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From CQL to CEP to BAM - Oracle's Event Processing Platform Now and in the (near) Future

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Senior Sales Consulting Manager

Agenda

- EDA – The Big Picture
- Event Publishers – Database
- Event Publishers – XTP Infrastructure
- Event Processors – CQL and Stream Processor
- EDA Platform – Overview and Example
- Event Consumers – Real-time Decision Engine
- Summary

Event-Driven Architecture

Market Context

- Increased Realization of EDA Benefits
 - For Real-Time Intelligence
 - For Compliance
 - For Supply Chain Optimization
 - For High Performance / XTP Applications
- Increased EDA Adoption
 - Sensor computing - RFID, etc.
 - Telco - 3G services
 - Finance - trading & settlement, risk mgmt.
 - Retail - real time inventory mgmt.
 - CRM - real time customer analytics
- Some Move Towards Standardization
 - EPCIS, Query languages

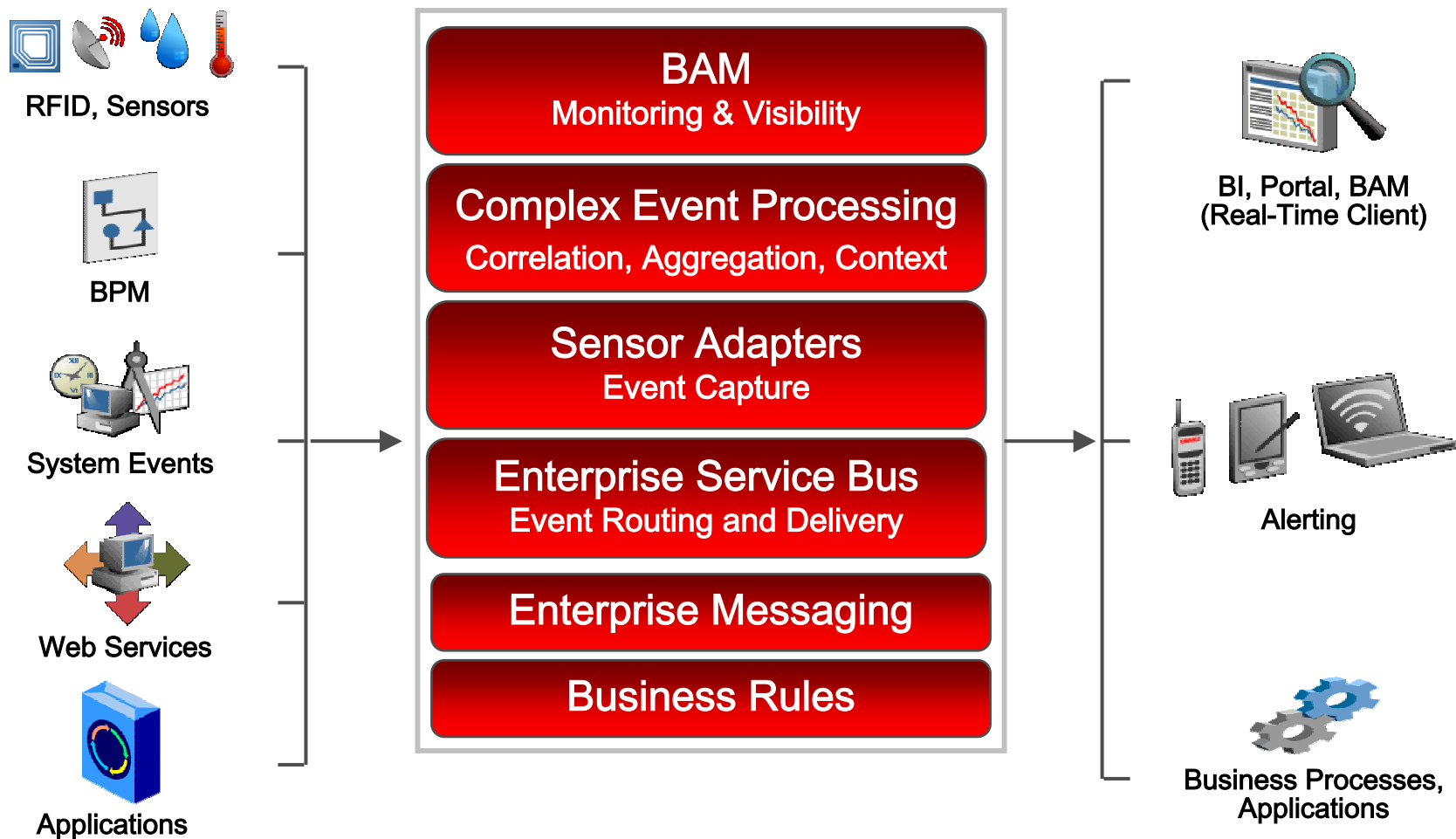
Event-Driven Architecture

Technology Challenges

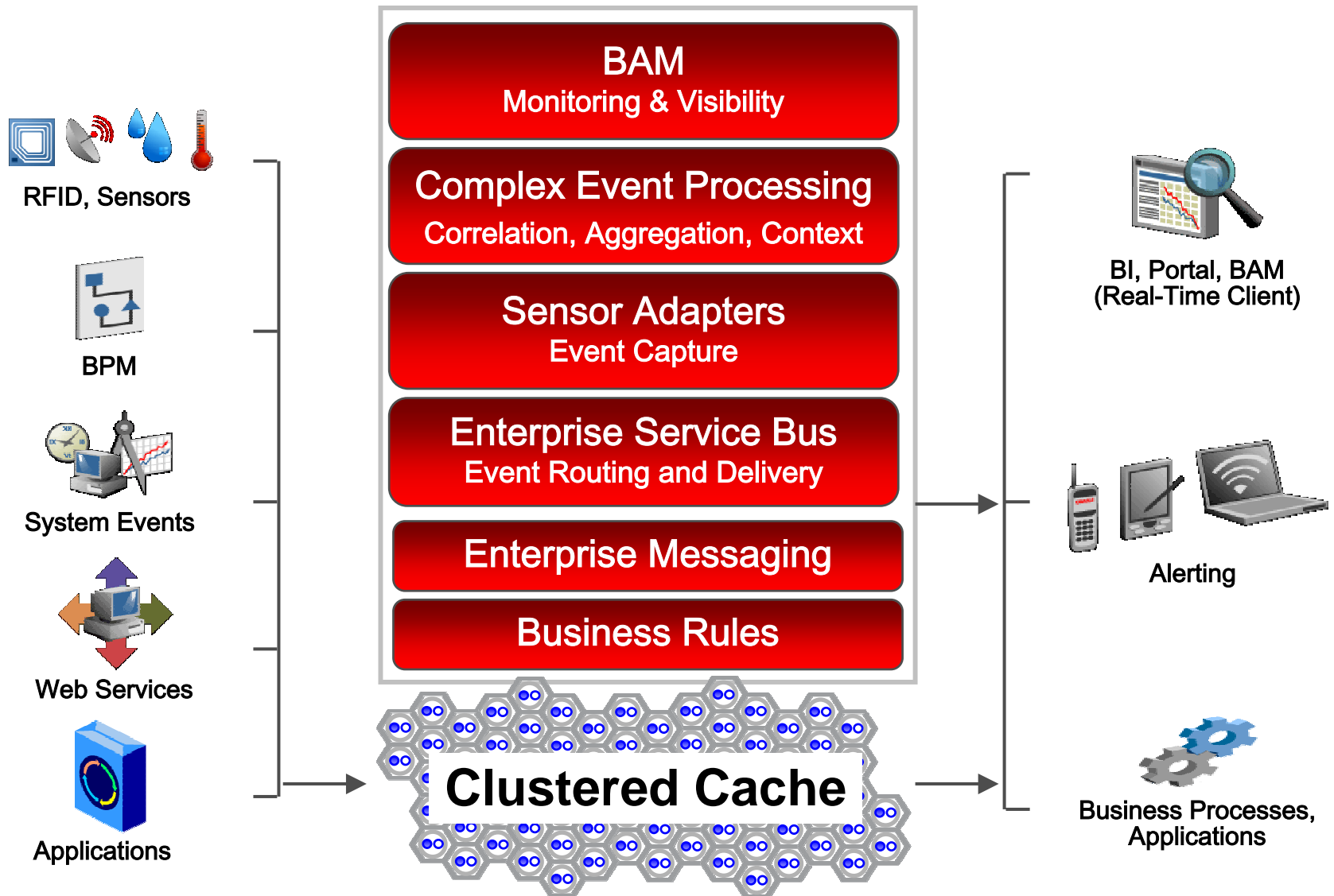
- Large Information Volumes
 - Millions of users, Millions of calls (Telco)
 - 100k+ SKUs x 100s of Stores x 1000s of Daily Transactions (Retail)
 - 10k+ Instruments, Millions of Daily Trades (Finance)
- Short Response Time Requirements
 - Financial Trading, Telco - Sub-Seconds
 - ASPs - Response Time SLAs - Seconds, Continuous
 - Financial Settlement, Risk Management - Hourly or Less
 - Retail - Re-Pricing & Demand Forecasting - Overnight

Event Driven Architecture

Publishers – Processing Platform – Consumers



EDA and eXtreme Transaction Processing (XTP)



Event Publishers - Database



Mechanisms for Event Creation

in the Database

- Triggers
 - comprehensive functionality (context, constraint validation, ...)
 - performance overhead
- Log Mining
 - non-intrusive, fast access to committed data
 - works with databases from several vendors
- Continuous Query Notification
 - registration of queries
 - powerful use also with database history

Database Native Event Support

Continuous Query Notification

- Allows applications to subscribe to a watch list in the database and be notified when:
 - A specific object changes, or
 - The result set of a query changes (new for Database 11)
- The notifications are published when the transaction (DML or DDL) commits.
- Easy to use JDBC Interface.
- Prevents unnecessary database querying and implements efficient and consistent result set caching and cache invalidation.

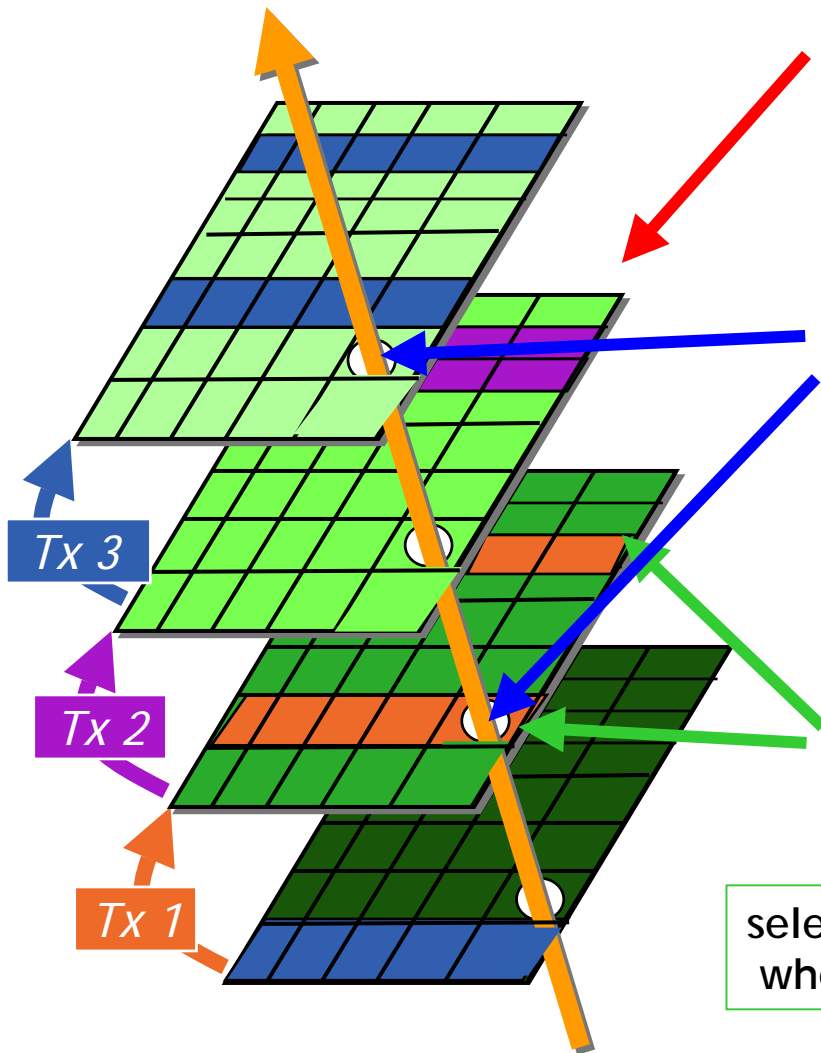
Query Evaluation

- Predicate Sharing
 - In Memory structure for evaluation shares predicate elements across Registered queries.
- Adaptive Filtering
 - Autotunes the predicate evaluation order based on selectivity
- Single System View on Cluster Systems
 - Registrations propagated on all RAC instances
 - Evaluation processing distributed to RAC nodes
- In Band Evaluation
 - On the fly processing done PURELY IN MEMORY
- Uses Specialized In Memory Index structures
 - Converts Query subscriptions into predicates and join conditions
 - Extracts predicate and join filters and indexes them in memory

Query Notification

- Notification to end user or Application
 - multitude of protocol: HTTP, SQL, SMTP, JDBC etc
- Guaranteed Delivery
 - For mission critical applications
 - Notifications persisted on disk
- In Memory Notification
 - High Performance
 - Real-time delivery
- Application Integration APIs
 - End points can be OCI, JDBC, PI/SQL
- Group Notification
 - Notifications collapsed during a period of time
 - Flow control/Flooding control of notifications
- Notification Payload
 - Provides Query, Table and Row information

Investigating the Database History



- **Flashback AS OF Query**

- Query all data at point in time

```
select * from Emp AS OF '2:00 P.M.' where ...
```

- **Flashback Version Query**

- See all versions of a row between times
- See transactions that changed the row

```
select * from Emp VERSIONS BETWEEN  
'2:00 PM' and '3:00 PM' where ...
```

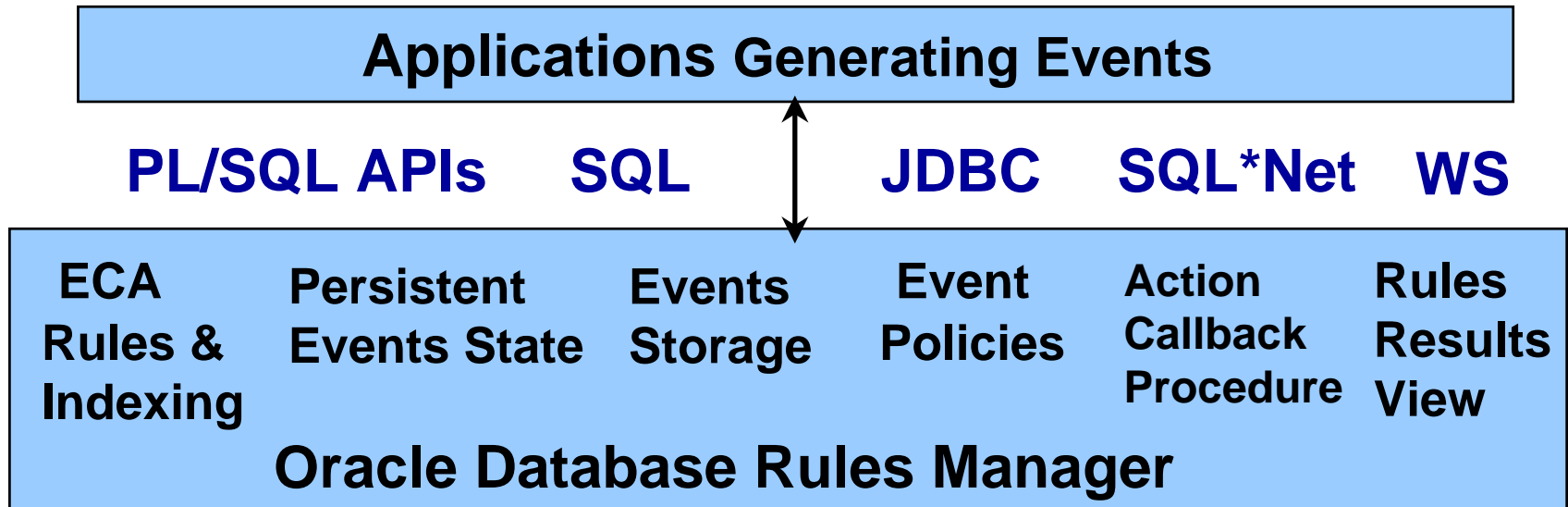
- **Flashback Transaction Query**

- See all changes made by a transaction

```
select * from FLASHBACK_TRANSACTION_QUERY  
where xid = '000200030000002D';
```

Database Native Event Support

Database Rules Manager



- Declarative ECA rules w/ indexing, powerful semantics, rich data
- Coordinated CEP over any time frame and application space
- Incremental rule evaluation with multi-terabyte datasets
- Policies to control event and rule evaluation behavior
- Flexible rules actions triggered in the database and the application

Event Publishers – XTP Infrastructure



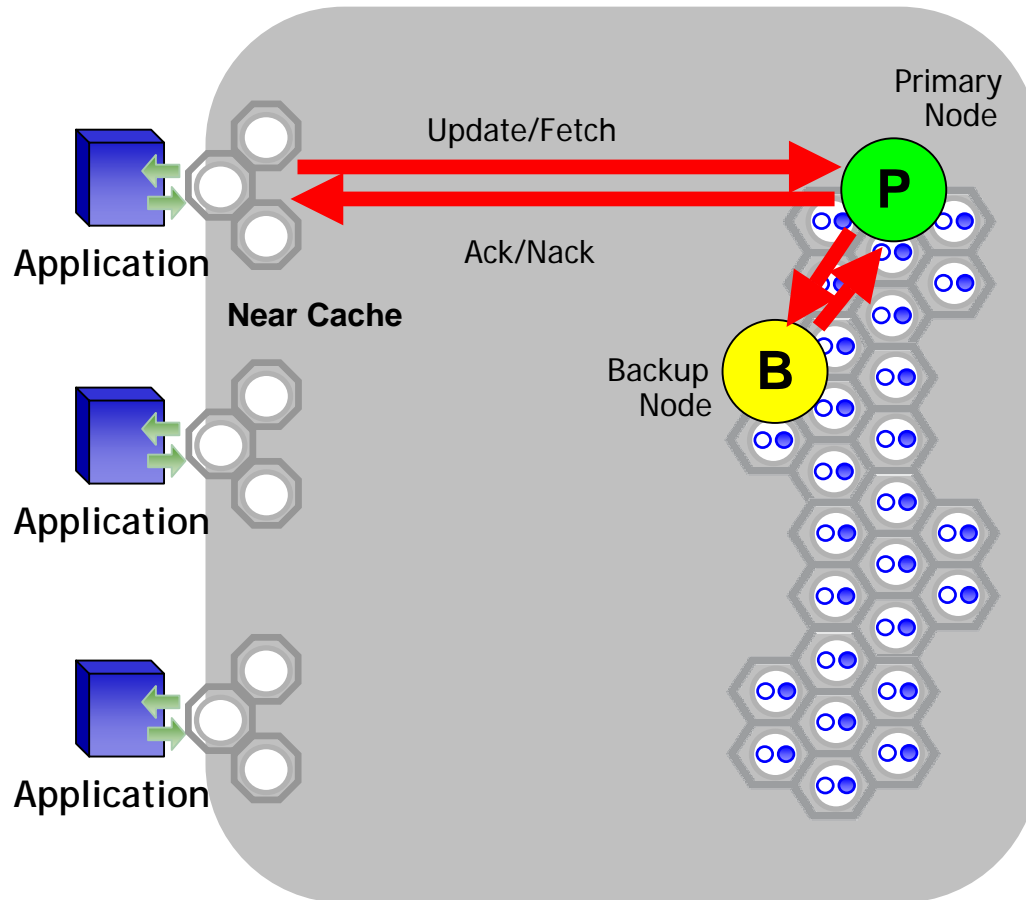
XTP Infrastructure

- State-aware continuous availability for service infrastructure, application data, and processing logic
- Predictable scalability for XTP
 - Scales out linearly, whether 2 or 2,000 servers
 - Heterogeneous Environment
 - High-end / low-cost commodity hardware
- Data Grid and Compute Grid
 - Linearly scalable shared memory and logic
 - Intelligent co-location and affinity between processing logic and Grid storage
- Dramatic overall increase in performance and throughput
 - Reduced/Eliminate dependency on disk persistence
 - Without sacrificing HA

SOA Grid - Primary/Backup synchronization

Non-storage-aware
Datagrid clients

Storage-aware
Datagrid servers

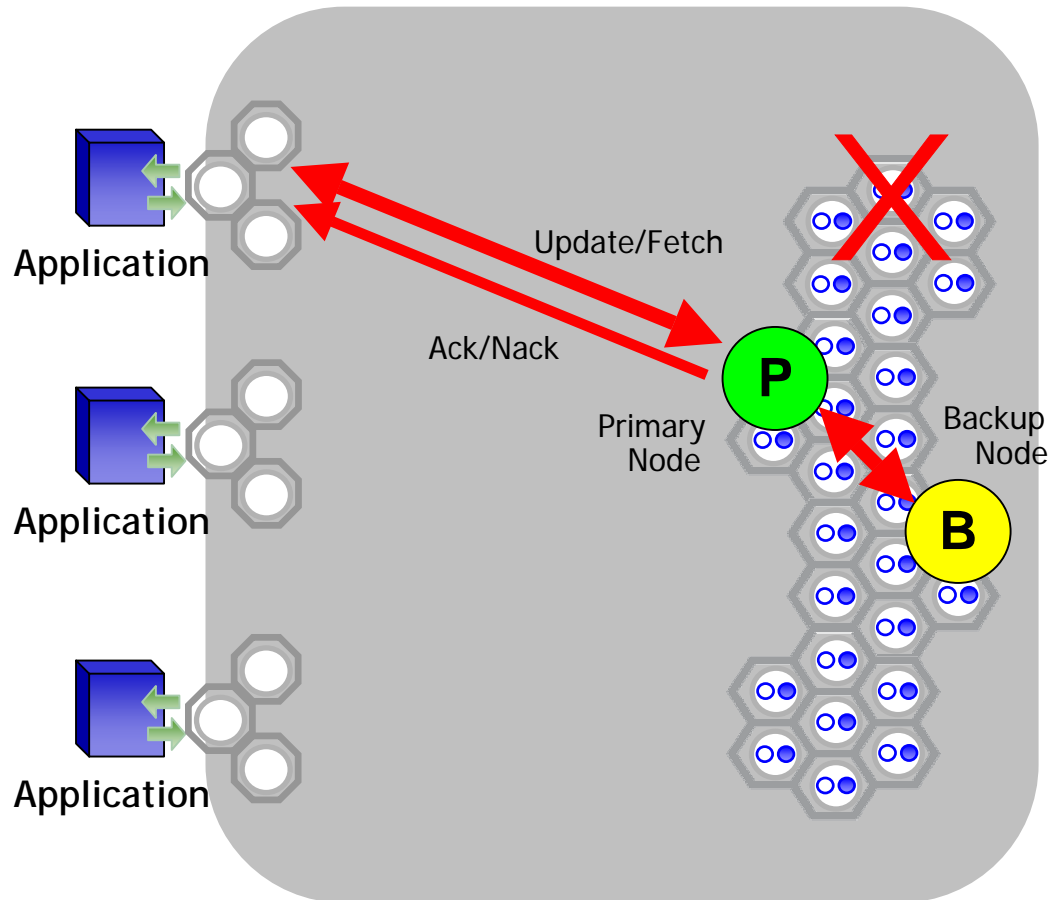


Available Today with Oracle Coherence

SOA Grid - Primary/Backup synchronization

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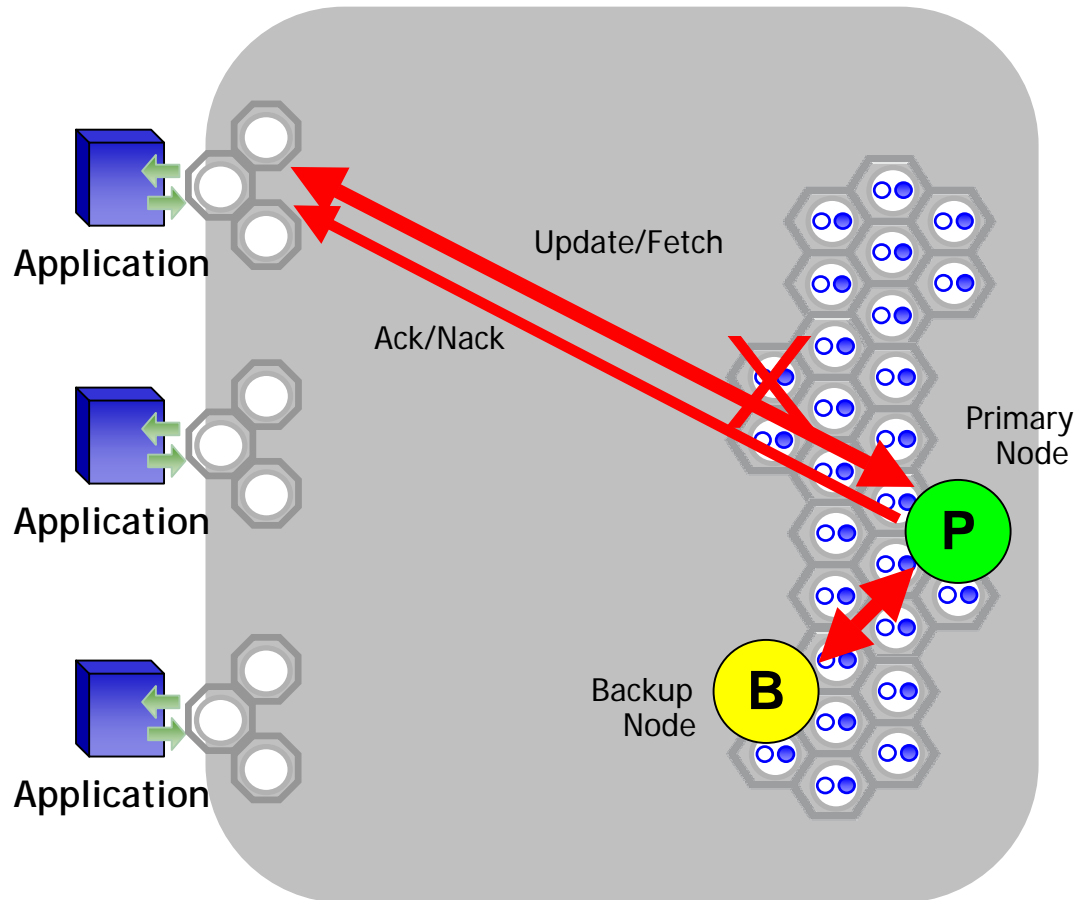


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SOA Grid - Primary/Backup synchronization

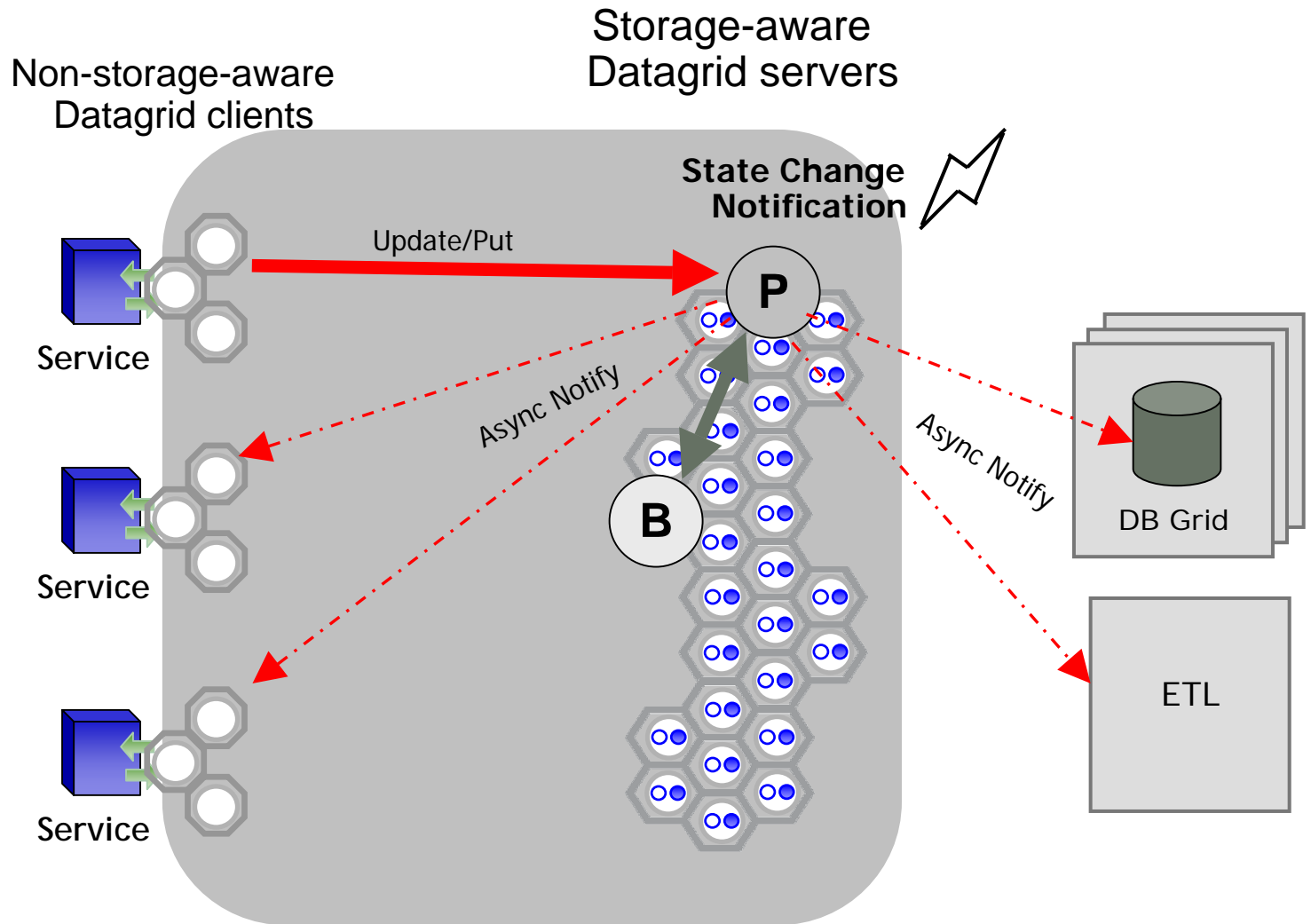
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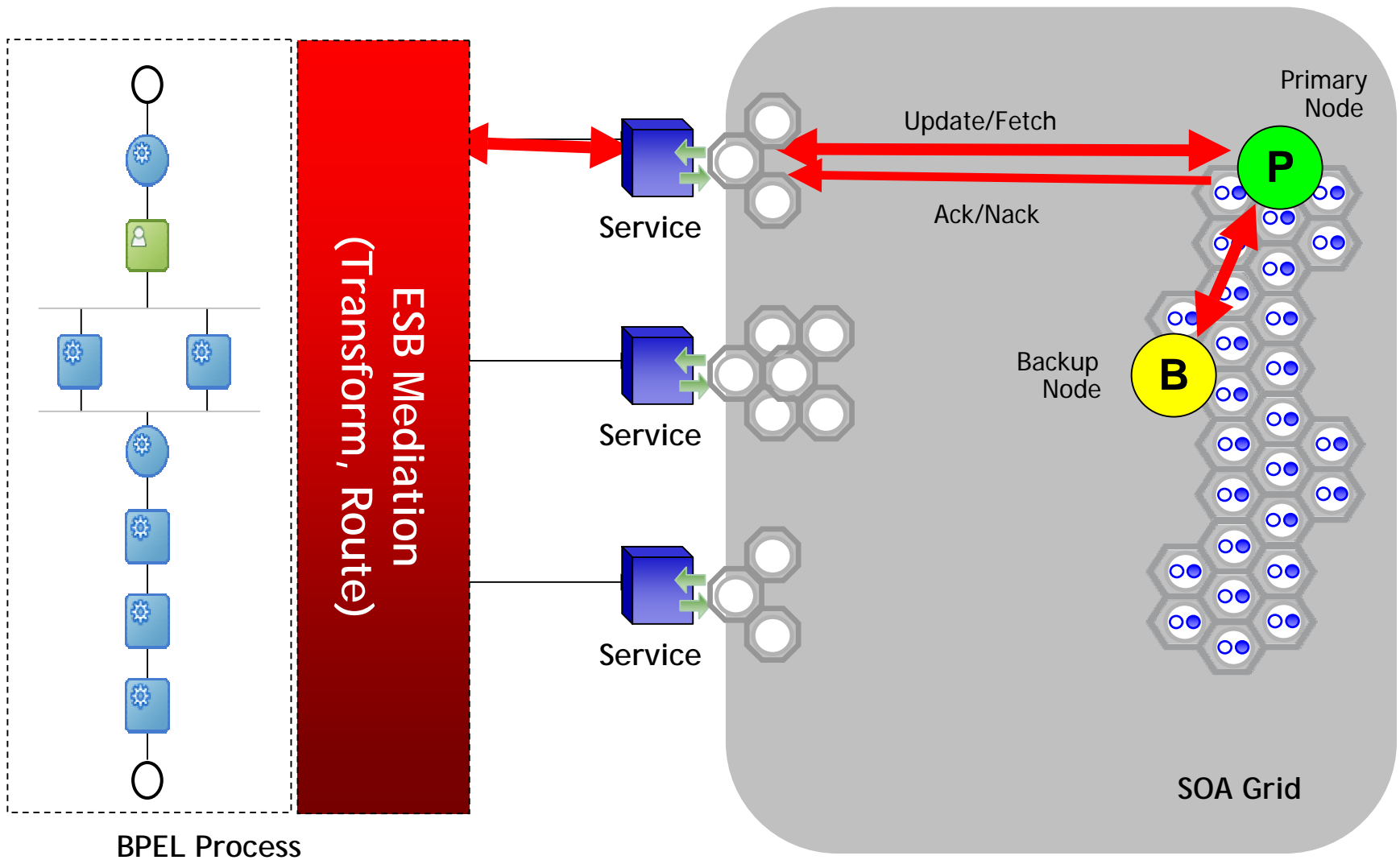


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State-Based Notifications



“The SOA Grid”

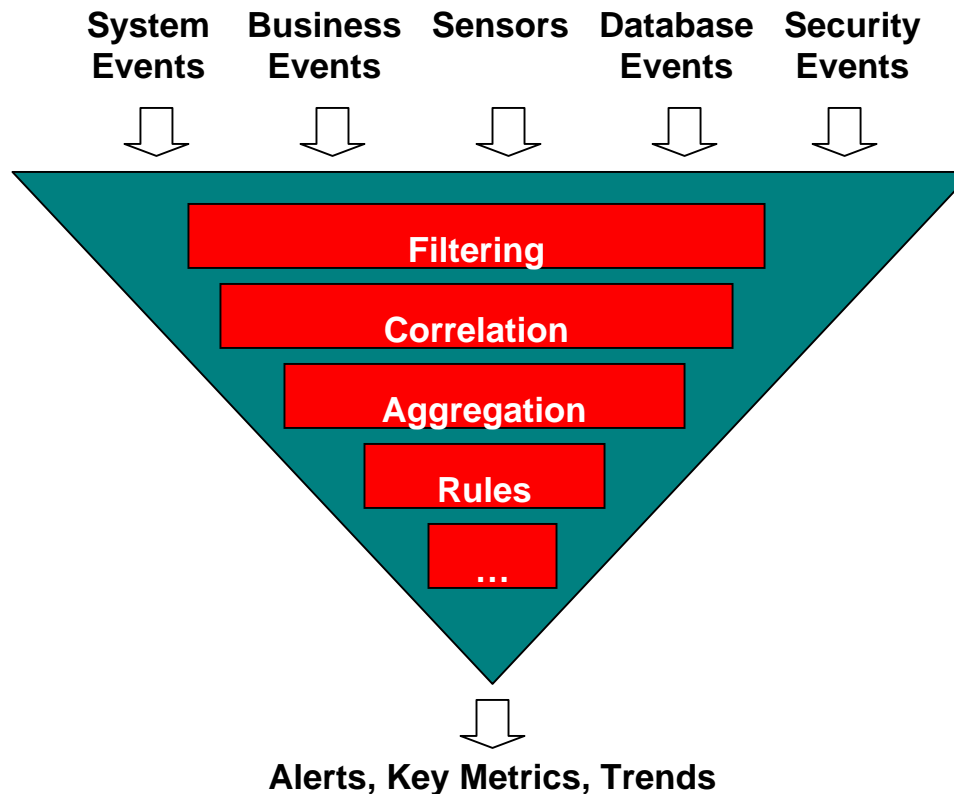


Event Processing – CEP and Stream Processing

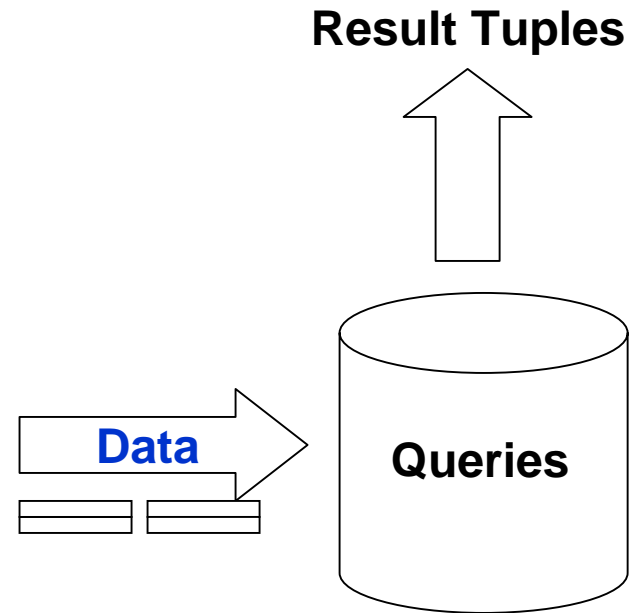
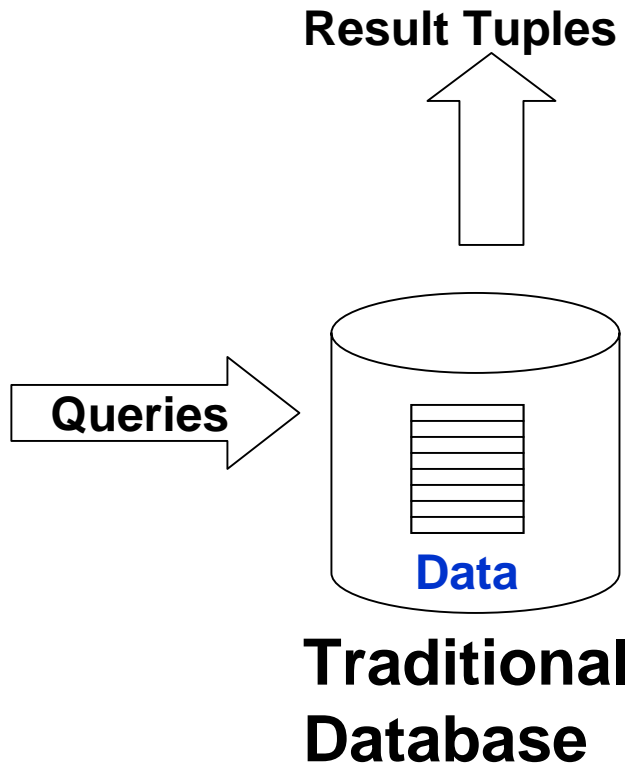


Complex Event Processing (CEP)

- “Funnel” model - lots of events occur, fewer events are significant



Oracle CEP Query Processing



- Data streams are unending
- Continuous, long running queries
- Real-time processing

...Executed Through

- Oracle **Continuous Query Language (CQL)**, a uniform declarative framework which provides:
 - **Data Definition Language (DDL)**
 - Define streams, relations, views, register event sources and destinations
 - **Query Language**
 - Model complex events as continuous queries with strong temporal focus
 - **Data Manipulation Language (DML)**
 - Insert event data into streams
 - **System DDL and relational views**
 - Manage streams

Complex Event Processing

Stream Query Processing

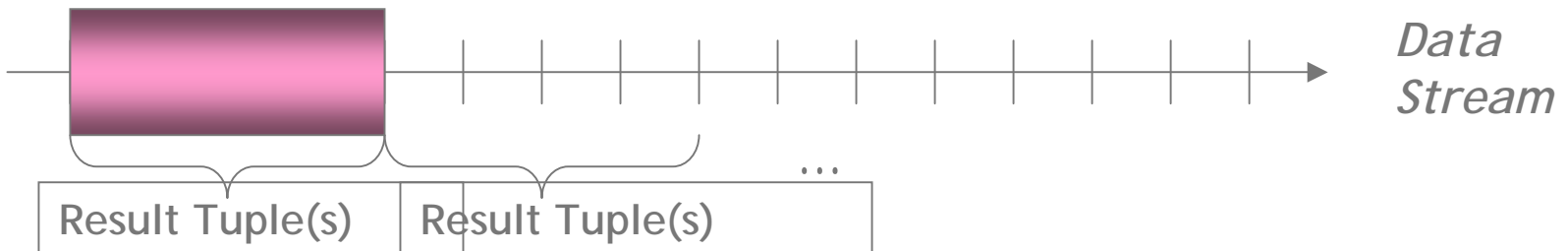
Window Clause

```
SELECT S.city, AVG(temp)
FROM SOME_STREAM S
[range by 10 slide by 5]
WHERE S.state = 'California'
GROUP BY S.city
```

“I want to look at 10 seconds worth of data”

“I want a result tuple every 5 seconds”

Window



Continuous Query Operators

- Relation-to-relation
 - Well understood and apply without change to time varying relations
- Stream-to-Relation
 - $S[W]$ is a relation — at time T it contains all tuples in window W applied to stream S up to T
 - When $W = \mid$ unbounded [SQL 99], it contains all tuples in stream S up to T
 - When $W = \text{NOW}$, it contains all tuples bearing timestamp T
- Relation-to-stream
 - $I\text{Stream}(R)$ contains all (r, T) where $r \in R$ at time T but $r \notin R$ at time $T-1$
 - $D\text{Stream}(R)$ contains all (r, T) where $r \in R$ at time $T-1$ but $r \notin R$ at time T
 - $R\text{Stream}(R)$ contains all (r, T) where $r \in R$ at time T
- Stream-to-stream
 - Operators can be composed from these other operators

Example CQL Queries

- 1) Filter stream S emits an IStream

```
IStream( SELECT * FROM S [ROWS UNBOUNDED]  
          WHERE S.A > 10);
```

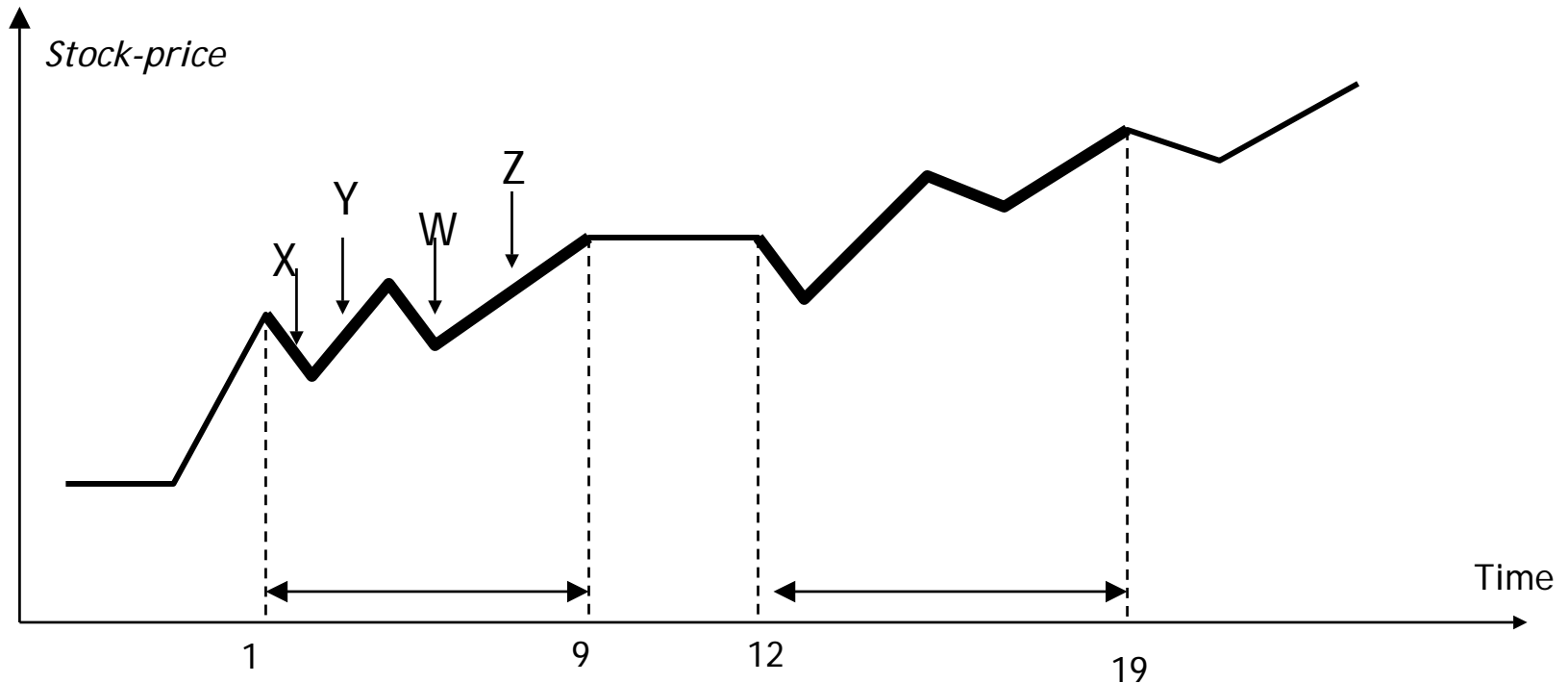
- 2) Windowed join of streams S1 and S2 emits a relation

```
SELECT * FROM S1 [RANGE 10 MIN, SLIDE 1 MIN],  
          S2 [RANGE 2 MIN, SLIDE 1 MIN]  
          WHERE S1.A = S2.A AND S1.A > 1000;
```

- 3) Probe a stored table R based on each tuple in Stream S emits an Rstream

```
RStream(SELECT S.A, R.B FROM S [NOW], R  
         WHERE S.A = R.A);
```

Pattern matching – find double bottom

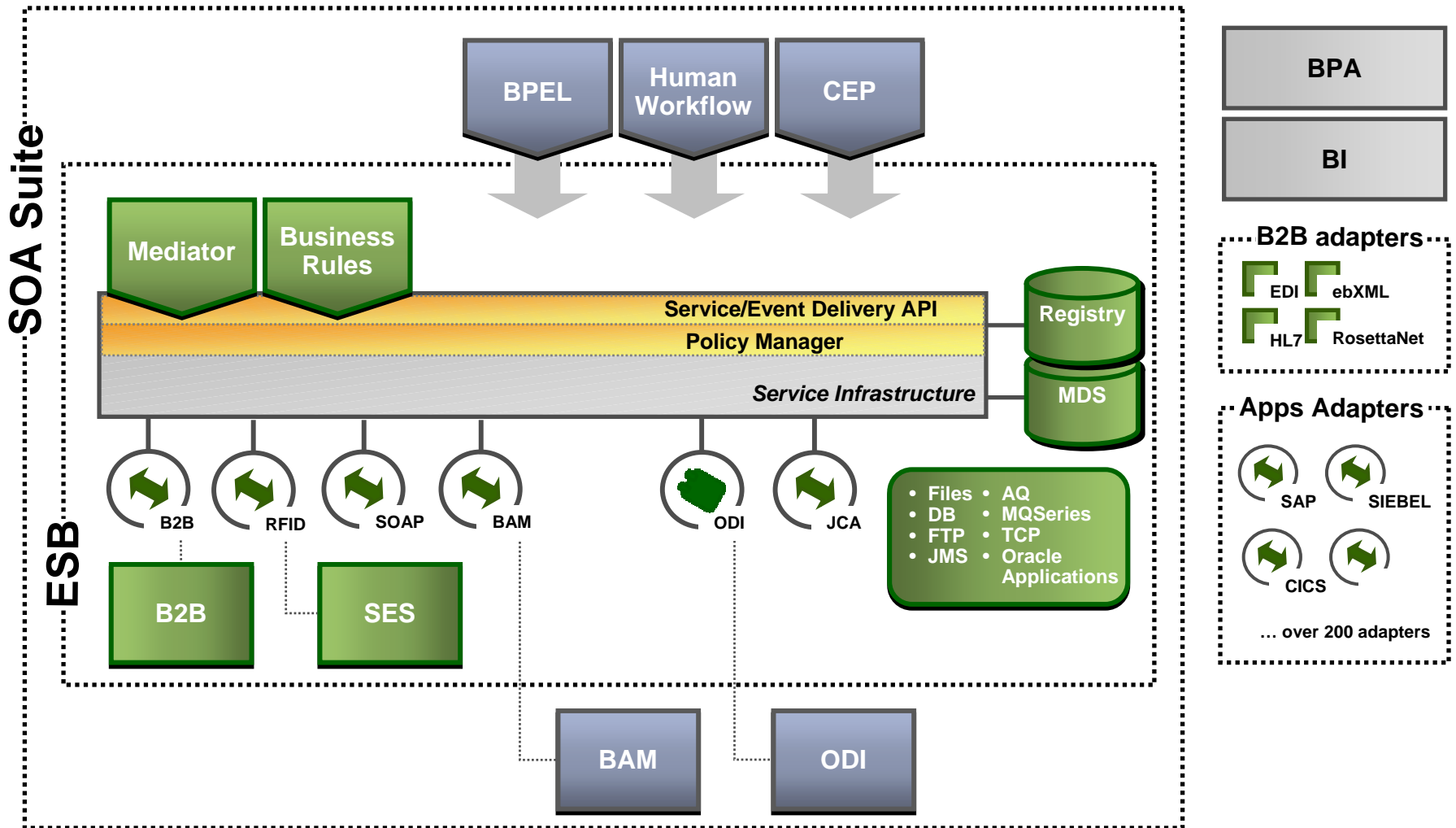


```
SELECT FIRST(x.time), LAST(z.time)
FROM ticker RECOGNIZE (ROW PER MATCH PARTITION BY name
    PATTERN (X+ Y+ W+ Z+)
    DEFINE X AS (price < PREV(price))
           Y AS (price > PREV(price))
           W AS (price < PREV(price))
           Z AS (price > PREV(price)) )
```

EDA Platform – Overview and Example



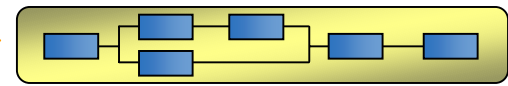
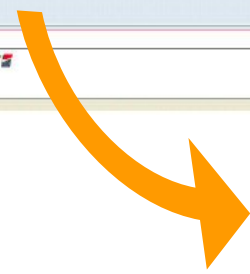
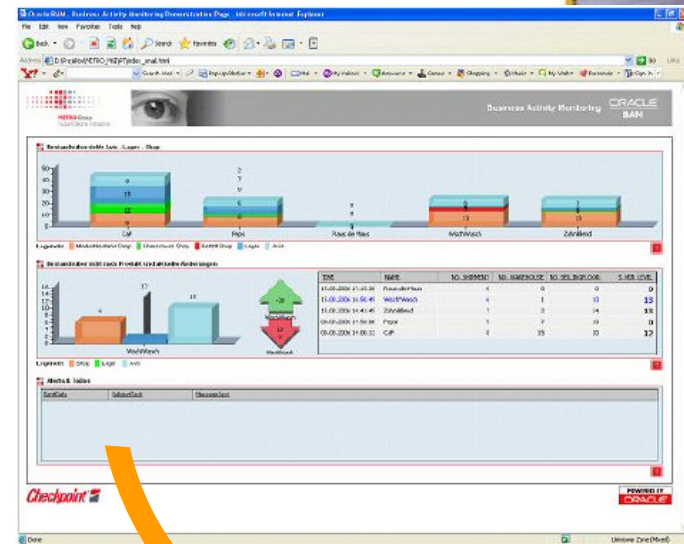
CEP in the Oracle SOA Infrastructure 11g





EXAMPLE

- Third largest retailer worldwide.
- Loss through Out of Stock estimated at 1 Billion € for German retailing.
- Reality is “Not-on-shelf-but-on-stock”
- RFID used for accurate stock management.
- BAM monitors actual and expected inventory levels
- BAM used to warn if inventory levels are below certain thresholds
- Ideal is not to monitor just in-store logistics, but whole supply chain



Event Consumption – Real-time Analytics



Siebel Real Time Decisions

(formerly Sigma Dynamics)

- Enhances Oracle Siebel CRM with Real-Time Predictive Analytics
- Base Current User Experience on Past Customer Interactions
- Self-Learning, Models Update in Real Time
- Track, Optimize Multiple Metrics
- SOA Based, J2EE Runtime

Summary



Summary

- Oracle views events and EDA as fundamental to software architectures
- Oracle has a comprehensive EDA product portfolio spanning middleware, tools, database & applications
- Oracle differentiators include:
 - Common Tools for SOA & EDA Development
 - Common Runtime Platform for SOA & EDA
 - Patent-Pending Active Data technology for BAM
 - Stream Query Engine (R11)
 - Coherence Data Cache/Times Ten in-Memory SQL Database
 - EDA Suite Packaging to Drive Visibility, Adoption

Further information

- www.oracle.com/goto/eda
- White Paper on Complex Event Processing
 - containing several CQL sample scenarios
- Technical information on products/components
 - otn.oracle.com
 - EDA Suite, BPEL PM, BAM, ESB, EDN, Coherence
 - „Oracle-by-Example“ (OBE), Forums, etc.
 - Software available for download

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