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Using RFID to Make Sure Children Do Not Get Lost

Event Processing Symposium (RFID Session)

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Losing a Child is a HUGE Problem

- Kids get lost everywhere: amusement parks, shopping malls, stadiums, skiing areas, etc.
 - Kids tend to wander away
 - Kids are sometimes kidnapped
-
- If a child is missing, **EVERY SECOND COUNTS**





Solution: RFID Tracking

- Break down the area into a grid of cells
- Place an RFID Reader into each cell of the grid
- Place Active RFID tags into bracelets that both kids and parents wear





Technical Problems

- Number of cells: 100 – 1,000
- Number of people in a cell: 10 – 100
- Combined message rate: 1,000 – 100,000 events per second!





Problems Continue

The input stream has only reader IDs and person (tag) IDs

| Timestamp | PersonID | ReaderID |
|----------------------------|----------|----------|
| 2006/03/08 15:21:21.468750 | 32 | 306 |
| 2006/03/08 15:21:21.468750 | 32 | 308 |
| 2006/03/08 15:21:21.468750 | 32 | 308 |
| 2006/03/08 15:21:21.468750 | 32 | 407 |
| 2006/03/08 15:21:21.468750 | 32 | 407 |
| 2006/03/08 15:21:21.500000 | 178 | 1203 |
| 2006/03/08 15:21:21.515625 | 125 | 305 |
| 2006/03/08 15:21:21.515625 | 125 | 305 |
| 2006/03/08 15:21:21.515625 | 3 | 203 |
| 2006/03/08 15:21:21.531250 | 136 | 602 |
| 2006/03/08 15:21:21.531250 | 136 | 701 |
| 2006/03/08 15:21:21.578125 | 106 | 1202 |
| 2006/03/08 15:21:21.578125 | 17 | 106 |
| 2006/03/08 15:21:21.578125 | 17 | 107 |
| 2006/03/08 15:21:21.593750 | 199 | 802 |
| 2006/03/08 15:21:21.593750 | 148 | 708 |
| 2006/03/08 15:21:21.609375 | 146 | 201 |
| 2006/03/08 15:21:21.609375 | 146 | 300 |
| 2006/03/08 15:21:21.625000 | 200 | 619 |

135.88 messages/sec | Total: 18871 messages





Solution Overview

1. Enrich RFID data by doing a DB subquery
 - Reader locations
 - Family information
2. Split the enriched stream into Parents and Children streams
3. Join Parents and Children streams and select the pairs that are far apart





Step 1: Enrich Data by Doing DB Subquery

```
INSERT INTO StreamOutRFIDFull
SELECT
    StreamInRFID.PersonID,
    StreamInRFID.ReaderID,
    db.FamilyID,
    db.IsChild,
    db.LocationX,
    db.LocationY
FROM
    StreamInRFID,
    ( database "MyOracleDB"
      [[select pd.family_id, pd.is_child,
            rd.location_x, rd.location_y
        from person_data pd, reader_data rd
        where pd.person_id = ?StreamInRFID.PersonID
        and rd.reader_id = ?StreamInRFID.ReaderID]]
    ) as db
```





Result: a Stream with Context

StreamOutRFIDFull - ccl://localhost:6789/Stream/Default/RfidParkFiles/RfidPark/S...

File Edit Debug Tools Help

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| Timestamp | PersonID | ReaderID | FamilyID | IsChild | LocationX | LocationY |
|------------------------------|----------|----------|----------|---------|-----------|-----------|
| 2006/03/08 15:29:47.984375 | 113 | 1011 | 56 | true | 10 | 11 |
| 2006/03/08 15:29:47.984375 | 113 | 1112 | 56 | true | 11 | 12 |
| 2006/03/08 15:29:48.000000 | 82 | 1209 | 41 | false | 12 | 9 |
| 2006/03/08 15:29:48.000000 | 82 | 1210 | 41 | false | 12 | 10 |
| 2006/03/08 15:29:48.015625 | 46 | 0 | 23 | false | 0 | 0 |
| 2006/03/08 15:29:48.062500 | 138 | 1216 | 69 | false | 12 | 16 |
| 2006/03/08 15:29:48.062500 | 138 | 1217 | 69 | false | 12 | 17 |
| 2006/03/08 15:29:48.062500 | 138 | 1316 | 69 | false | 13 | 16 |
| 2006/03/08 15:29:48.078125 | 176 | 517 | 88 | false | 5 | 17 |
| 2006/03/08 15:29:48.078125 | 176 | 617 | 88 | false | 6 | 17 |
| 2006/03/08 15:29:48.078125 | 94 | 0 | 47 | false | 0 | 0 |
| 2006/03/08 15:29:48.078125 | 42 | 1802 | 21 | false | 18 | 2 |
| 2006/03/08 15:29:48.093750 | 189 | 301 | 94 | true | 3 | 1 |
| 2006/03/08 15:29:48.093750 | 189 | 400 | 94 | true | 4 | 0 |
| 2006/03/08 15:29:48.093750 | 189 | 501 | 94 | true | 5 | 1 |
| 2006/03/08 15:29:48.109375 | 6 | 1701 | 3 | false | 17 | 1 |
| 2006/03/08 15:29:48.156250 | 107 | 101 | 53 | true | 1 | 1 |
| 2006/03/08 15:29:48.156250 | 107 | 102 | 53 | true | 1 | 2 |
| 2006/03/08 15:29:48.187500 | 48 | 605 | 24 | false | 6 | 5 |
| 2006/03/08 15:29:48.187500 | 165 | 11 | 82 | true | 0 | 11 |
| • 2006/03/08 15:29:48.218750 | 93 | 10 | 46 | true | 0 | 10 |
| • 2006/03/08 15:29:48.218750 | 93 | 109 | 46 | true | 1 | 9 |

95.51 messages/sec Total: 3234 messages





Step 2: Split the Stream into Two

```
-- Separate RFID data stream into parents AND children
```

```
INSERT INTO StreamChildren
```

```
SELECT
```

```
    *
```

```
FROM
```

```
    StreamOutRFIDFull
```

```
WHERE
```

```
    StreamOutRFIDFull.IsChild
```

```
INSERT INTO StreamParents
```

```
SELECT
```

```
    *
```

```
FROM
```

```
    StreamOutRFIDFull as StreamOutRFIDFull1
```

```
WHERE
```

```
    NOT(StreamOutRFIDFull1.IsChild)
```





Step 3: Perform a Join

```
INSERT INTO StreamOutAlerts
SELECT
    StreamChildren.PersonID,    StreamChildren.FamilyID,
    StreamChildren.LocationX,  StreamChildren.LocationY,
    StreamParents.LocationX,   StreamParents.LocationY
FROM
    StreamChildren KEEP LAST PER StreamChildren.PersonID,
    StreamParents  KEEP LAST PER StreamParents.PersonID
WHERE
    StreamChildren.FamilyID = StreamParents.FamilyID
AND
    (StreamChildren.LocationX - StreamParents.LocationX) *
    (StreamChildren.LocationX - StreamParents.LocationX) +
    (StreamChildren.LocationY - StreamParents.LocationY) *
    (StreamChildren.LocationY - StreamParents.LocationY) >
    $MAX_DISTANCE * $MAX_DISTANCE
```



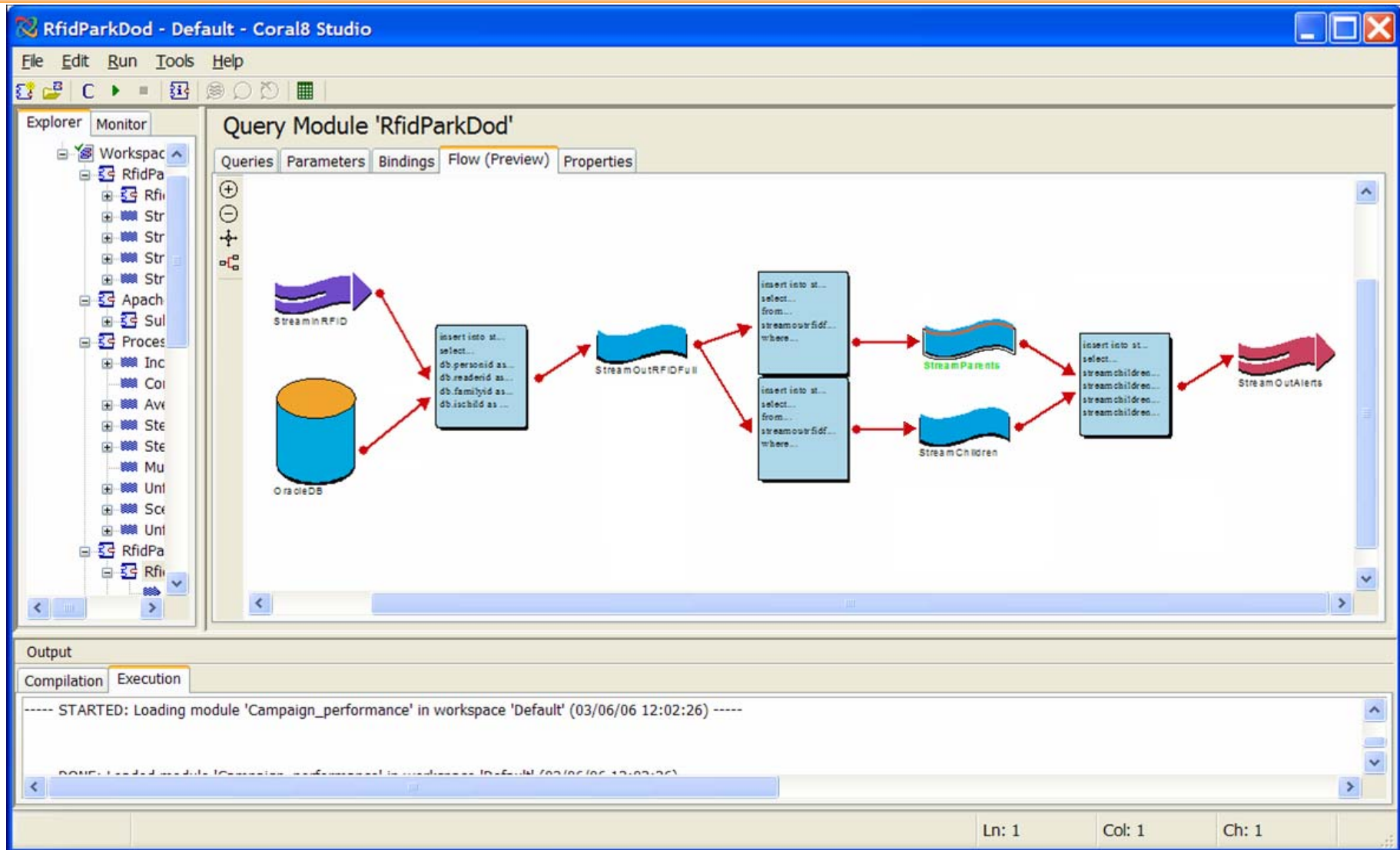


Result: an Alert Whenever a Kid is Lost!





The Whole Application at a Glance





Location-based RFID Applications: Lessons Learned

- Must analyze large volumes of data at high data rates
- Must provide real-time response
- Must enrich real-time data with reference data from databases
- Must provide rich join functionality to make distance-based correlation easy





Conclusion and Q&A

An SQL-based ESP Engine
will
Find Your Children!

Coral8 Engine: Easy to Program, Easy to Deploy, Easy to Scale
www.coral8.com

