.salary < 100000
    and D.name = ?
    and E.dept = D.dno"
);  
...
Data Is *Everywhere* Now

- Perhaps relational databases made things too easy?
  - Departmental vs. inter-galactic centralized databases

- Databases come in many flavors
  - Relational: Oracle, DB2(s), SQL Server, MySQL, …
  - Hangers-on: IMS, IDMS, VSAM, …

- Not all data is SQL-accessible
  - Packaged apps: SAP, PeopleSoft, Siebel, Oracle, SalesForce, …
  - Custom “homegrown” apps
  - Files of various shapes and sizes
  - And the list goes on…
Painful to Develop Applications

- No one “single view of X” for any X
  - What data do I have about X?
  - How do I stitch together the info I need?
  - What else is X related to?
- No uniformity (model or language)
  - Data about X is stored in many different formats
  - Accessing or updating X involves many different APIs
  - Manual coding of “distributed query plans”
- No reuse of artifacts
  - Different access criteria and/or returned data → different access plans
  - And how would anyone even begin to find them? (No model)
The SOA Movement

- Service-Oriented Architecture (SOA)
  - Loosely-coupled interfaces (e.g., Web service contracts)
  - Each subsystem is a component with a service API
  - Create new assets by integrating & composing your existing assets!

- We’re closer to dealing with heterogeneity
  - Services all have XML Web service foundations
  - Hide custom logic (e.g., data access and/or integration)

- Fine …. but what about my data…?
  - What are my business entities and how are they interrelated?
  - How can I find them, and what can I do to them?

→ SOA what?
Agenda

Why data services?

**Building declarative data services**

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Summary and Q&A
Evolution of SOA Data Access

Coding

Manual Coding
- Java or C Programming
- Majority of application development effort goes toward building and maintaining data access logic

EAI
- Workflows and messages
- Large complex workflows that are cumbersome to build and maintain

DSP

DSP: Data Services
- Declarative approach
- Same basic principles as RDBMS
- Details left to system
- Designed for data service automation
Declarative Integration via XQuery

<table>
<thead>
<tr>
<th>Requirements</th>
<th>Standards</th>
</tr>
</thead>
<tbody>
<tr>
<td>A standard for data format and data interchange</td>
<td>XML</td>
</tr>
<tr>
<td>A standard for describing and modeling data</td>
<td>XML Schema</td>
</tr>
<tr>
<td>A standard for interfacing into applications</td>
<td>Web Services</td>
</tr>
<tr>
<td>A standard for querying both relational and non-relational data</td>
<td>XQuery</td>
</tr>
<tr>
<td>A standard Java programming model (read + write)</td>
<td>SDO (Service Data Objects)</td>
</tr>
<tr>
<td>A standard for publishing available services</td>
<td>Web Services</td>
</tr>
</tbody>
</table>
Data Services a la AquaLogic DSP

- Logical models capture data access and integration complexity once
- Same data model, programming model, and API for all enterprise data
Ex: Customer Profile Data Service
Data Service – Design View
Service Model View (Physical Services)
Service Model View (Logical Services)
Data Service – “Get All” Read Method

(:::pragma function ... kind="read" ...::)

declare function tns:getProfile() as element(ns0:PROFILE)*
{
  for $CUSTOMER in db1:_CUSTOMER()
  return
    <tns:PROFILE>
      <CID>{ fn:data($CUSTOMER/CID) }</CID>
      <LAST_NAME>{ fn:data($CUSTOMER/LAST_NAME) }</LAST_NAME>
      <ORDERS>{ db1:getORDER($CUSTOMER) }</ORDERS>
      <CREDIT_CARDS>
        db2:CREDIT_CARD()[CID eq $CUSTOMER/CID]
      </CREDIT_CARDS>
      <RATING>{
        fn:data(ws1:getRating{
          <ns5:getRating>
            <ns5:lName>{ data($CUSTOMER/LAST_NAME) }</ns5:lName>
            <ns5:ssn>{ data($CUSTOMER/SSN) }</ns5:ssn>
          </ns5:getRating>
        }
      } </RATING>
    </tns:PROFILE>
};
Data Service – Read & Navigate Methods

(...::pragma function ... kind="read" ...:::)

declare function tns:getProfileByID($id as xs:string)
    as element(ns0:PROFILE)*
{
    tns:getProfile()[CID eq $id]
};

...

(...::pragma function ... kind="navigate" ...:::)

declare function tns:getCOMPLAINTs($arg as element(ns0:PROFILE))
    as element(ns8:COMPLAINT)*
{
    db3:COMPLAINT()[CID eq $arg/CID]
};

...
Graphical Query Editor
Fine-Grained Security in ALDSP
Agenda

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**Query processing in ALDSP**
Updating data in ALDSP
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Architectural Overview
Query Processing in ALDSP

- **Compile-time function composition**
  - Similar to RDBMS view rewriting & unnesting optimizations
  - Facilitates efficient pushdown, eliminates irrelevant data sources, …
    → It’s what makes data services *reusable!!*

- **Joins and related operations**
  - *Goal*: Let each RDBMS do what it does best → *maximize SQL pushdown!*
  - Outerjoins, presorted grouping, sorting pushdown, function calls, …
  - PP-k joins for pipelined/distributed query processing

- **Runtime system**
  - Pipelined (“streaming”) via XML TokenIterator model

- **Other related goodies**
  - Including *async(exp), failover(exp1,exp2), timeout(exp1,t,exp2)*
Example: “Get All” Read Method Revisited

(pragma function ... kind="read" ...::)

declare function tns:getProfile() as element(ns0:PROFILE)*
{
    for $CUSTOMER in db1:CUSTOMER()
        return
            <tns:PROFILE>
                <CID>{ fn:data($CUSTOMER/CID) }</CID>
                <LAST_NAME>{ fn:data($CUSTOMER/LAST_NAME) }</LAST_NAME>
                <ORDERS>{ db1:getORDER($CUSTOMER) }</ORDERS>
                <CREDIT_CARDS>{
                    db2:CREDIT_CARD()[CID eq $CUSTOMER/CID]
                }</CREDIT_CARDS>
                <RATING>{
                    fn:data(ws1:getRating(
                        <ns5:getRating>
                            <ns5:lName>{ data($CUSTOMER/LAST_NAME) }</ns5:lName>
                            <ns5:ssn>{ data($CUSTOMER/SSN) }</ns5:ssn>
                        </ns5:getRating>
                    )
                }</RATING>
            </tns:PROFILE>
};
Query Processing, Example 1 (getProfile)
Query Processing, Example 2 (query getProfile)

declare namespace tns="Id:DemoSources/PROFILE";
for $p in tns:getProfile()
  where $p/CID eq "CUSTOMER00000001"
  return
  <PROFILE>
  <LAST_NAME>(data($p/LAST_NAME))</LAST_NAME>
  <RATING>(data($p/RATING))</RATING>
  </PROFILE>

FLWOR
  return
  $t & 1725
  let $t26 = fn:desc()
  fn:find-data()
  /getRatingResult
  web:service source getRating
  (getRating)
  <getRating>
  <Name>($t25/(0))</Name>
  <ssn>($t25/(3))</ssn>
  </getRating>
  for $t25
  relational source partial =
  SELECT t1."LAST_NAME" AS c1,t1."SSN" AS c2
  FROM "RTLALL":"CUSTOMER" t1
  WHERE t1."CUSTOMER_ID" = "CUSTOMER00000001"
Caching in ALDSP

- Query plan cache
  - Cache recently compiled query plans, as in RDBMSs
  - Cache partially-compiled plans for views to speed query compilation

- Data service function cache
  - Favorite RDBMS can be configured as a cluster-wide data cache
  - Cache is functional, i.e., a map: \( function(params) \rightarrow results \)
  - Autonomous data sources \( \rightarrow \) TTL-based “consistency”
  - Turns expensive (high-latency) operations into single-record fetches, so a typical use case might be \( getCreditRating(ssno) \)
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Data Service Updates

- So far we have covered read services
  - Declaratively specified using XQuery
  - System selects efficient implementation

- Obviously need write services as well
  - Automation through lineage analysis of read services
  - Full automation possible for SQL-based data services
  - Update overrides required for Web services (non-SQL sources)

- What programming model for writes?
  - Disconnected model is highly desirable
  - Want flexible optimistic concurrency options
  - Answer: SDO from IBM, BEA, Oracle, SAP, and XCalia
SDO API & Change Tracking

//Get SDO
CustomerDoc custSDO = CustomerDS.getCustomerById("007");

// Make changes to SDO
custSDO.setCustName("Mike");
custSDO.setEmail("mcarey@bea.com");

//Submit SDO
CustomerDS.submit(custSDO);
Update Decomposition

Update Framework
- XA and non-XA sources
- Automated change decomposition
- Automatic SQL generation for RDBMS
- Update “hooks” for business validations, replacement logic, or compensation logic (e.g., via a workflow)

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Update Automation (RDBMS Sources)

- **Primary key handling**
  - Automated key generation using Identity or Sequence
- **Foreign keys can be filled in based on context**
  - Need not be projected in the child elements
  - Inferred from predicates in the designated read query
- **Updates sequenced to avoid RI issues**
  - Deletion of children before deletion of parent
  - Insertion of parent before inserting children
Concurrency Model (RDBMS Sources)

- Based on optimistic concurrency control
  - Before values are compared to current database values
  - Ex: `update CUSTOMER set FIRST_NAME=?`  
    `where CUSTOMER_ID=? and FIRST_NAME=?`

- Comparison (consistency) options include
  - All updated fields
  - All read or updated fields
  - Designated field or fields (e.g., timestamp or version id)

- Benefits of this approach
  - Stateless and therefore scalable
  - Natural fit for Web apps and services
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Work in Progress (or Recently Completed)

- Native JDBC/SQL92 support – ALDSP 2.5
  - Bilingual server for efficient reporting/BI tool access
  - Limited to flat views and procedures (of course)

- Update automation – goal is for no Java coding to be needed in most cases
  - Declarative editor for modifying system’s default update behavior
  - XQuery update & procedure language (XUP – related to XQueryP)

- Compensating transactions – goal is for no BPEL (or JPD) coding to be needed in most cases either
  - Like current SDO updates, but with non-XA sources (via Sagas)
  - DS architect will provide undo/did-I-do operations (and CRUD)
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Demo (*Time Permitting*)

BEA AquaLogic Data Services Platform 2.5:

*A declarative basis for data service creation & management...*
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Summary

- Challenges in the Brave New World
  - From databases (then) to *data services* (now!)

- Simplify data service development
  - Data-oriented modeling and design still critical
  - XQuery and XML Schema → *declarative* data services
  - Java / WS APIs + SDO → update as well as read automation

- BEA AquaLogic Data Services Platform 2.5
  - A declarative basis for designing and building data services
  - (Now bilingual for SQL-based reporting applications)

- Next steps
  - Richer, more declarative update facility (including Sagas)
For More Info

- Technical papers and online information
  - Product information: [http://www.bea.com/dataservices](http://www.bea.com/dataservices)

- Feel free to contact me: mcarey@bea.com

Questions…?