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Complex Event Processing with Oracle

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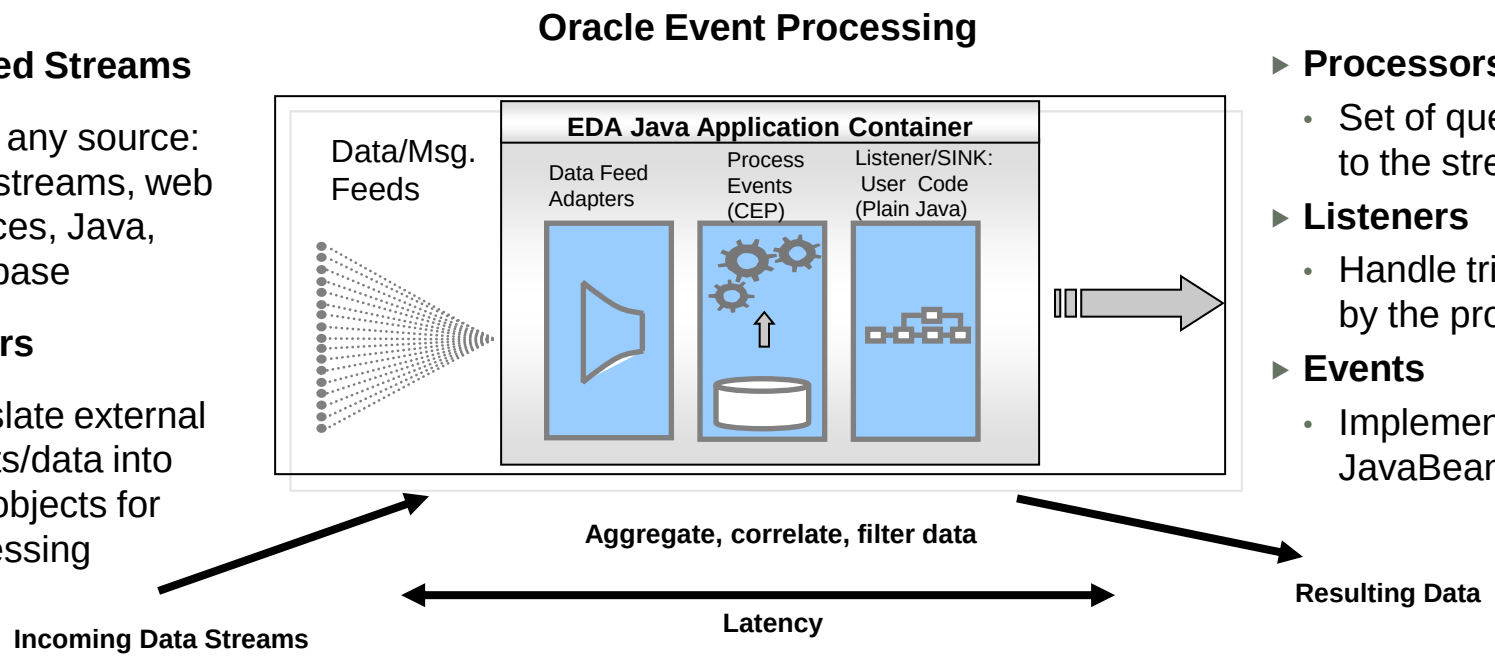
Agenda

- Oracle Event Processing Overview
- Continuous Query Language Concepts
- Tooling and Visualization
- Fast Data and Big Data
- References and Resources

Oracle Event Processing Overview

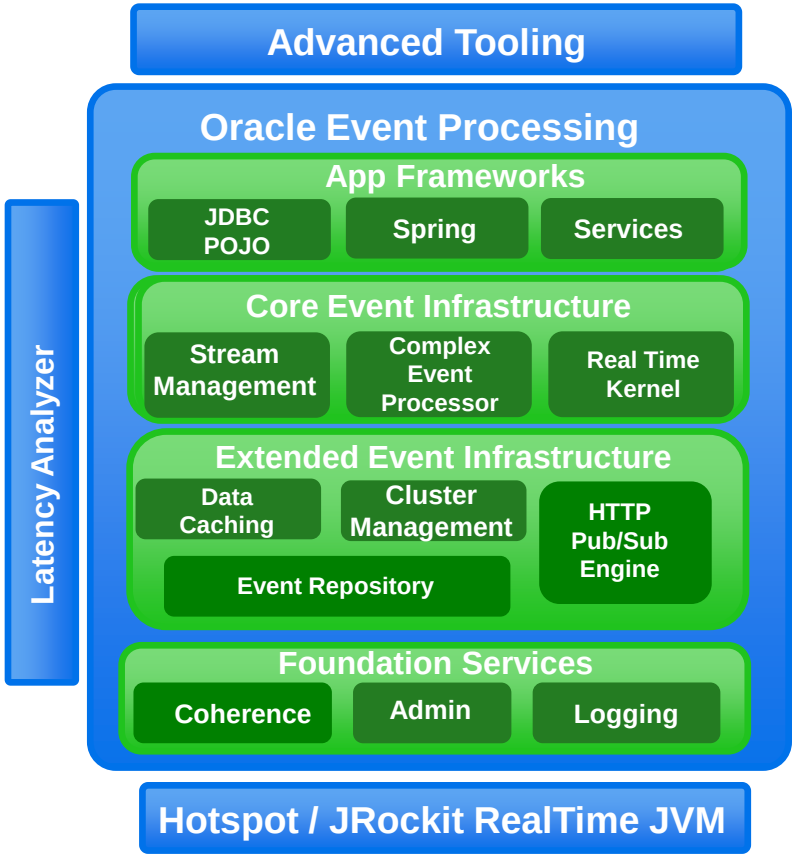
Streaming Event-Driven Architecture (EDA)

- **Enriched Streams**
  - From any source: data streams, web services, Java, Database
- **Adapters**
  - Translate external events/data into java objects for processing



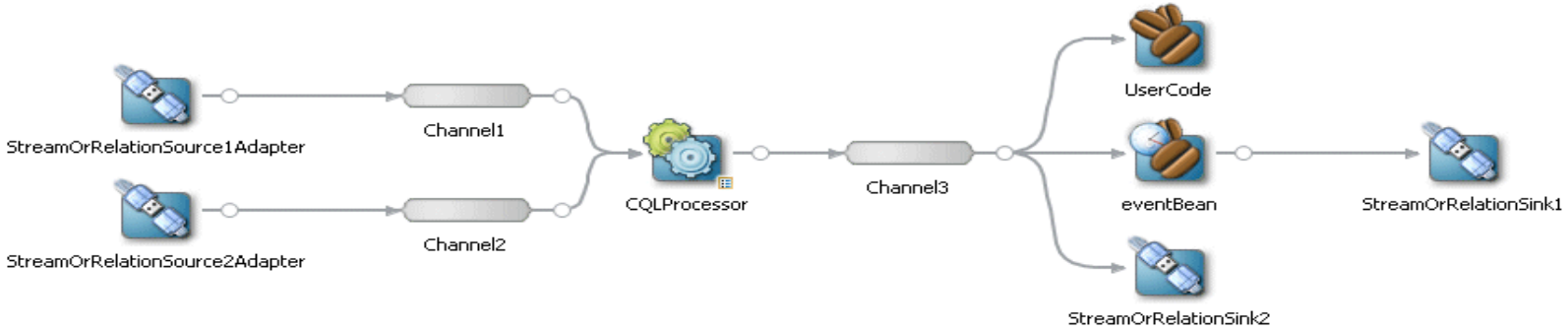
- **Processors**
  - Set of queries applied to the streams
- **Listeners**
  - Handle triggers raised by the processors
- **Events**
  - Implemented as JavaBean or Map

OEP Product Architecture



- Lightweight Java Application Server (Jetty)
  - Full environment for building and running Java applications
  - Services -- Security, Logging, User Mgmt
- Designed for High Throughput
  - Hundreds of thousands of events/second
- Event Processing Infrastructure
  - CEP Engine
  - Event Processing programming constructs and services
  - Continuous Query Language
- Easy-to-Use Development Environment
  - OSGi, Spring Framework, POJO
- Eclipse-based Tooling
  - Plugins for EDA Application Development

OEP Application



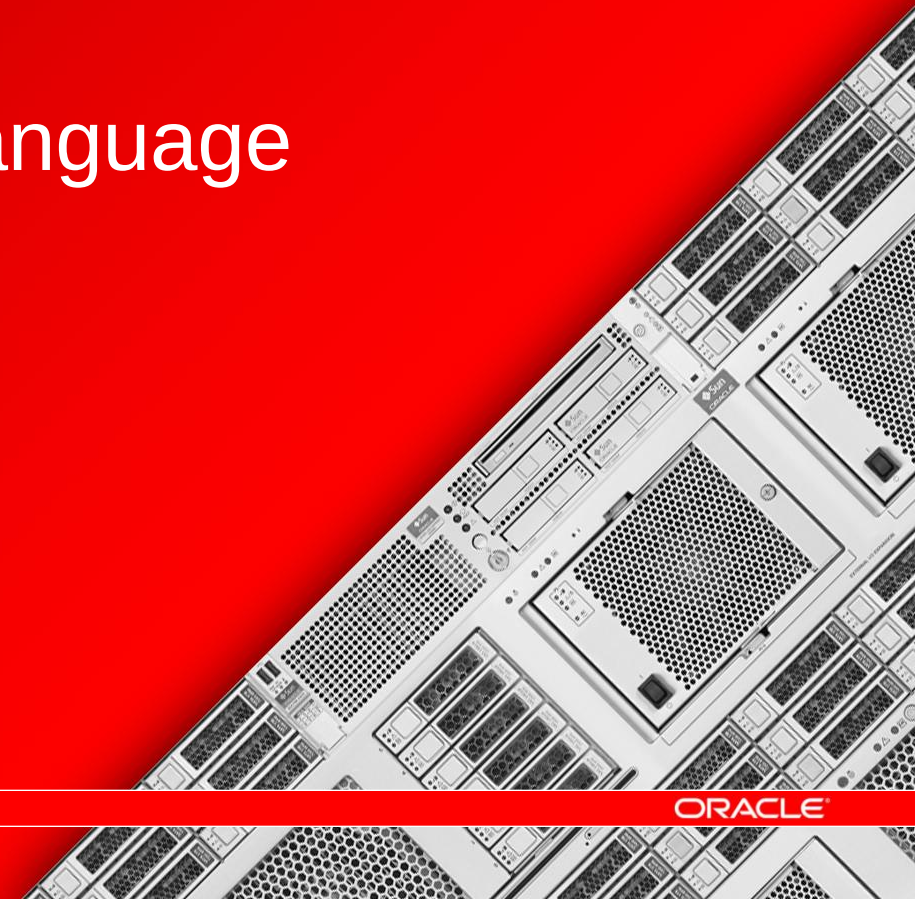
Adapter
interfaces directly to the event stream source and sink, understands inbound/outbound protocol, converts event data into normalized form

Channel
event processing connection point, can queue data, multi-threadable

Processor
consumes normalized data from channel, executes CQL queries, may generate new events to output channel

Event Bean / User Code
Java classes that register to listen to output channel, EventBean uses API to be managed by OEP container

Continuous Query Language Concepts



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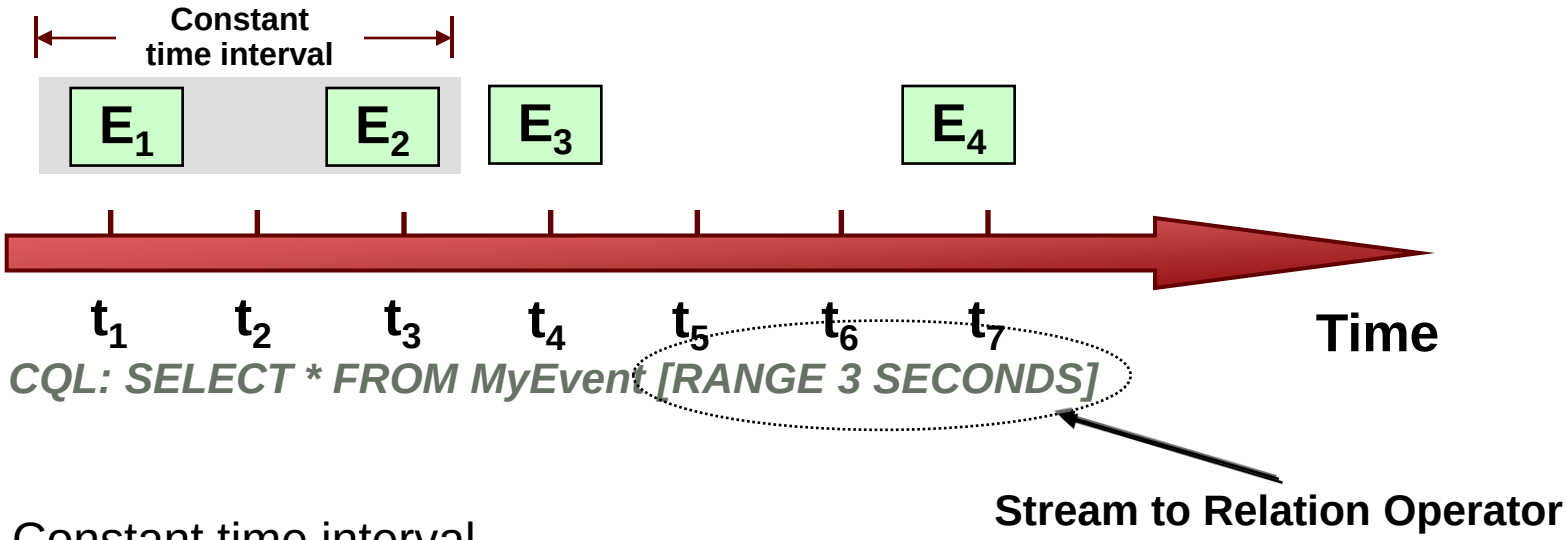
Continuous Query Language (CQL)

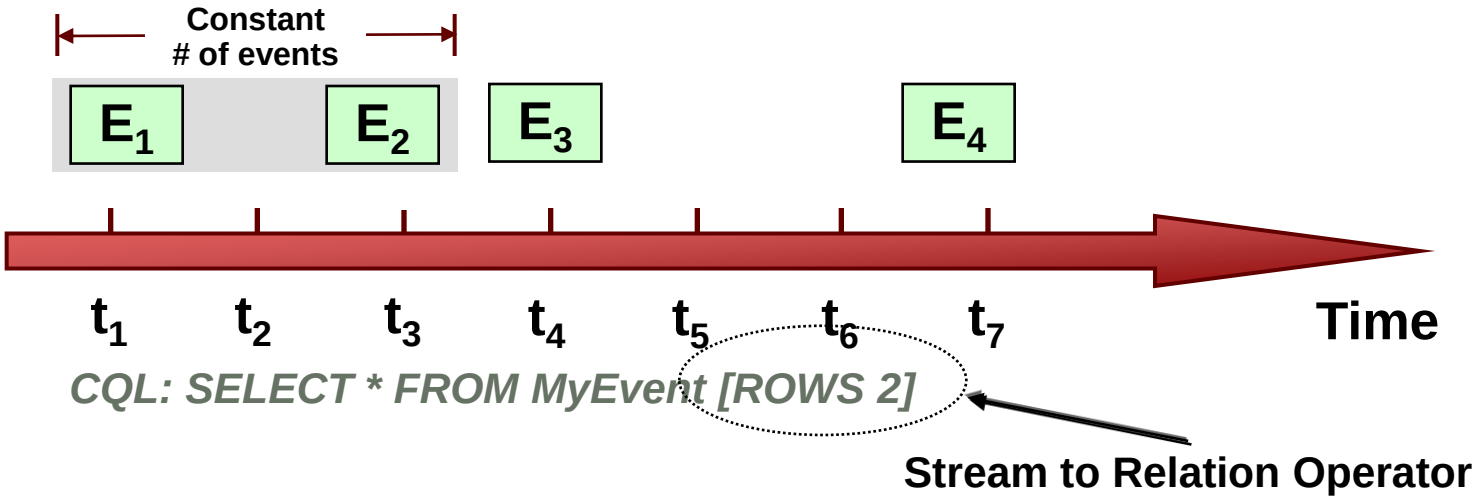
- Extends the relational model to support “continuous” queries
  - Formal model for describing Time, Streams, and Relations
  - Adds extensions to SQL-99
- Enables construction of “windows” over event streams
  - Bounded by time or count
  - Partitioned based on values
  - Processed incrementally or in batches
- Defines a “working set” of events to apply queries to
  - Filtering, aggregation, and correlation of events
- Adds pattern matching
  - Supports track-and-trace scenarios (e.g. detecting missing events)
  - accepted as ANSI SQL standard in 2012, implemented in Oracle Database 12c

Time-based event windows



- Constant time interval
- Number of events in Relation will vary
- Events will expire from Relation over time

Row-based event windows



- Constant number of events in Relation
- Events will not expire from Relation until replaced

Pattern Recognition with MATCH_RECOGNIZE

Example: Missing Event Detection

```
<query active="true" id="DetectMissingEvent">
    <![CDATA[
            SELECT
                "Event has not occurred in 5 seconds" AS detail,
                "ALERT ALERT" AS alertType,
                EventMiss.tStamp AS tStamp
            FROM RelayChannel  MATCH_RECOGNIZE (

                MEASURES A.ELEMENT_TIME AS tStamp include timer events
                PATTERN( A B ) DURATION 5 seconds
                DEFINE
                    A AS A.psi > 0,
                    B AS B.psi > 0
            ) AS EventMiss
                ]]>
</query>
```

The **MEASURES** clause gives a name to the value in the events timestamp so it can be used in the select statement.

The **PATTERN** clause defines that you are looking for an ‘A’ event followed by the ‘B’ event which are defined in the **DEFINE** clause.

The **DURATION** clause defines how long in between events can occur.

Extending CQL with Data Cartridges

Allows to integrate other data types and functions to use within CQL:

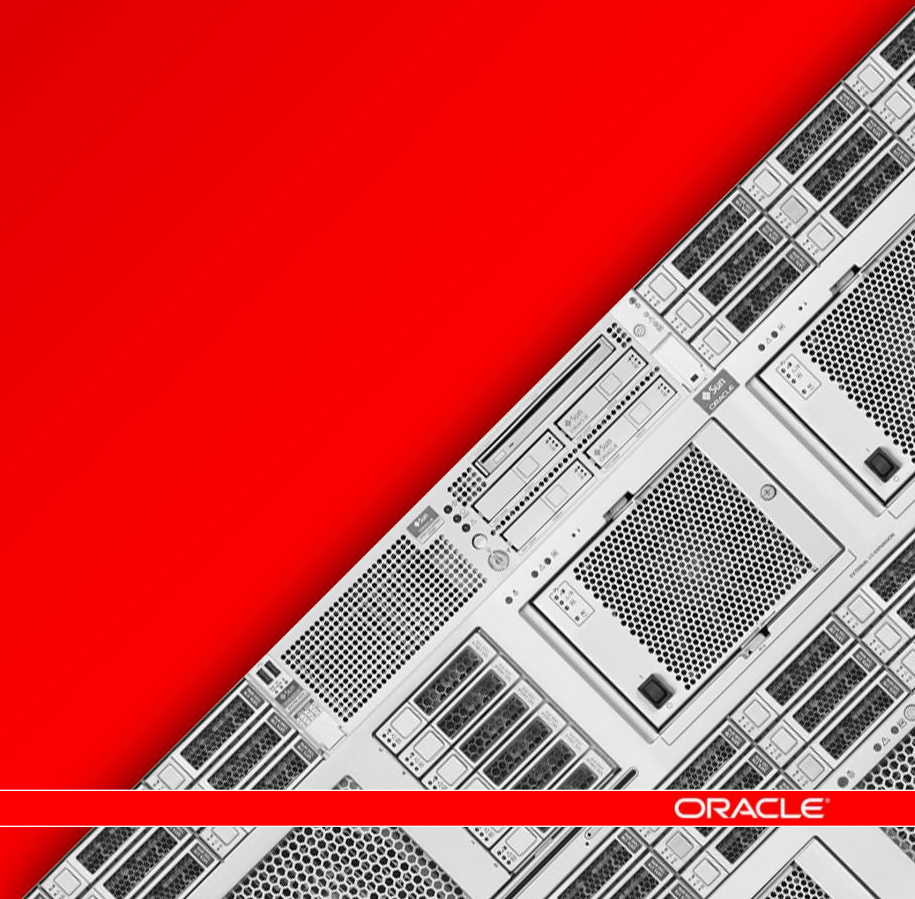
Oracle Java Data Cartridge
Use Java types, methods, fields, and constructors in CQL queries

Oracle Spatial
An option for Oracle Database providing advanced spatial features to support high-end geographic information systems and location-enabled business intelligence solutions

Oracle JDBC Data Cartridge
Execute SQL queries against databases and use returned results in CQL queries

Oracle NoSQL Database Data Cartridge / Oracle Hadoop Data Cartridge
Integrate an existing NoSQL or Hadoop data source into an event processing network

Tooling
and Visualization



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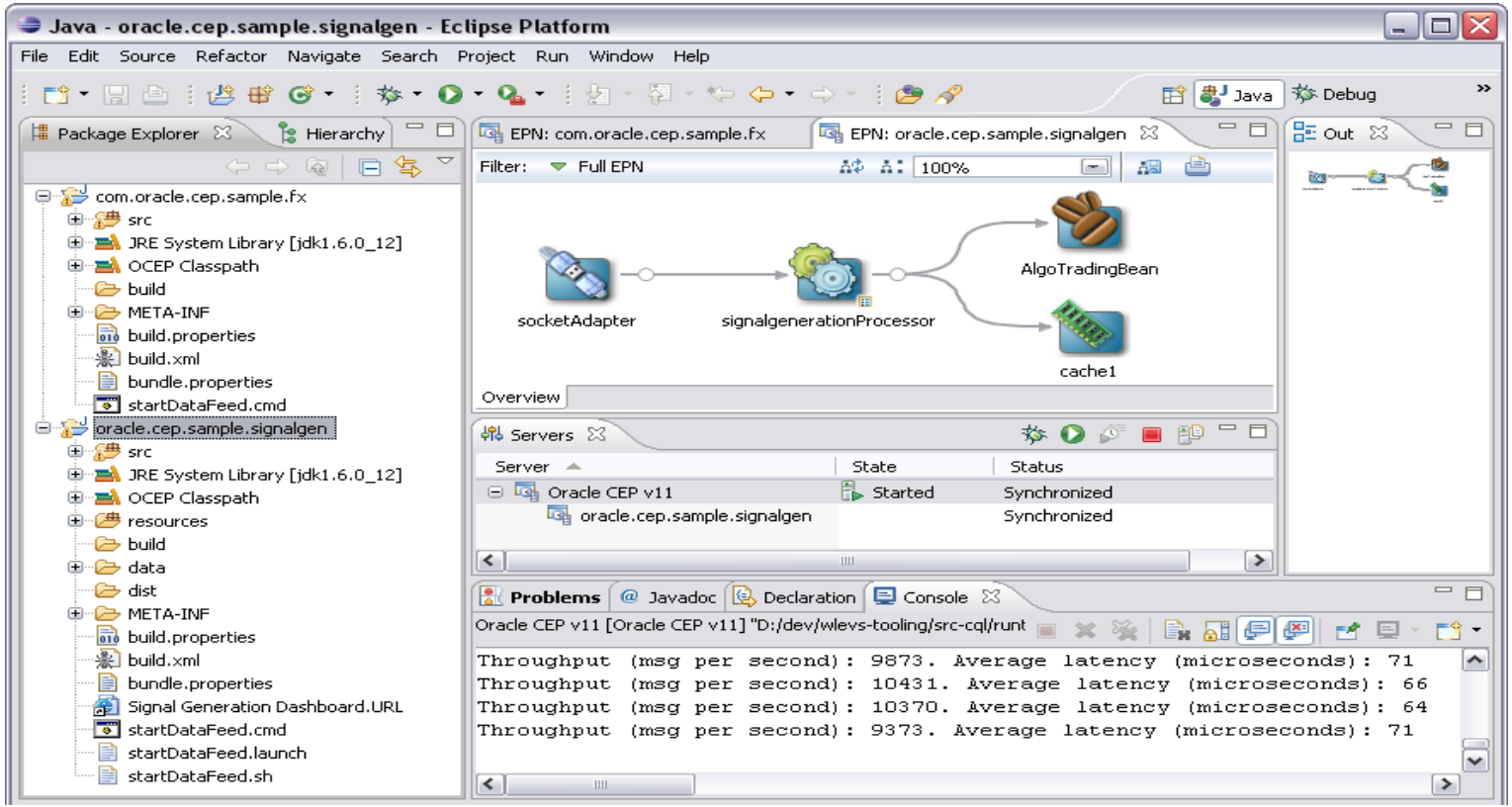
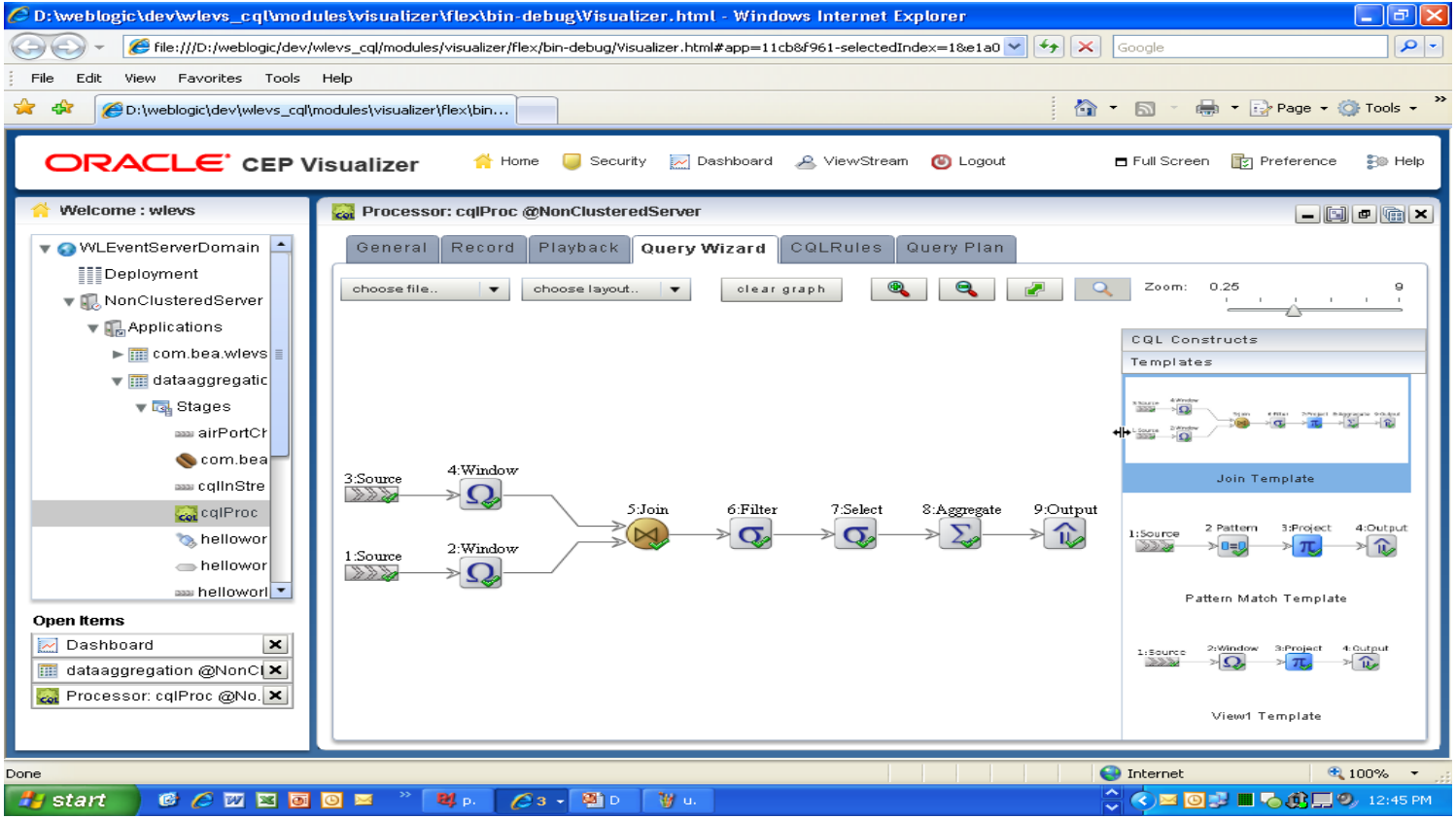
Eclipse OEP App Development

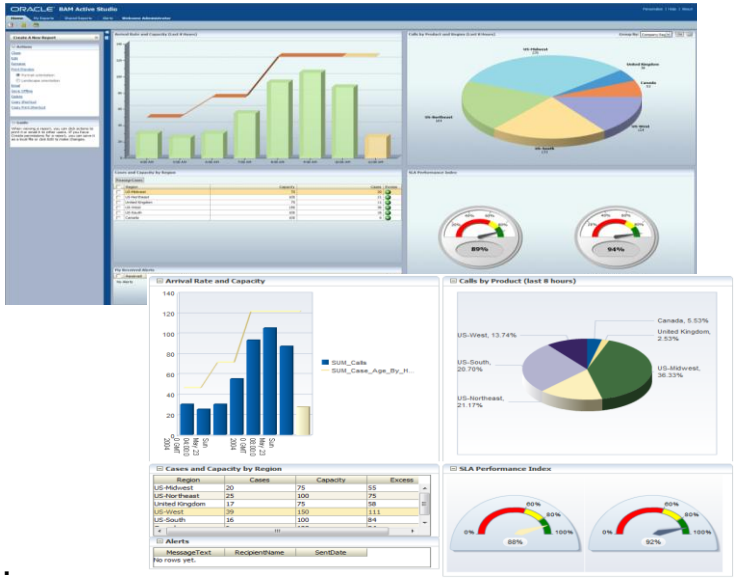


Monitoring and Managing OEP Applications

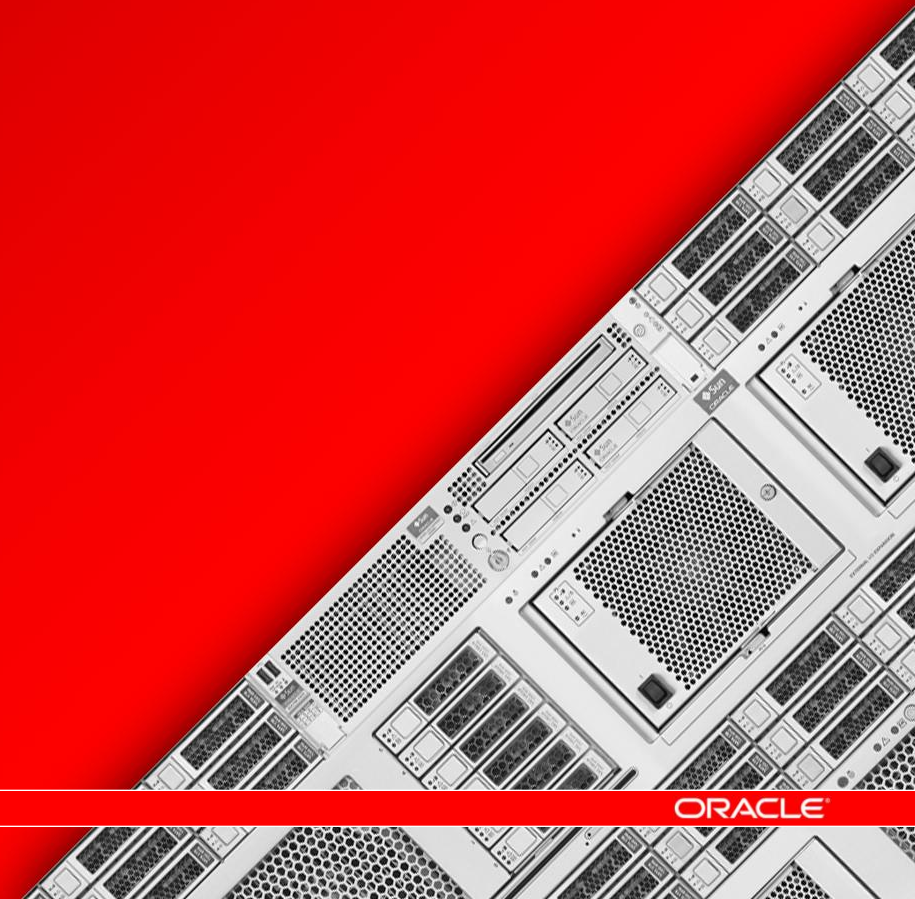


Visualizing Events: Oracle Business Activity Monitoring

- **Monitor** business processes & services in real-time
  - Key Performance Indicators (KPIs)
  - Service-Level Agreements (SLAs)
- **Analyze** events as they occur
  - Correlate events & KPIs
  - Identify trends as they emerge
  - Alert users to bottlenecks & solutions
- **Act** on current conditions
  - Event-driven alerts
  - Real-time dashboards
  - BPEL processes & web services integration



Fast Data
and Big Data



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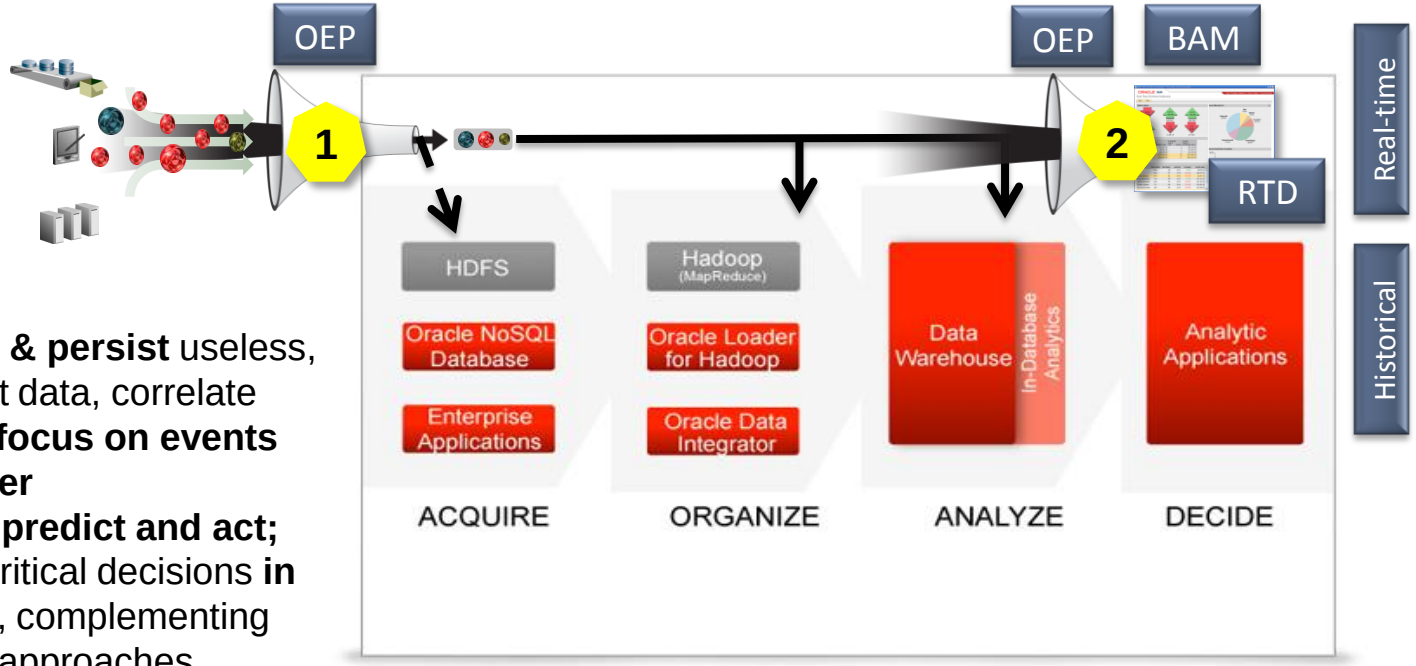
Fast Data & Big Data

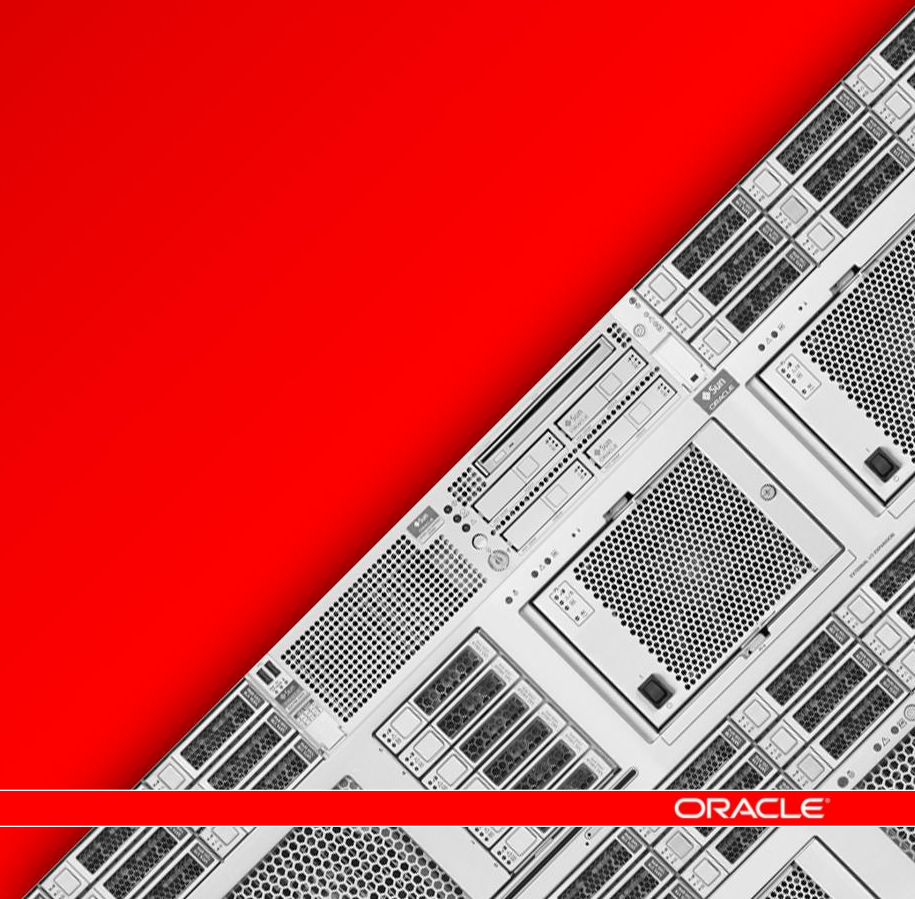
Adding real-time value/capabilities with OEP, BAM* & RTD**



1. **Filter out & persist** useless, redundant data, correlate **find and focus on events that matter**
2. **Analyze, predict and act;** execute critical decisions **in real-time**, complementing historical approaches

***BAM: Oracle Business Activity Monitoring** ****RTD: Oracle Real-Time Decisions**

References and Resources



Customer Adoption of Oracle's Fast Data

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Where to Get More Information?

www.oracle.com/fastdata

Hardware and Software

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Engineered to Work Together