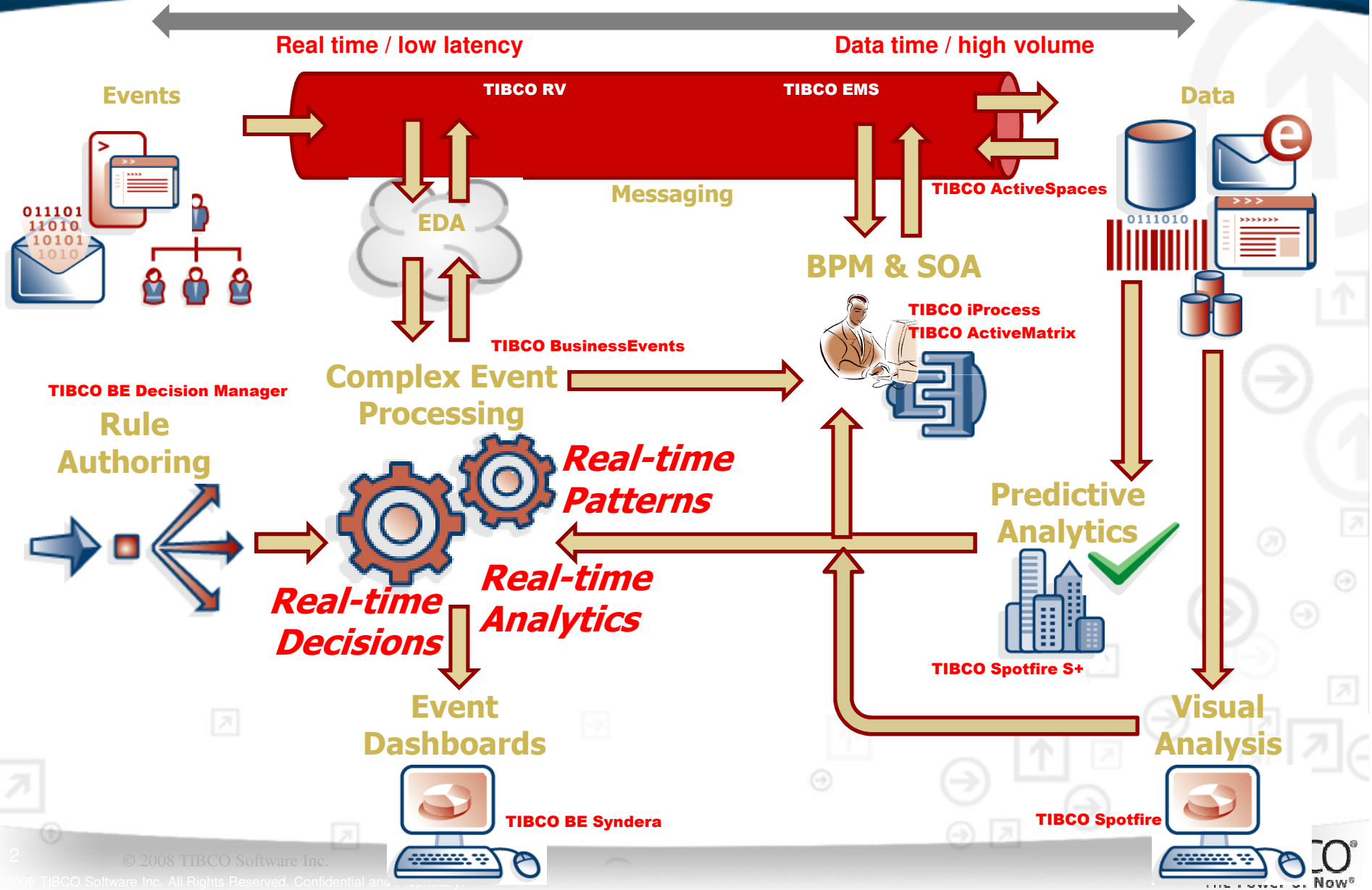
# The Role of Rules in CEP ^ and vice versa

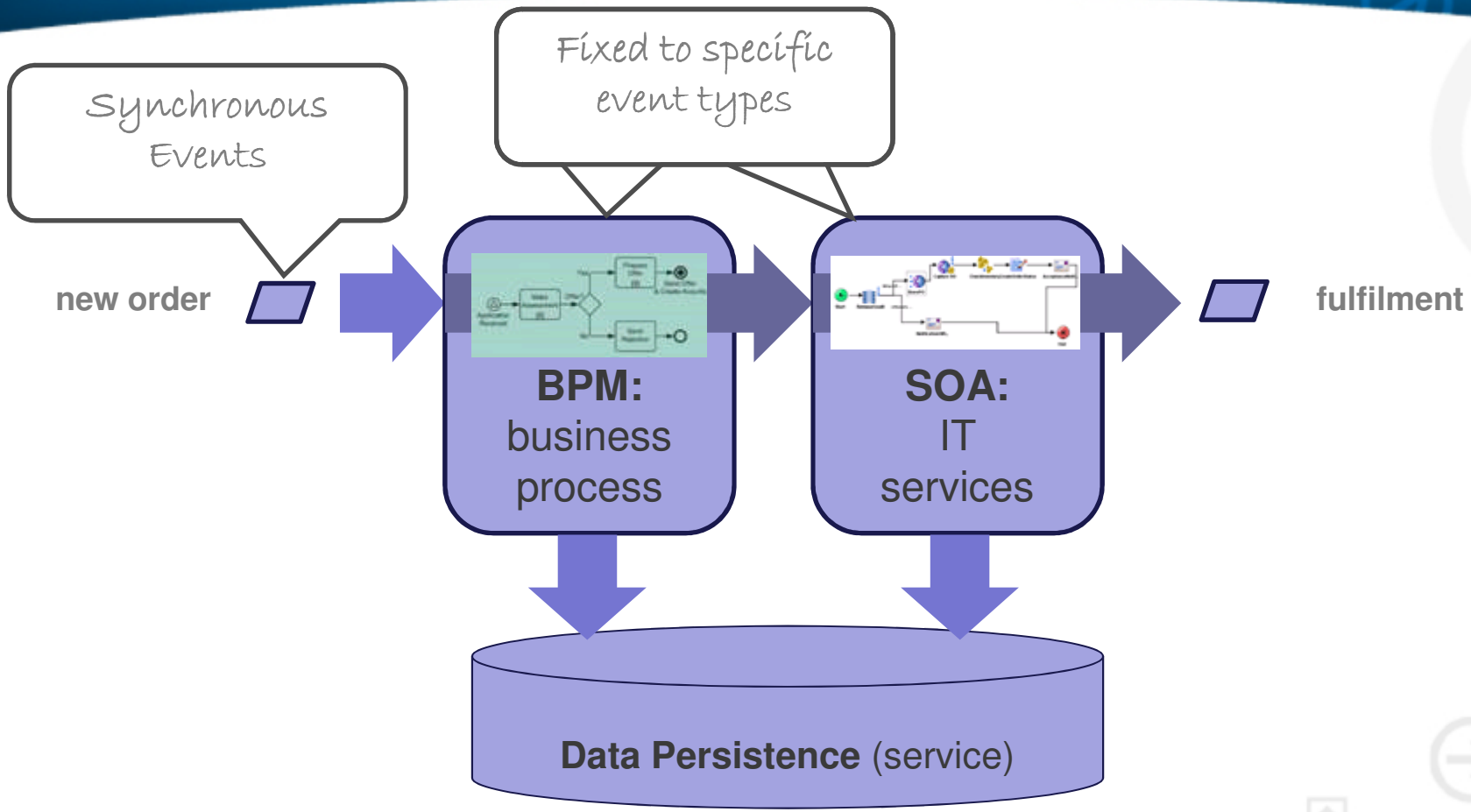
**Paul Vincent,**
**CTO Business Rules and CEP, TIBCO Software**

# Introduction - TIBCO

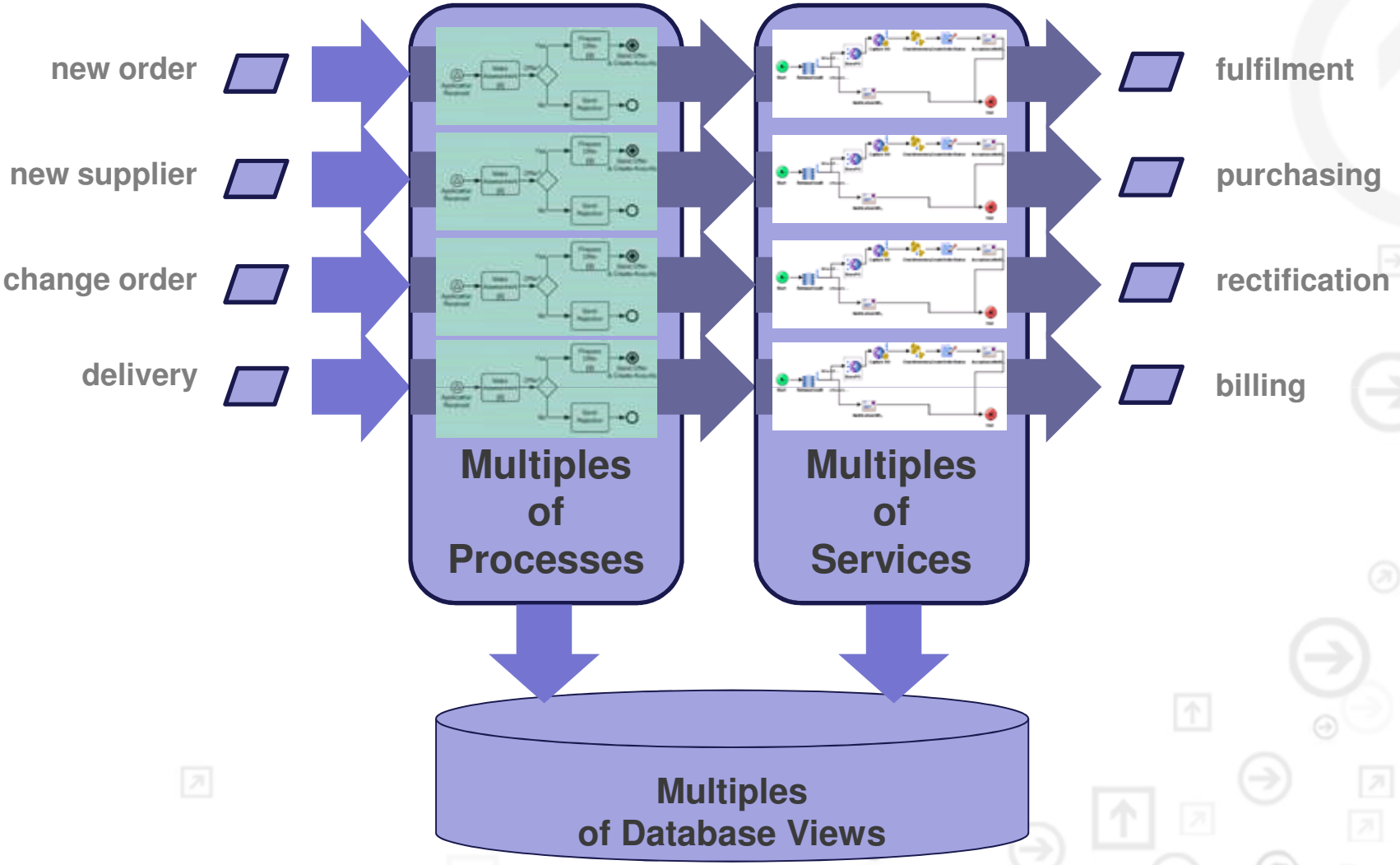


# What is CEP?

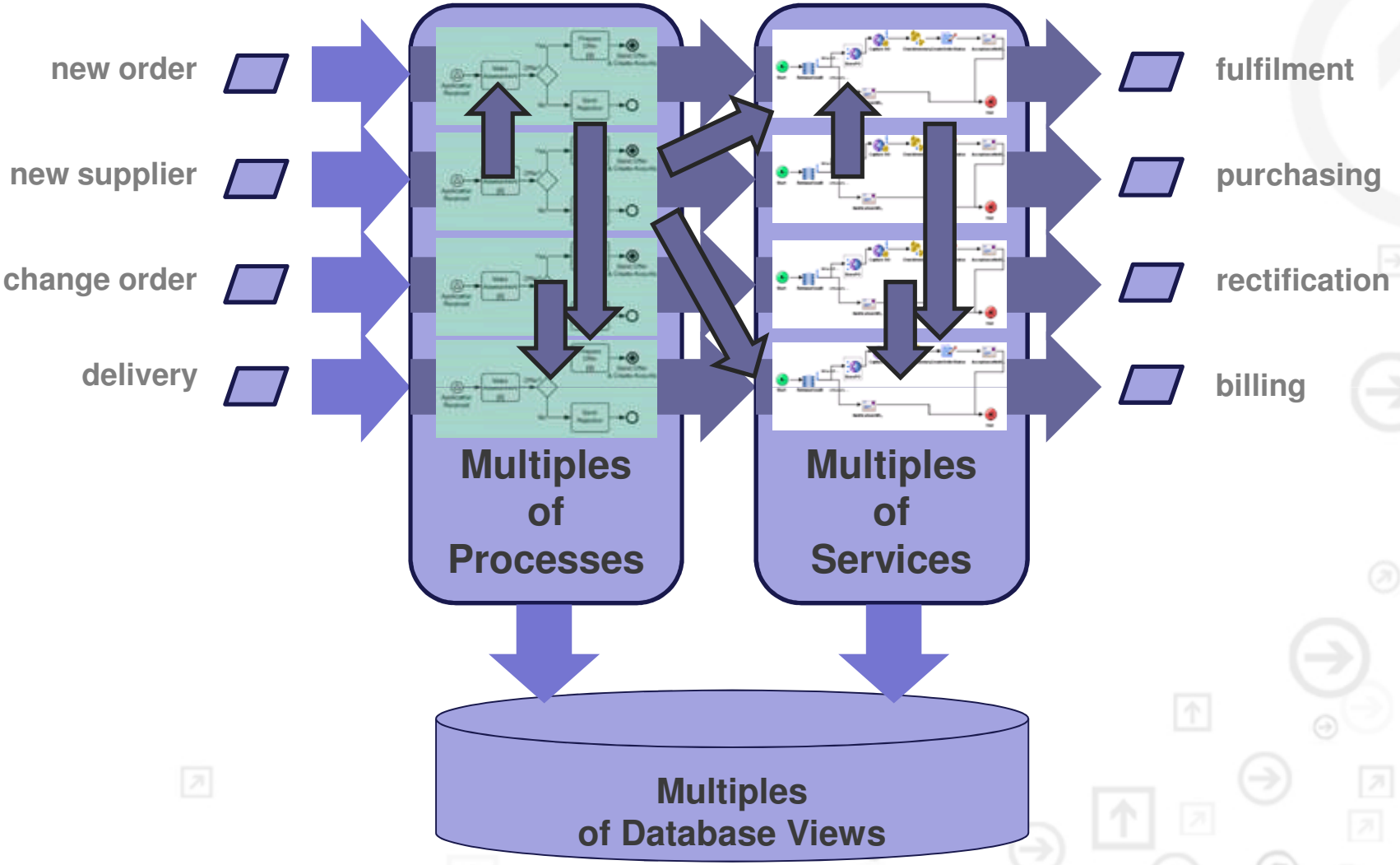
# Simple Event Processing



# Multiple Simple Event Processing



# Multiple Simple Event Processing (theory)



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# Simple EP = default IT Model, 1950-now

# Real-world Events




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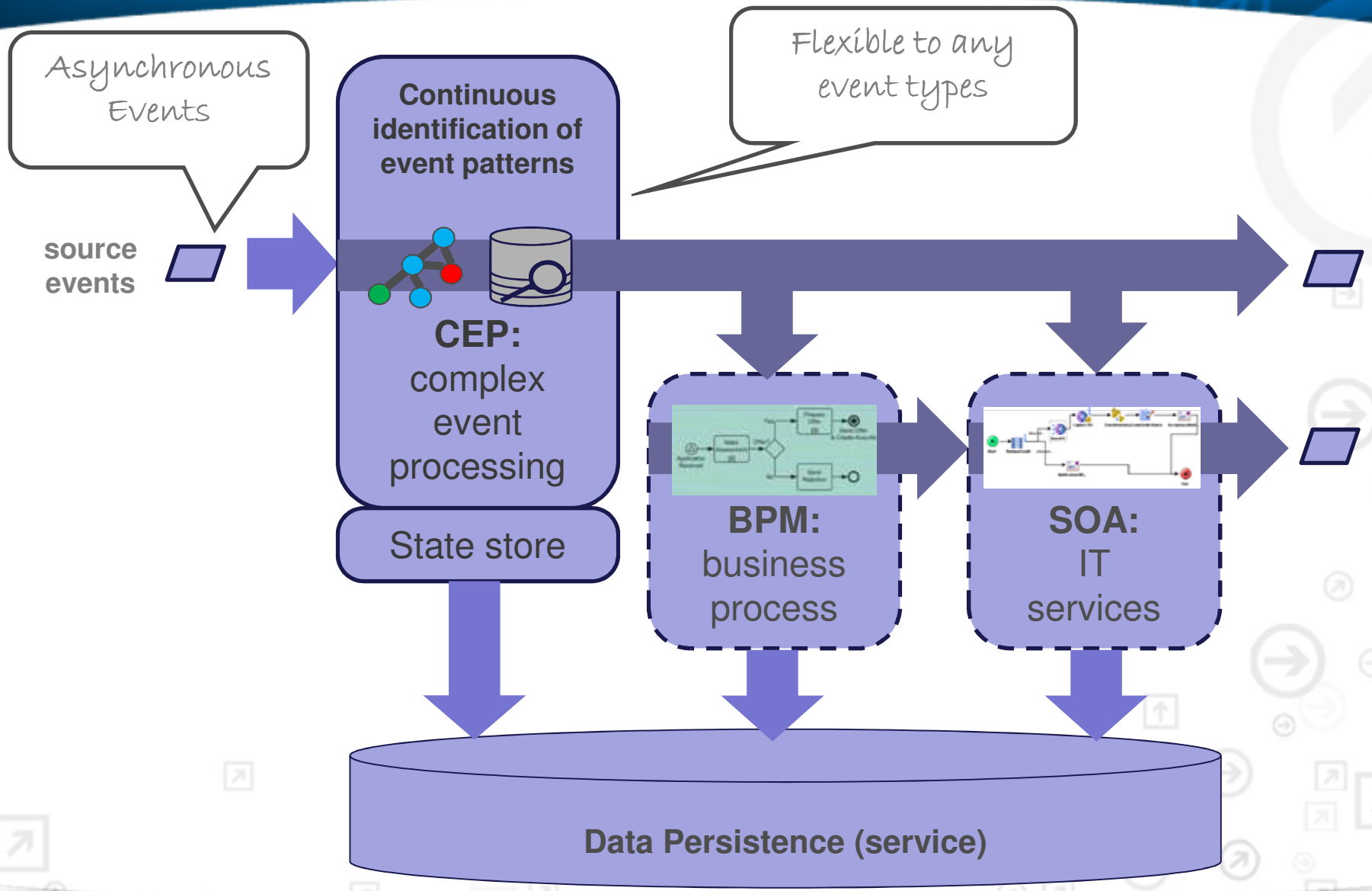
Customer Logon
Fed Base Rate Increase
Customer Checks Close Account Web Page
New Order
Production Item Arrives at Store
New Liability Added
Mobile Call from CT @11.13
Contract Submitted
Rental Car Crashed
Rental Car Returned
Contract Returned thru EDI


Fraud Risk!
Risk of Customer Defection
Customer CrossSell Opportunity
Change in Product Sales Trend
Contract Validated
Cell phone fraud alert
Employee Over hours
Compliance Limit Approached
Contract Valid
Customer now rated Gold
Rental Contract Complete

# Complex Event Processing



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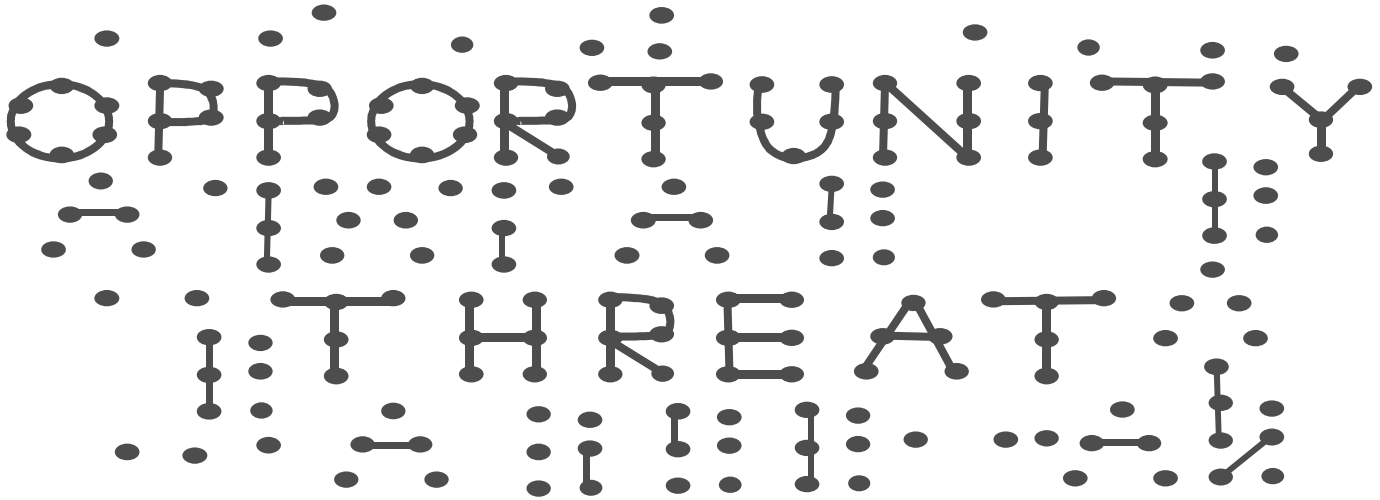
# CEP's role: detect patterns, in real-time



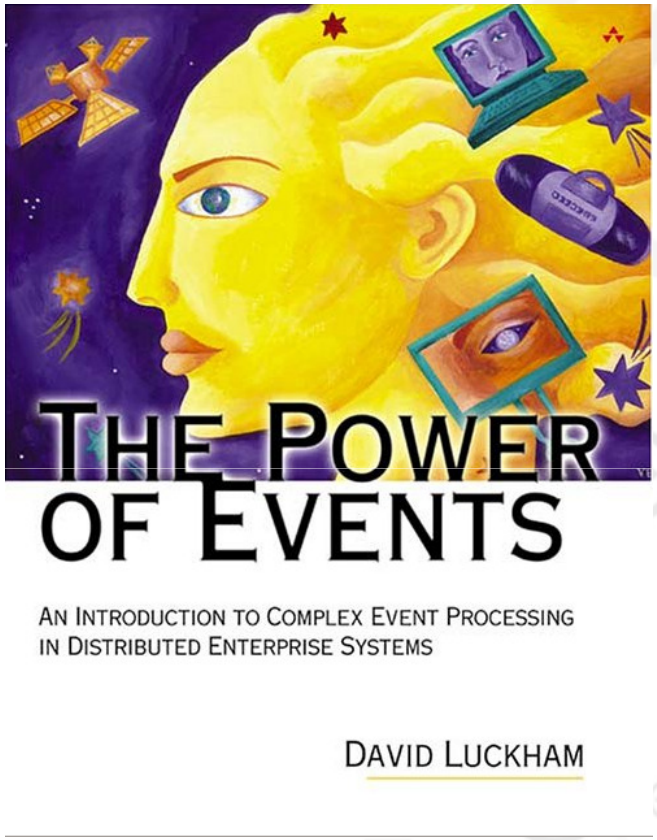
# CEP's terminology


- CE
  ev
- Mu
  av
- Pr
  se

# What does CEP cover?

*"CEP applies to a very broad spectrum of challenges in information systems"*
*e.g.*

- Business process automation
- Service routing and coordination
- SLA, Policy fulfillment and breach checking
- Security and fraud detection
- Activity Monitoring

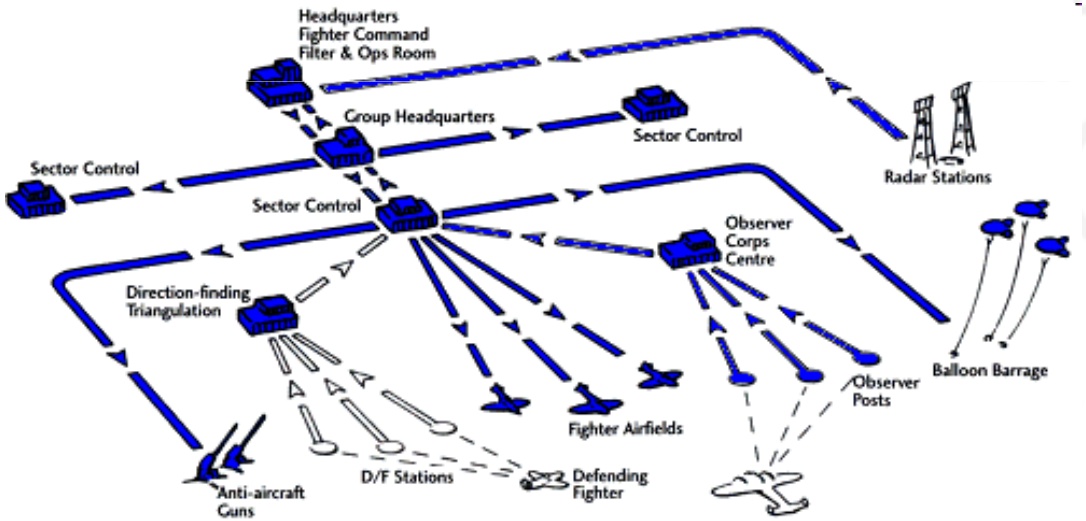



**The Power of Events, Addison Wesley, ISBN: 0-201-72789-7, 2002**

# Historic Background to CEP

# Command and Control

- **Command and Control**
  - Correlate all available information
  - Determine tactics based on strategy and up-to-date information

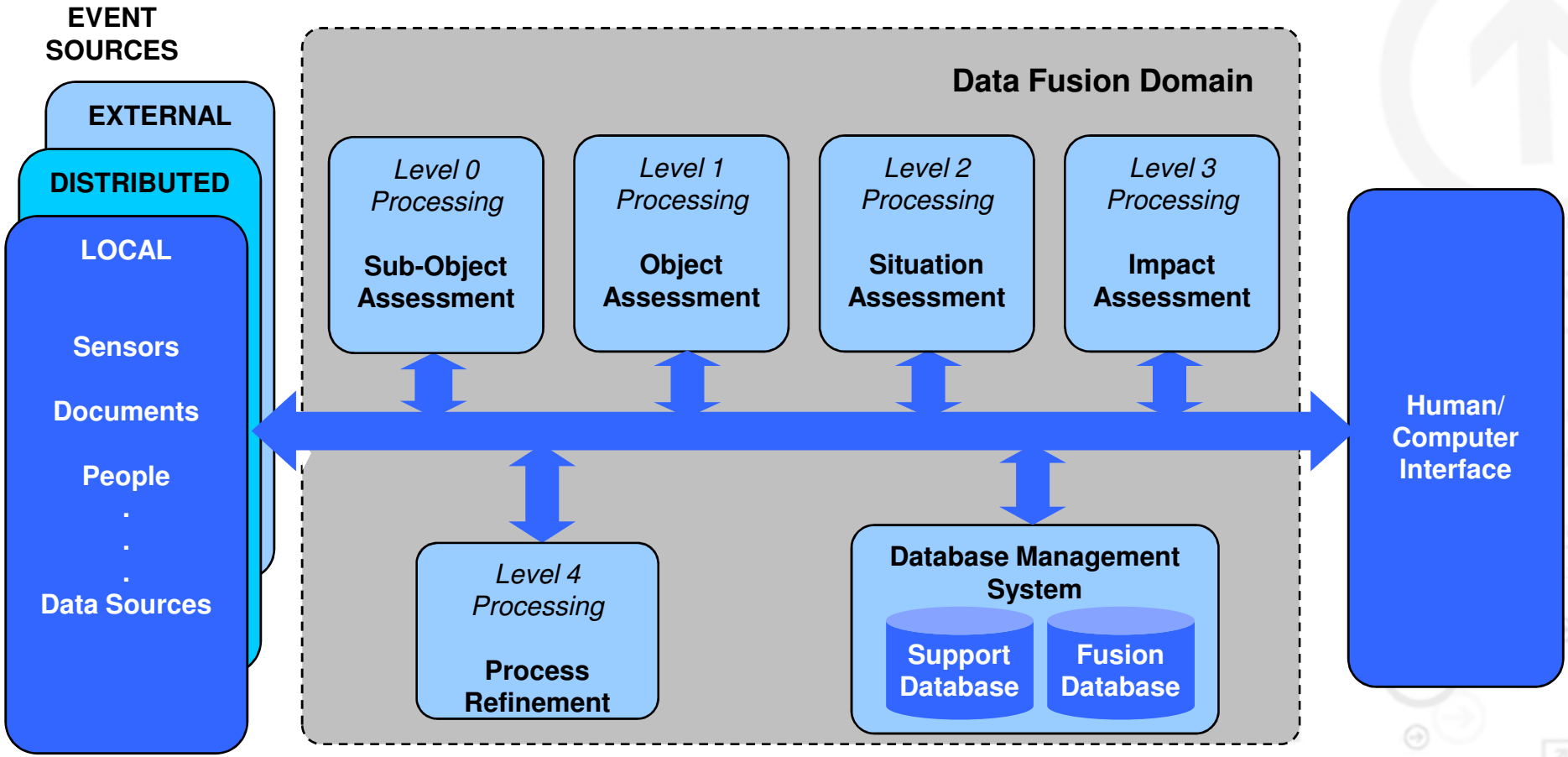



-- from RAF Battle of Britain Fighter Control System 1940

# Message process automation

- Collossus - http://www.tnmoc.org/ColRbd.htm
- Searched for patterns in encrypted messages
- Hardware-based

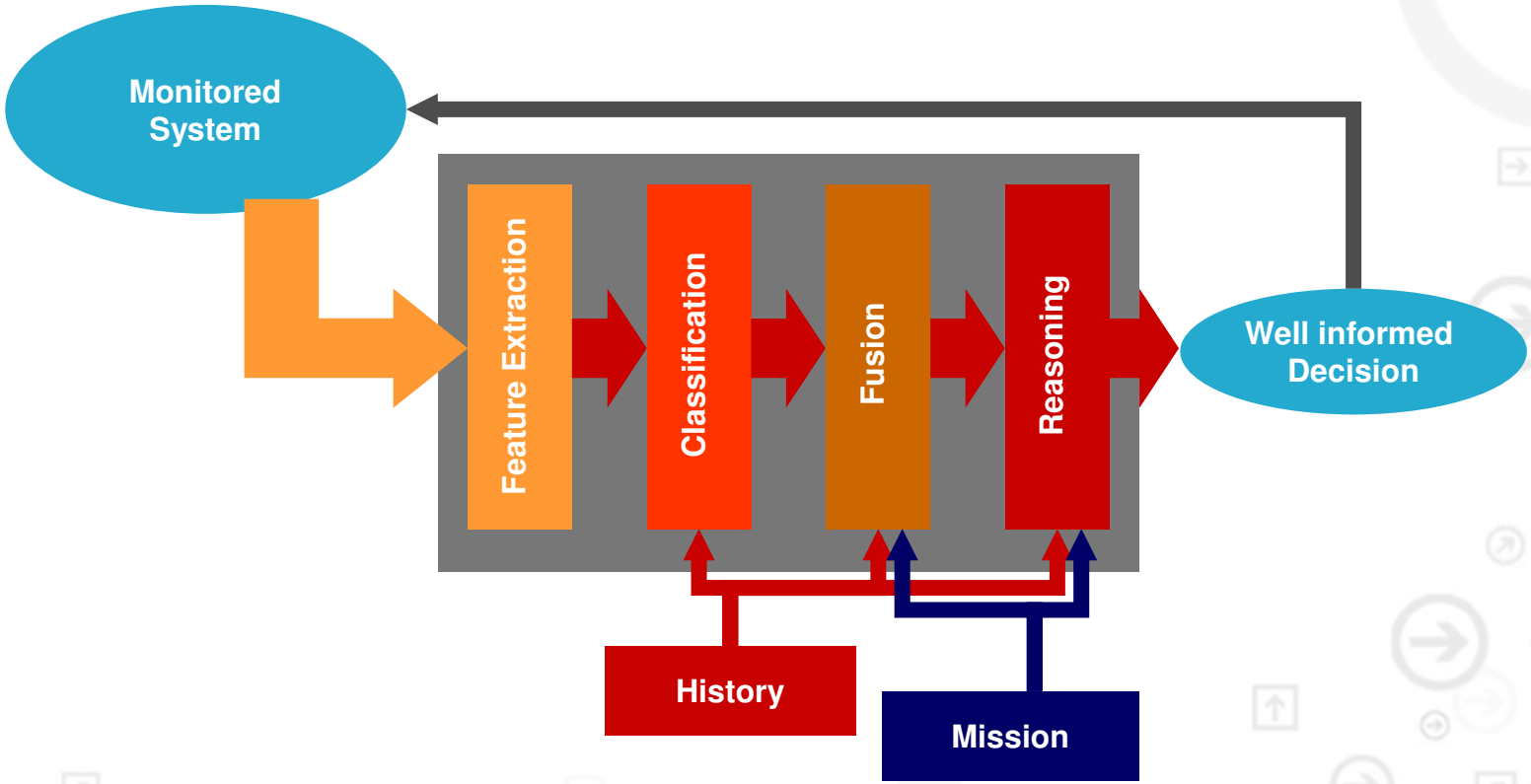
# Data Fusion




-- Revised JDL data fusion model, 1998

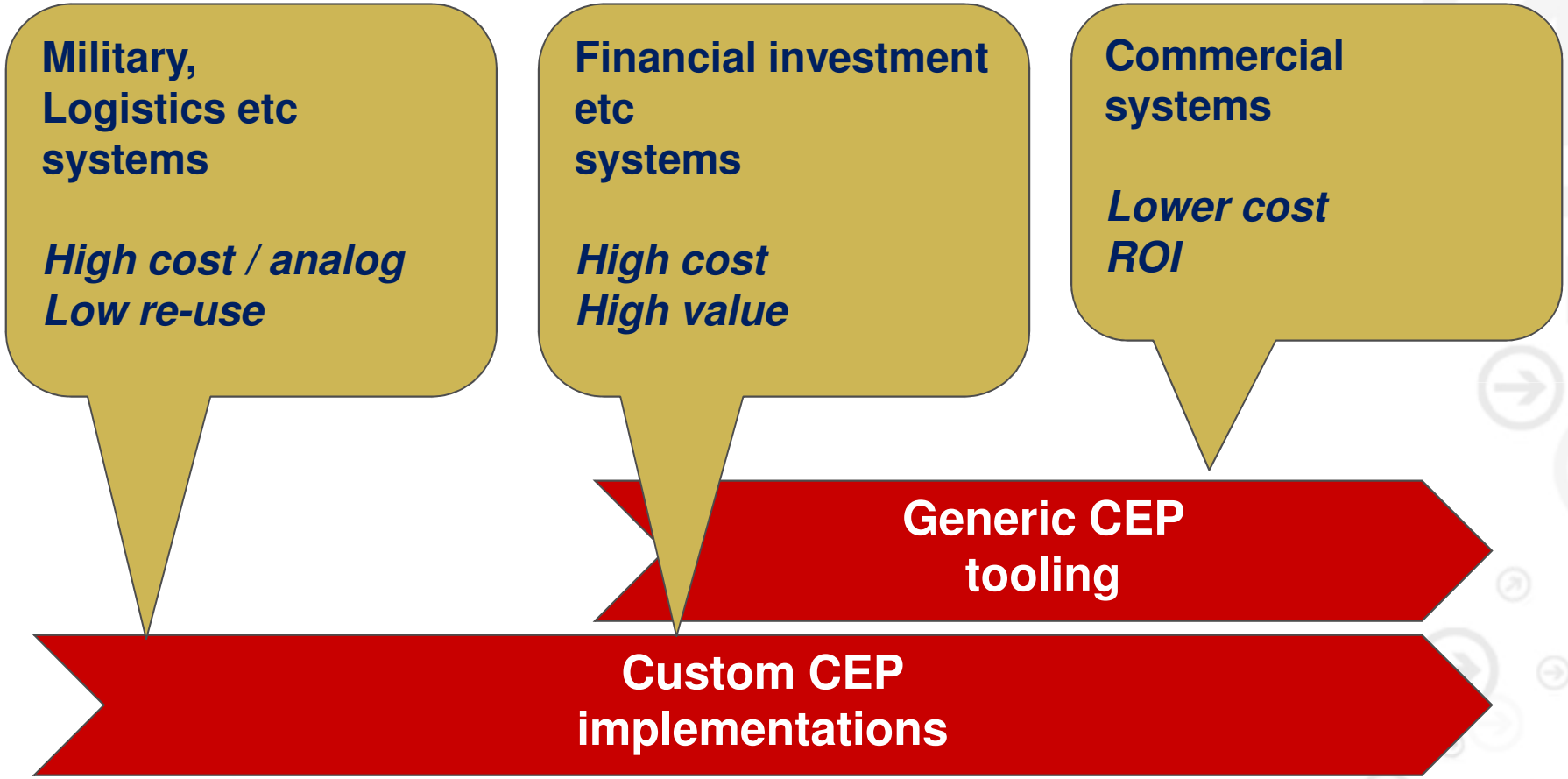
Steinberg, A., & Bowman, C., Handbook of Multisensor Data Fusion, CRC Press, 2001

# Condition Based Maintenance




-- from “Data Fusion for Developing Predictive Diagnostics for Electromechanical Systems”
Steinberg, A., & Bowman, C., Handbook of Multisensor Data Fusion, CRC Press, 2001

# CEP Timeline



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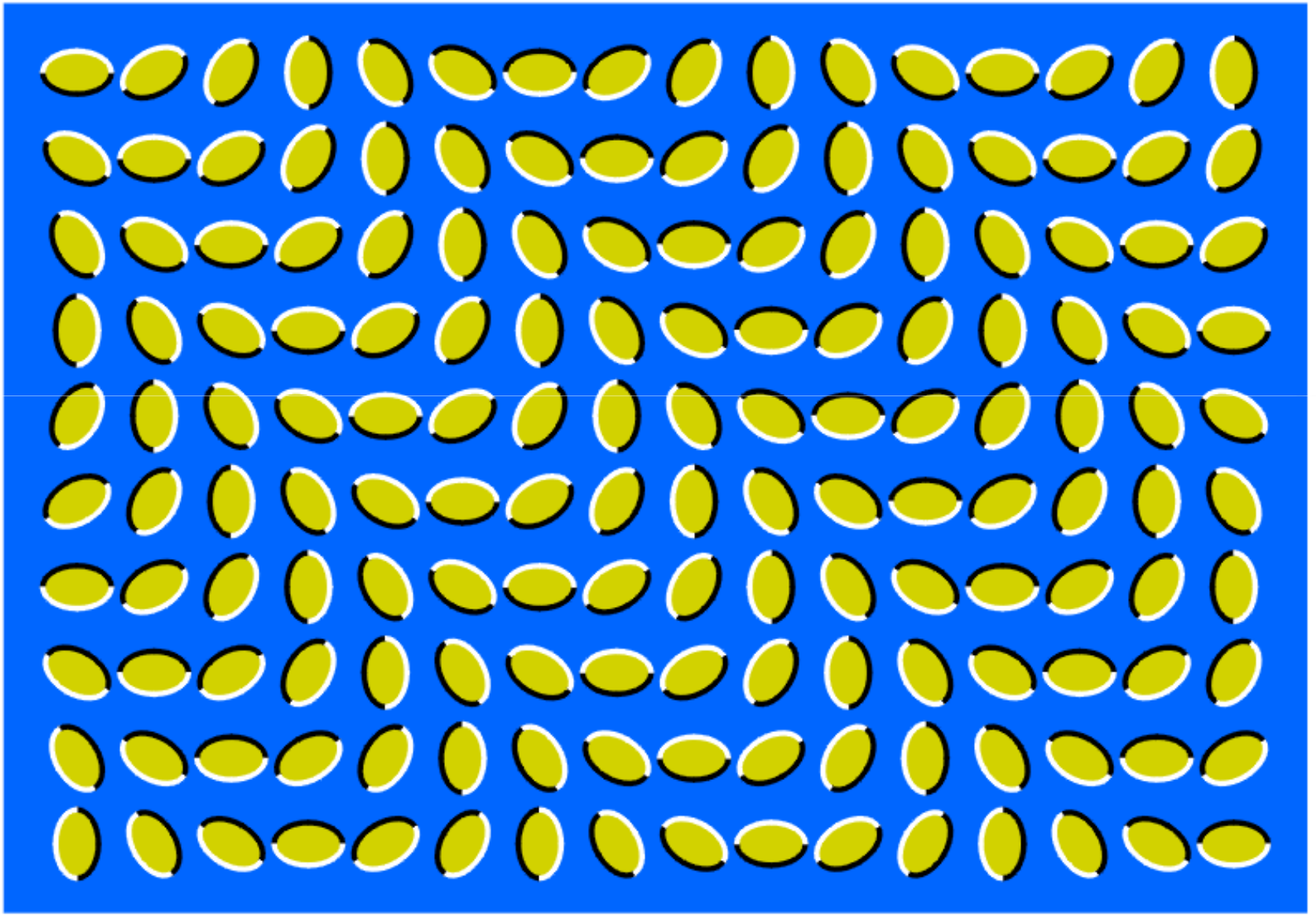
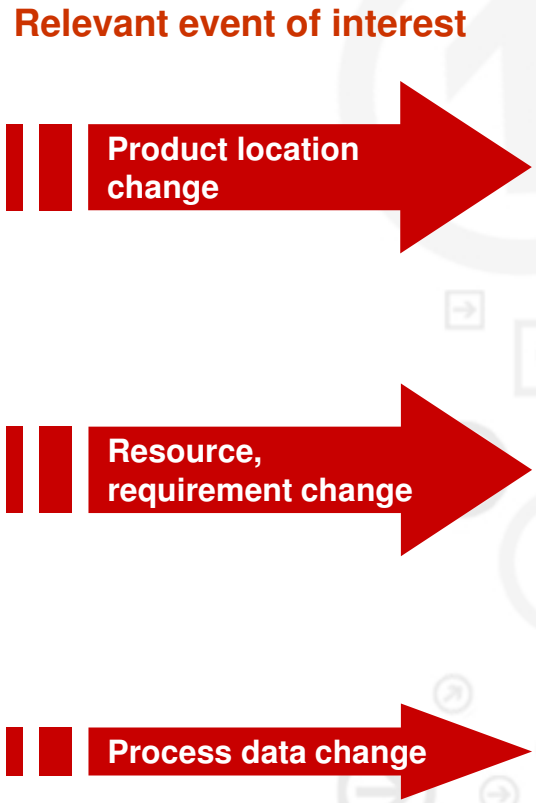
# Considerations about Events

# Events = Data in Motion



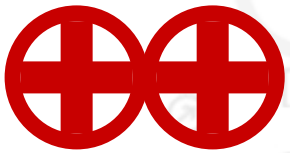
# Complex Business Problems

- **Fraud / Theft**
  - Thousands-to-millions of high-value small-size product items or transactions
  - How do you identify known patterns of “suspicious” behavior?
- **Logistics / Scheduling**
  - Raw material, production & delivery scheduling and resources are complex and prone to change
  - How do we reallocate resources to handle business and production changes?
- **Activity Monitoring**
  - Complex production and supply process with multiple actors
  - How to measure and action Key Performance Indicators?



# Associated Events

- **Positive Events**
  - Product item X arrives at Production station S from Store T
  - Production worker Y arrives at Production station S
  - Production contract for item Z by time T is posted
- **Negative Events**
  - Product item X has been in transit to Store T for >15 minutes
  - Subcomponent Y hasn't arrived at the Production station by the ETA
  - Delivery of contract Z has not taken place
- **Sets of Events**
  - 5+ items of Product item type Y failed to arrive at destination
  - Supplier Y was 5 mins late for 1 delivery, but made it early to the next
  - Return rate on component Z exceeds SLA %



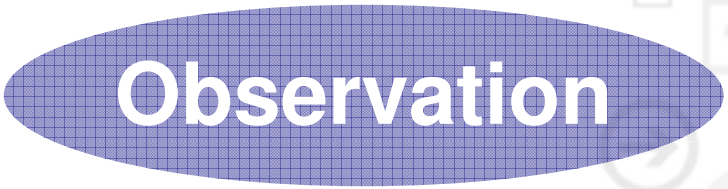
# Significant features of these Events

- **Time Sensitivity**
  - A thief may leave the building at the same time as stolen product
  - A product should take 40 minutes to travel a given production line segment
- **Distributed Event Sources**
  - A series of produced items fails at various QA stages, and their common attribute was a storage location
  - Multiple suppliers for a subcomponent are reporting delivery delays



# Defining an “event”

- **Change of state in some entity**
  - Customer call
  - Bank debit
  - Aircraft movement
- **Observation of some entity**
  - CRM record of a customer call
  - ATM report of debit transaction success
  - Radar plot update of an aircraft
- **IT Message**
  - Queued point-to-point message
  - Publish / subscribe message


# Event examples

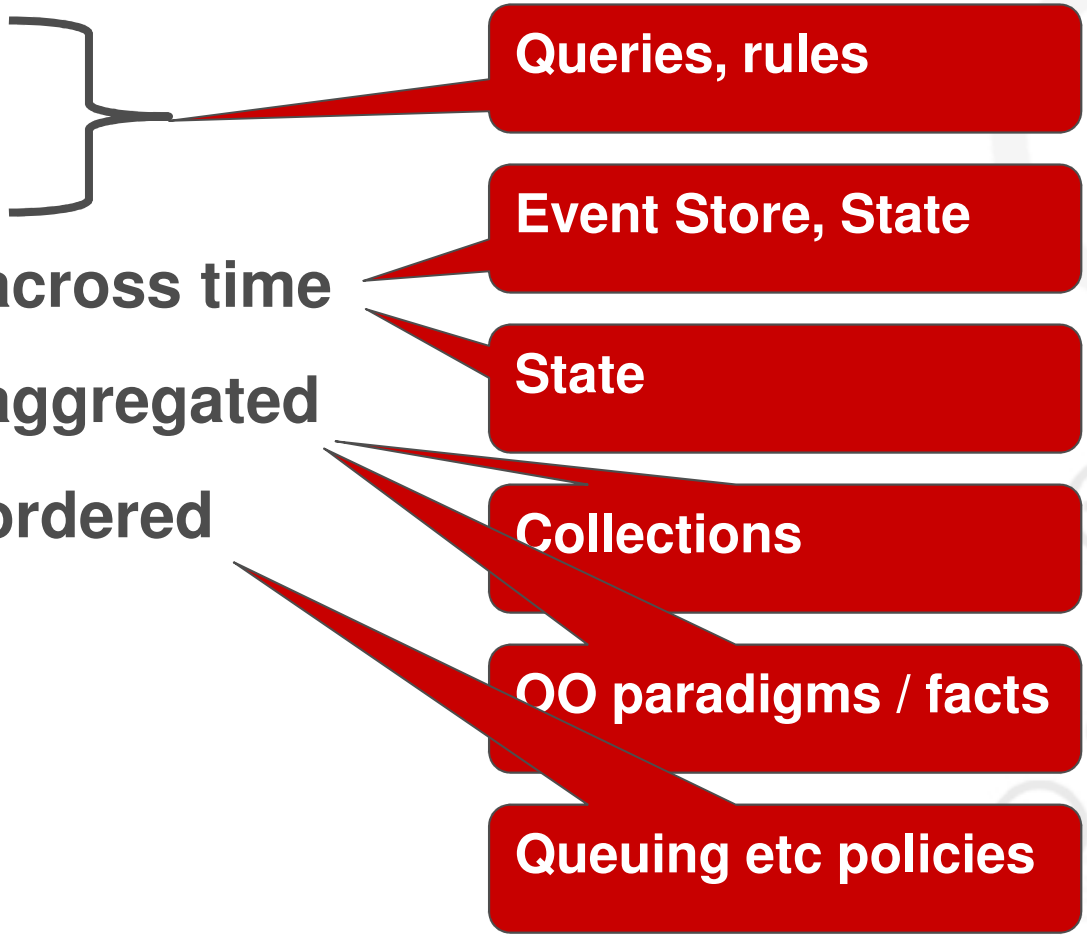
- **SOA service requests**
  → time, destination, payload
- **Scans (parcel, baggage, RFID, production line...)**
  → location, time, payload
- **Web requests**
  → source IP, destination, payload, frequency
- **Messages / packets (telco, smartgrid)**
  → source, destination, time, location
- **Data streams (data feeds)**
  → payload, time, source

# Where Rules fit in CEP

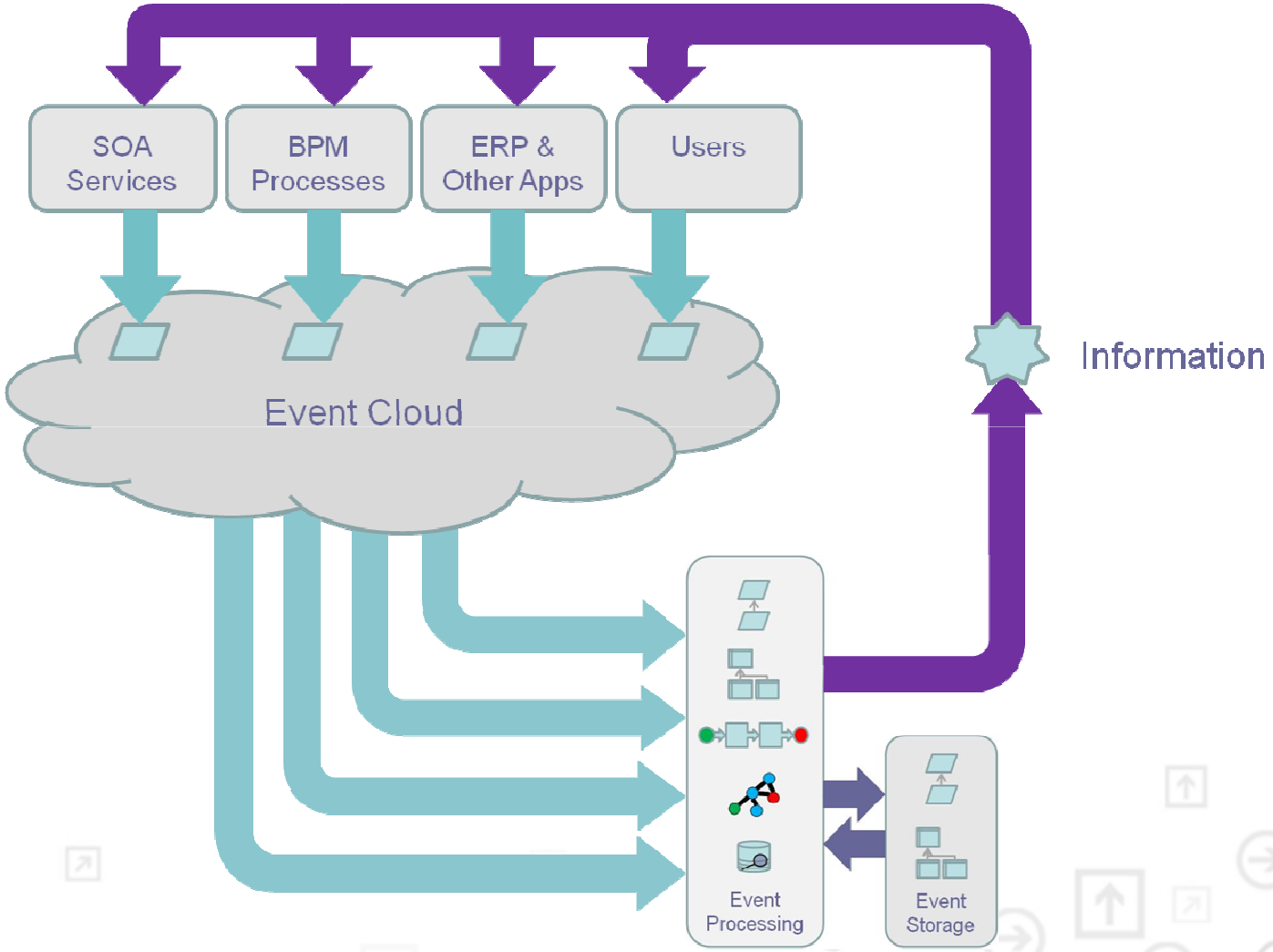
# CEP used for Situation Awareness

# Pattern Matching against events

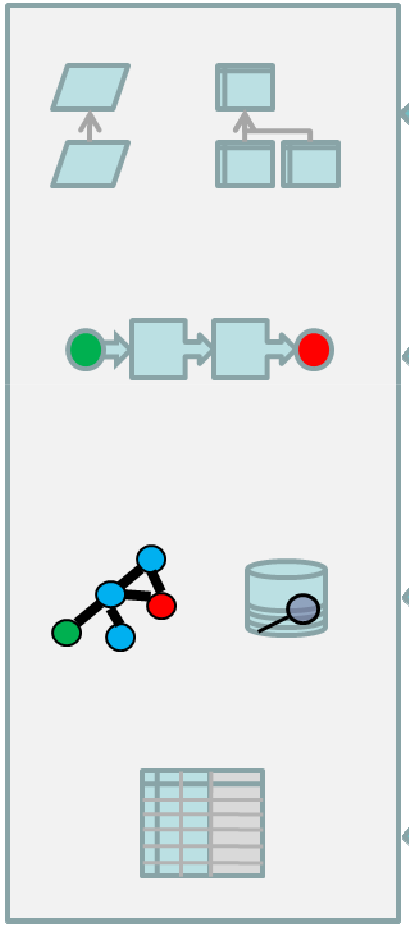
- Filter events
- Join events
- Events can be across time
- Events can be aggregated
- Events can be ordered



# CEP, a “technology”



# CEP = various technology components



**event definition:**
events and concepts

**Relationship rules**

**entity lifecycle:**
states

**State transition rules**

**event processing:**
rules and queries

**Pattern matching rules**

**decision processing:**
decision tables

**Reaction / decision rules**

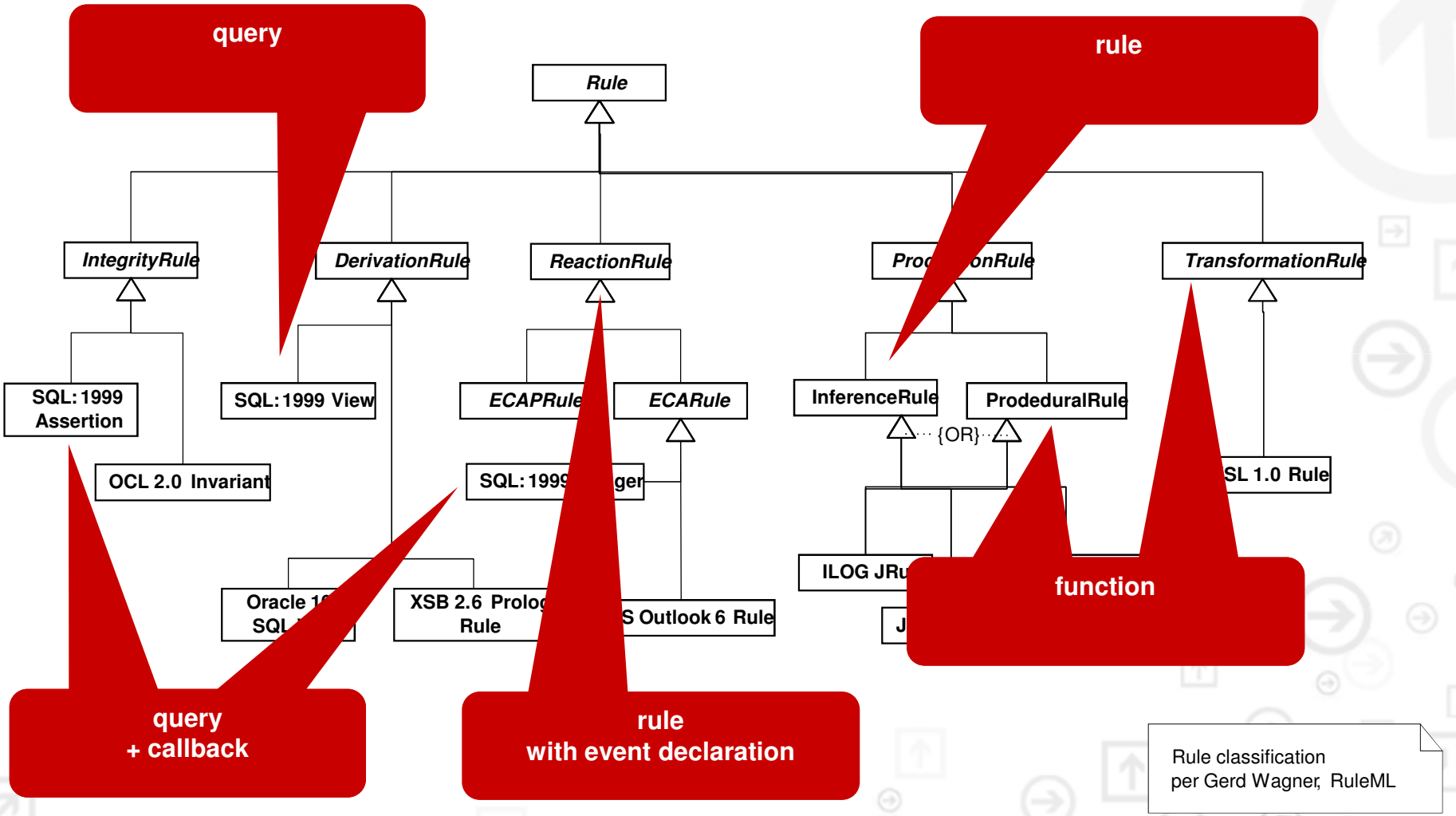
# Rule =

- <conditions> → result

- Logic: <conditions> → inferred fact
- Constraint: <conditions> → constraint satisfaction fact
- Data relationship: <ownership> → relationship fact

- Production: <conditions> → action
- ECA: <event conditions><conditions> → action
- State model: <state><event><conditions> → new state
- Query: <conditions> → resultset
- "CEP": <event><state><conditions> → new state

# Rule types: per RuleML as used in CEP




Rule classification
per Gerd Wagner, RuleML



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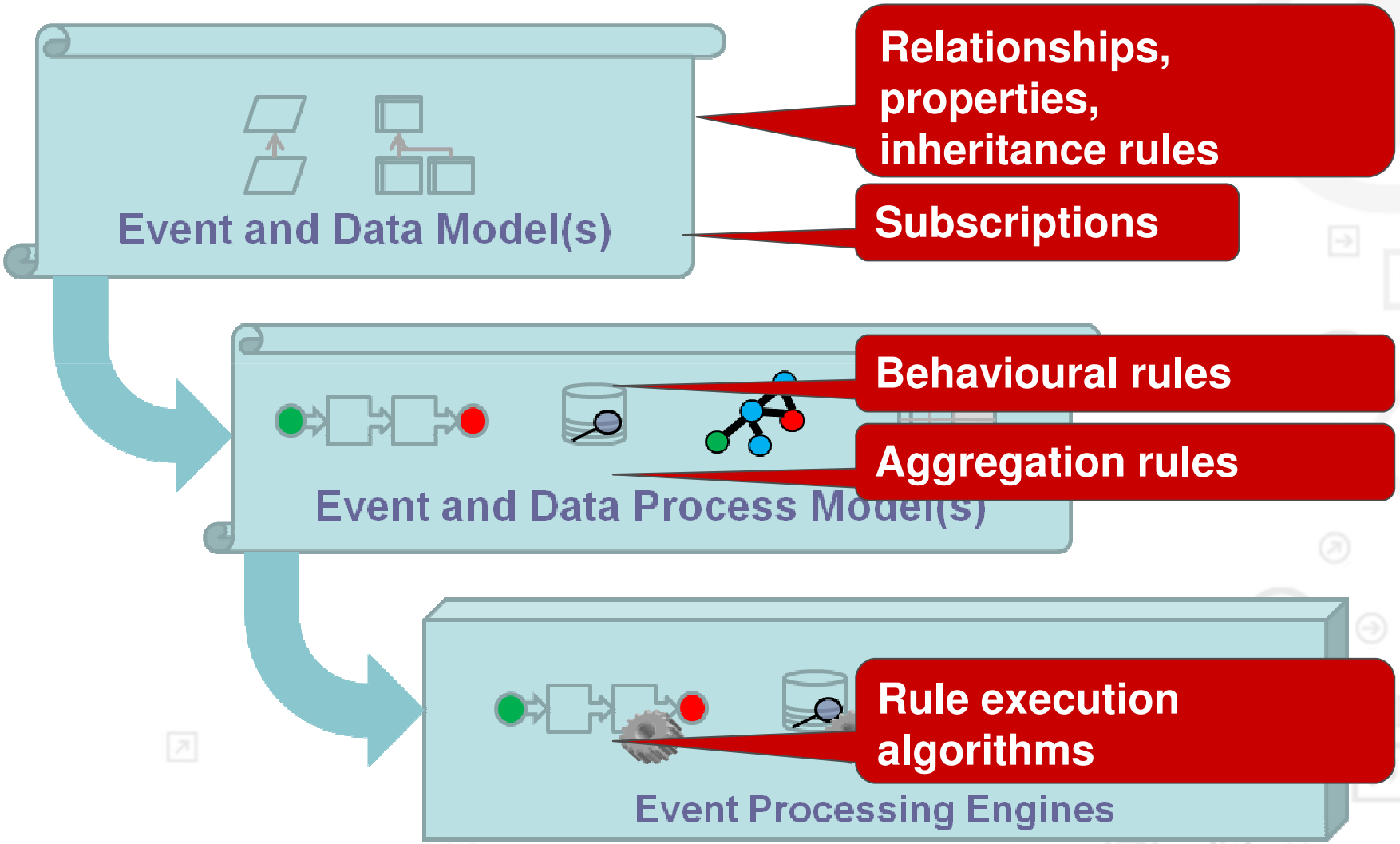
# EPTS Glossary: on Rules

- **Constraint** (also **event pattern constraint**): A Boolean condition that must be satisfied by the events observed in a system.
  - *Examples:*
    - A service level agreement limiting the time taken to complete a mortgage transaction from the time an application is received.
- **Rule** (in event processing): A prescribed method for processing events.
  - *Examples:*
    - Whenever three timeouts have happened send an alert to the network manager.
    - If more than ten shopping carts have been active for more than five minutes then activate the website reaction time monitor and display an amber alert on the dashboard.
    - Whenever IBM trades 2% above its 1 hour VWAP and then within 15 minutes trades 5 points below then buy 1000 shares IBM.
  - *Notes:* Event processing rules may be prescribed in many different ways, including by finite state machines, activity diagrams, Java code, SQL code, ECA (event-condition-action) rules or reactive rules that are triggered by event patterns.
- **Event pattern triggered reactive rule**: a rule that prescribes actions to be taken whenever an instance of a given event pattern is detected.

# CEP = a process involving rules



# Example: Rete-driven Production Rules

- **Scope / declaration**
  - Classes / Events relevant for the rule
- **Condition**
  - Filters on
  - Joins acr
- **Actions**
  - What to do for each of decl that satisfies the conditions…
- **Inference** ed

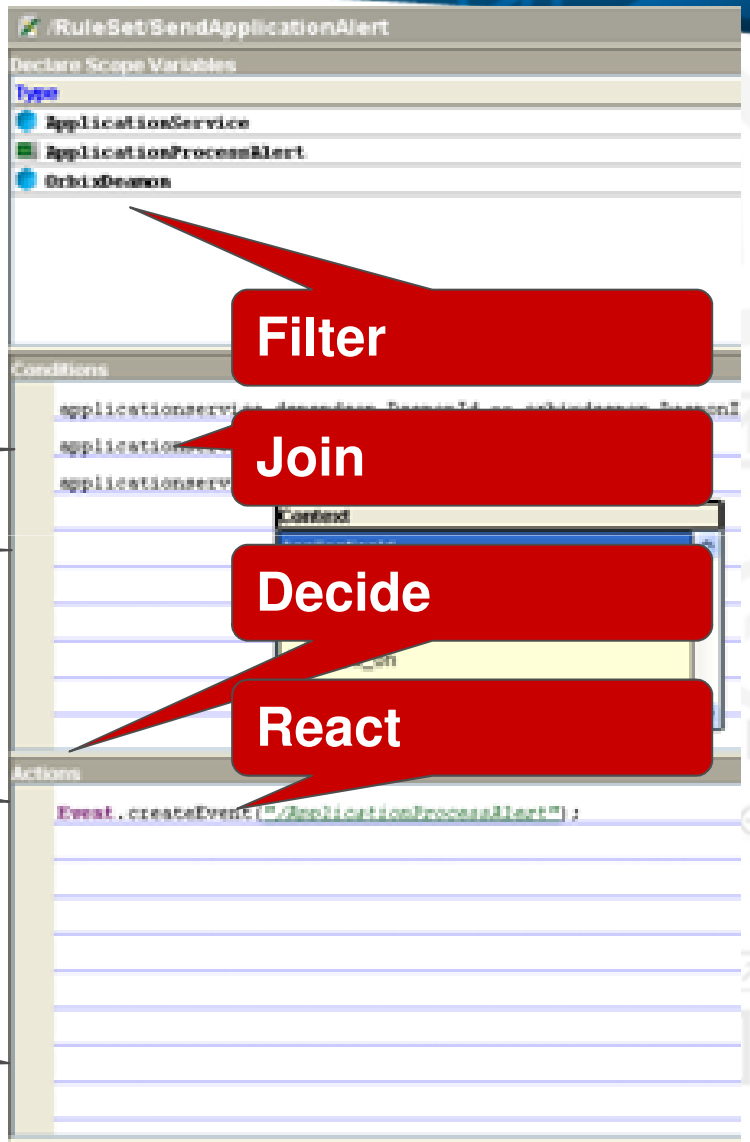
**Declarative**

**Performance**

**Scalable...**

**Inference = knowledge**

**Event-by-event but not set semantics**



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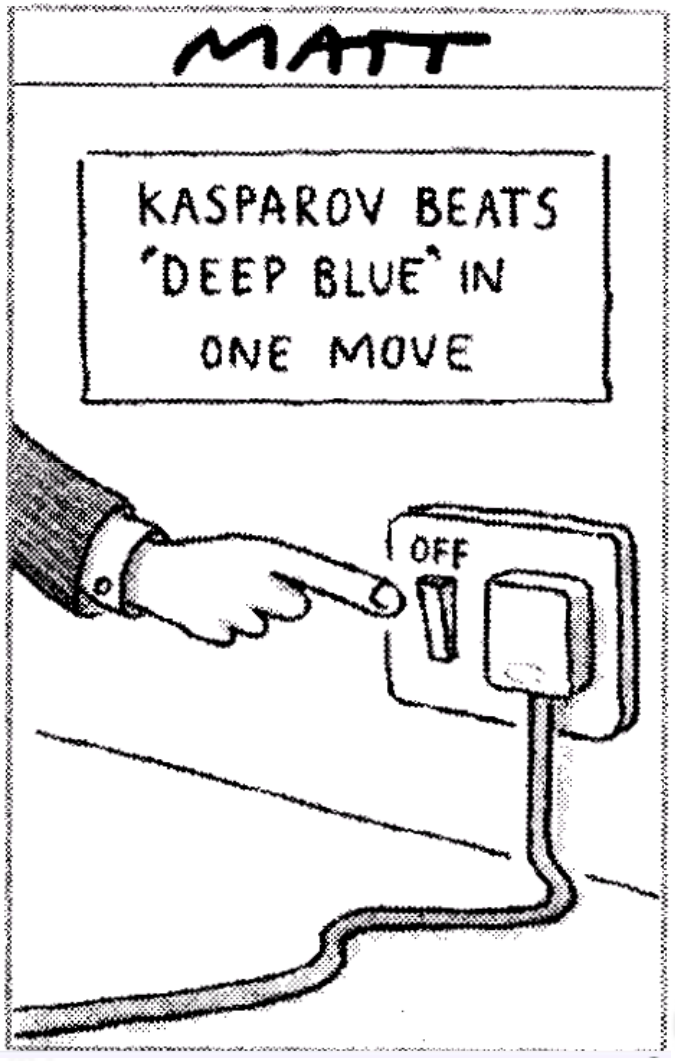
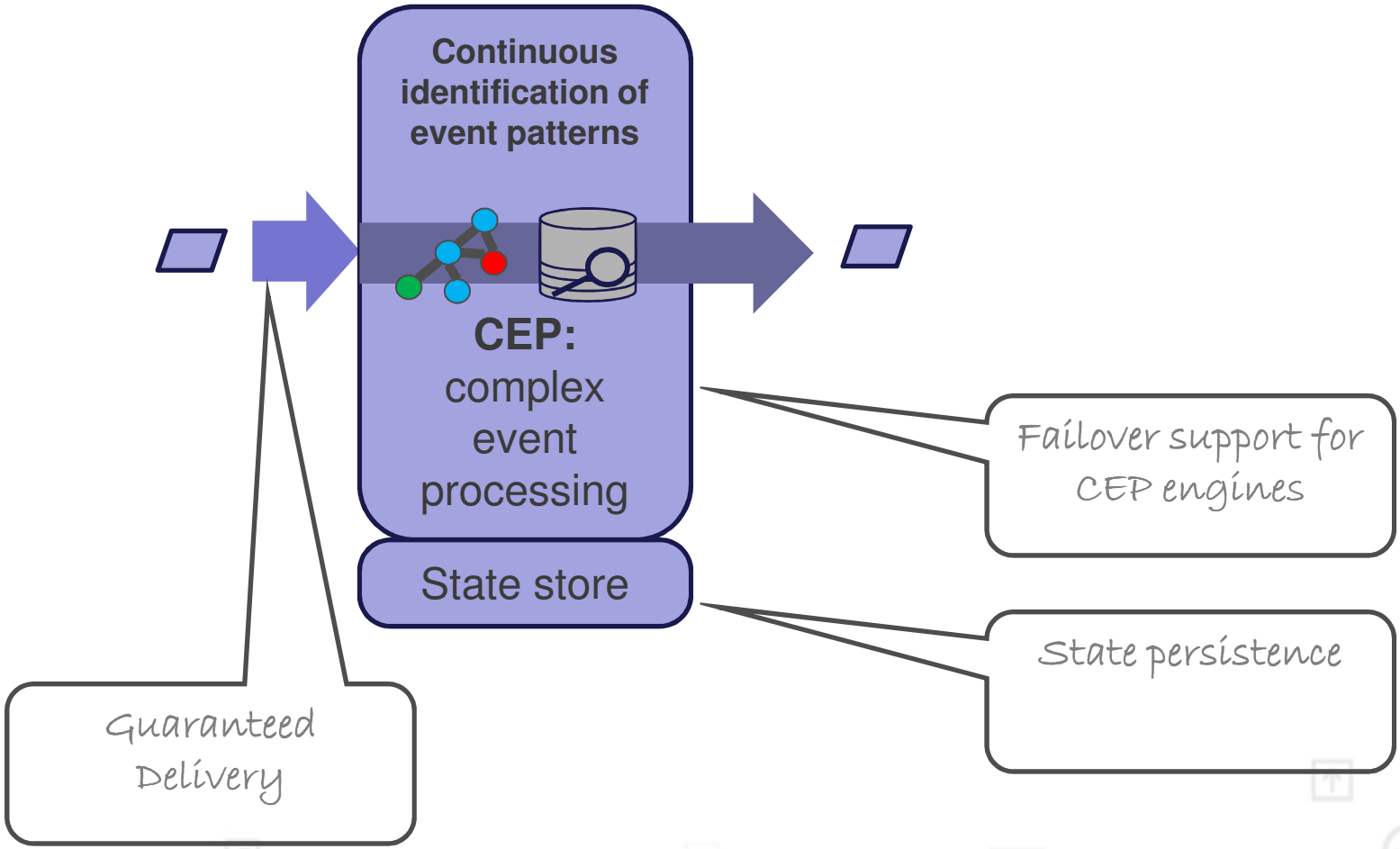
# What do CEP rules require?

# CEP Rules need to handle temporal logic



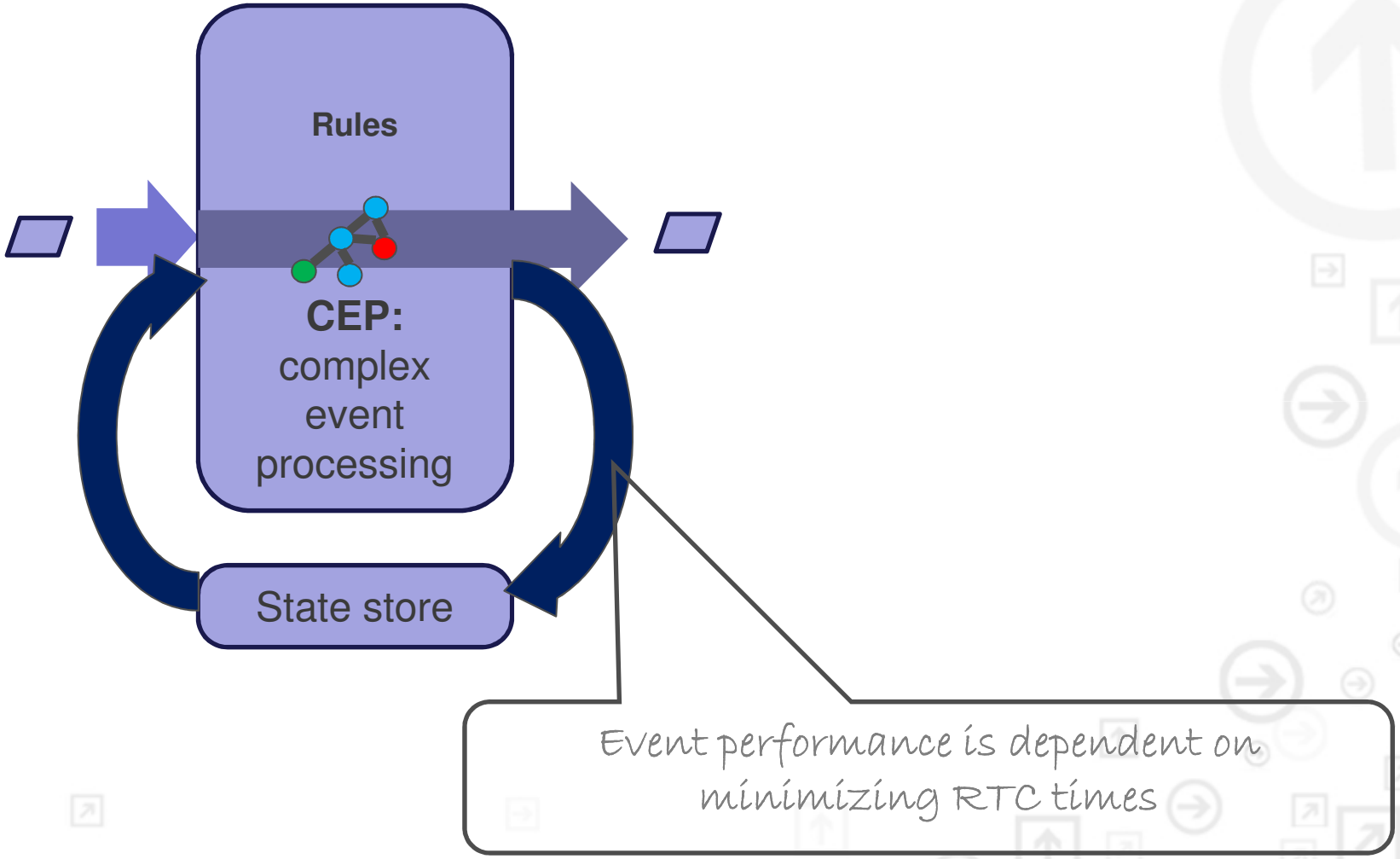
# CEP is a Stateful process



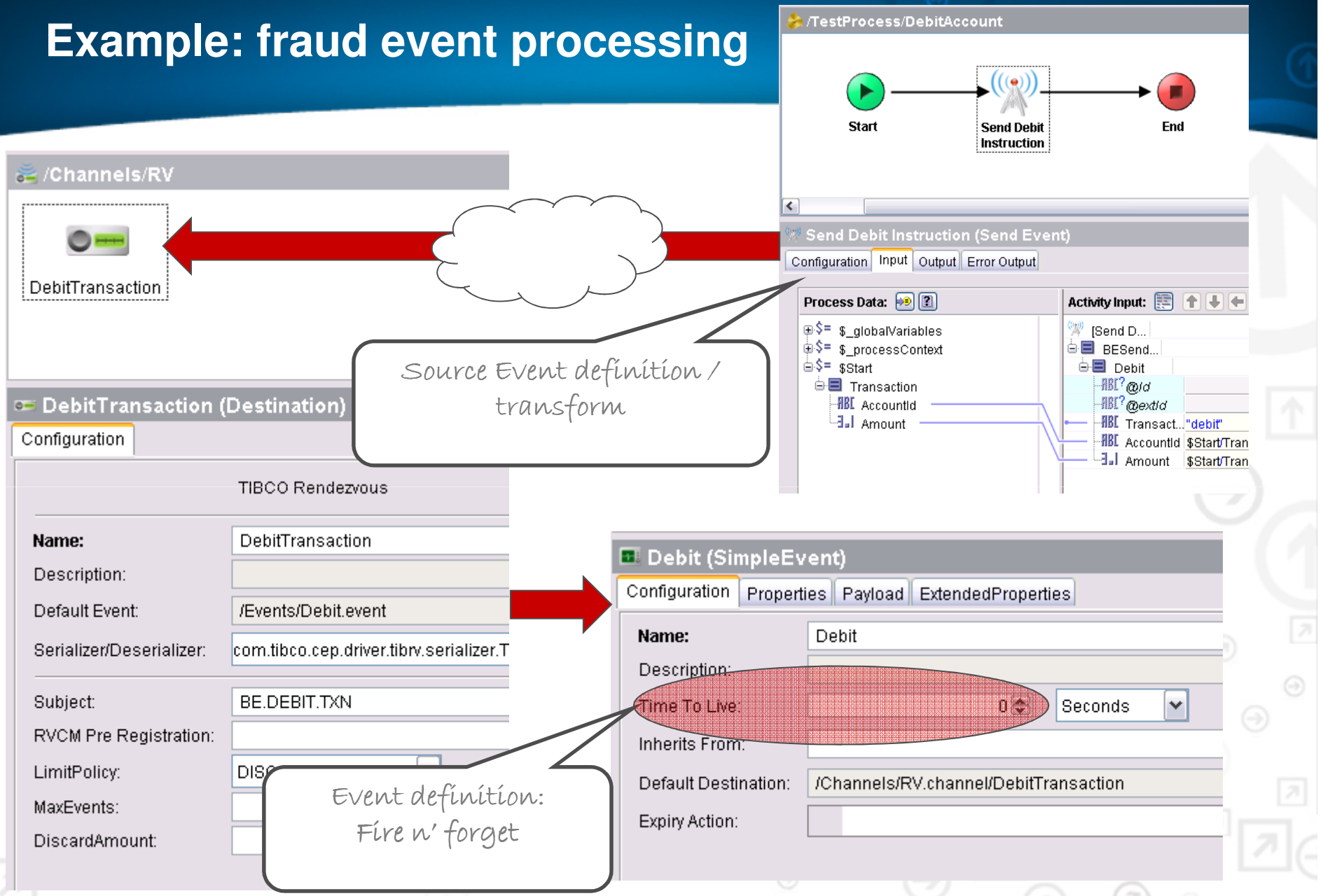
# Example Rule Types

- **Basic:**
  Condition-Action
- **Triggers:**
  Event-Condition-Actio
- **Timers/schedulers:**
  TimeUp-Action,
  TimeInterval-Action
- **Event lifecycle:**
  TimeToDie-Action

# ... also Low latency, Scalability



# Example: fraud event processing



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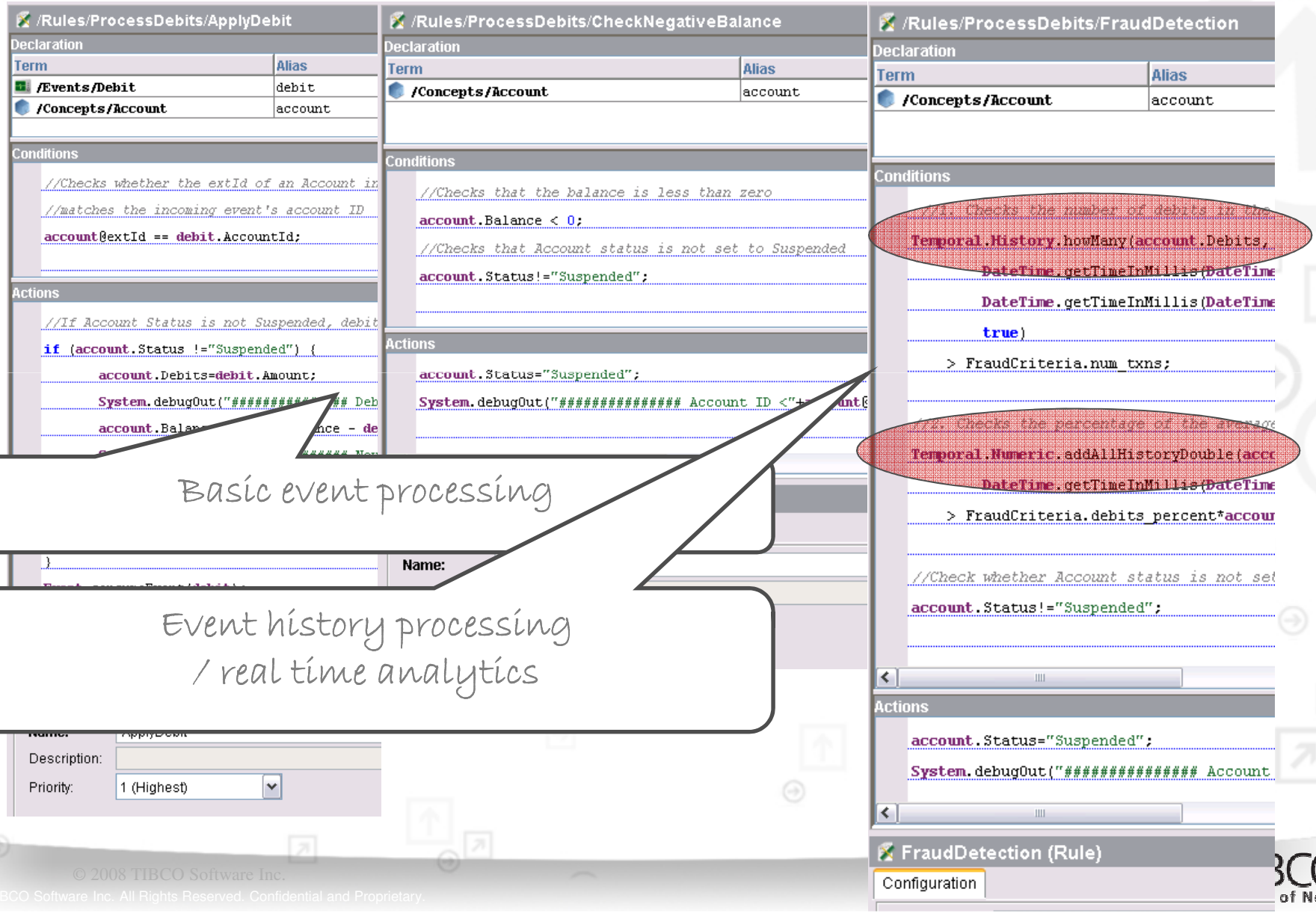
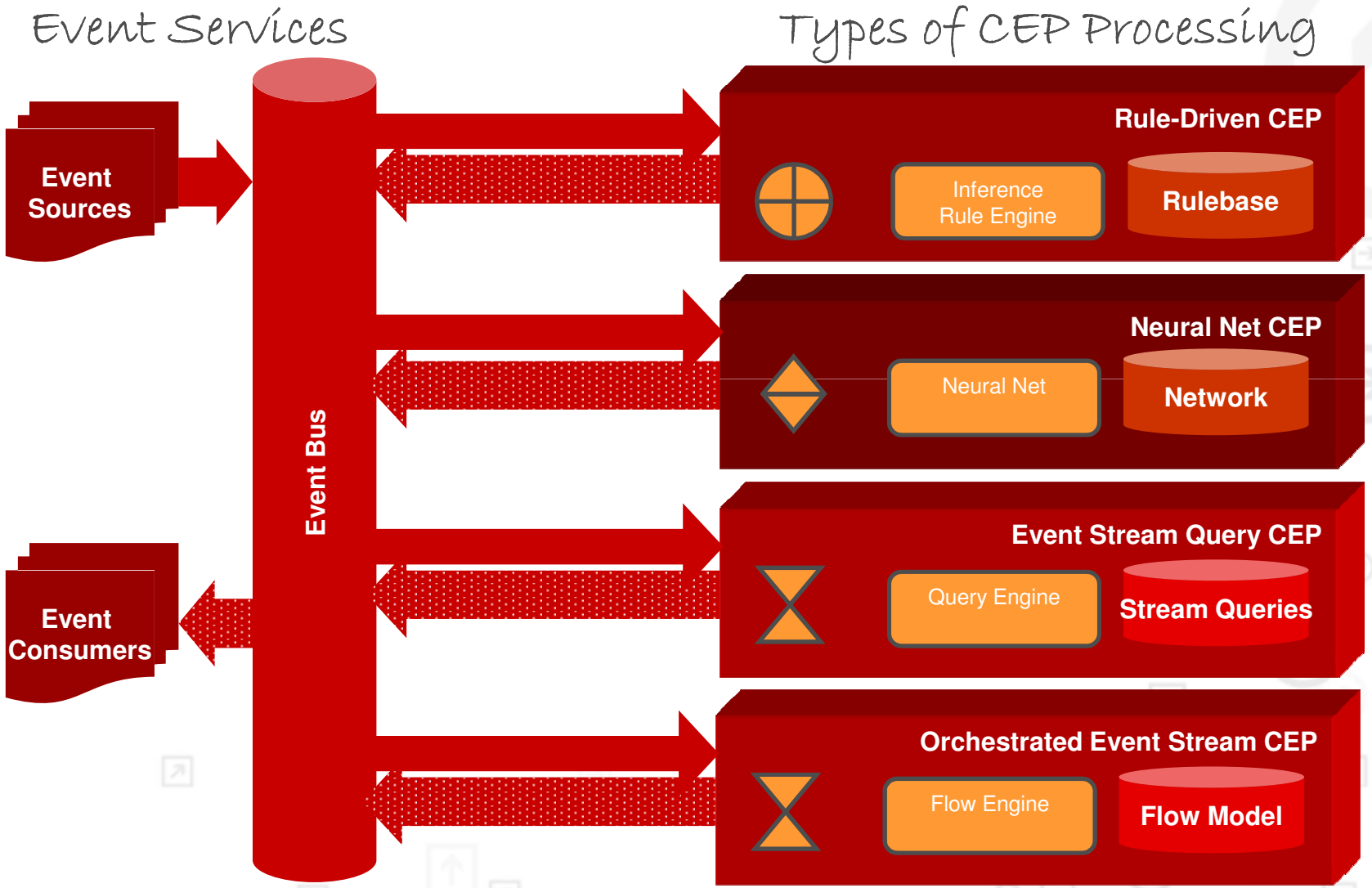
# Example: fraud event processing rules

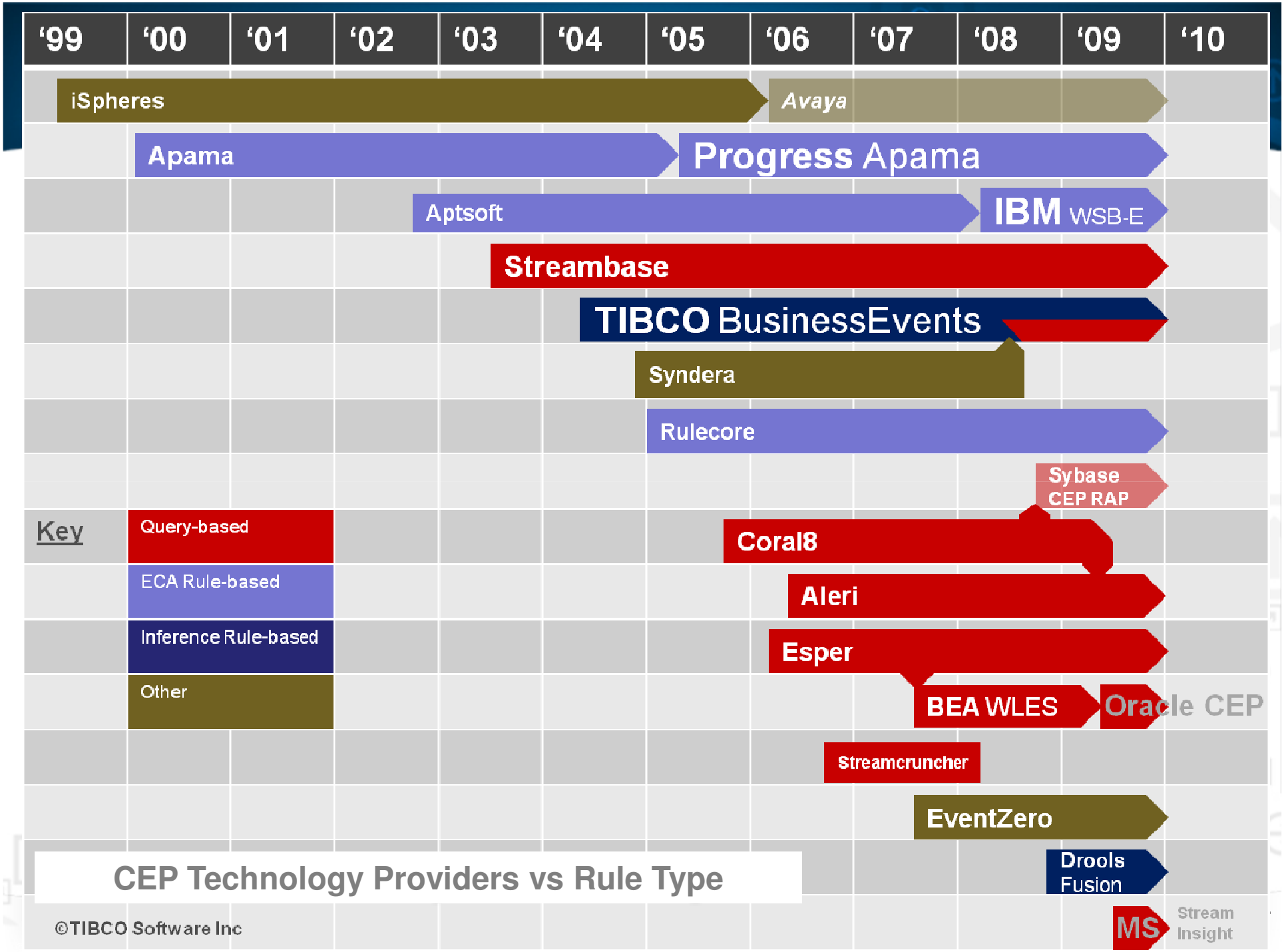


# Alternatives to rules in CEP?

# Some things are not meant to be

# Example CEP Technologies

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Progress Apama
Aptsoft
IBM WSB-E
Streambase
TIBCO BusinessEvents
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Rulecore
Sybase CEP RAP
Key
Query-based
ECA Rule-based
Inference Rule-based
Other
Coral8
Aleri
Esper
BEA WLES
Oracle CEP
Streamcruncher
EventZero
Drools Fusion
MS Stream Insight
CEP Technology Providers vs Rule Type
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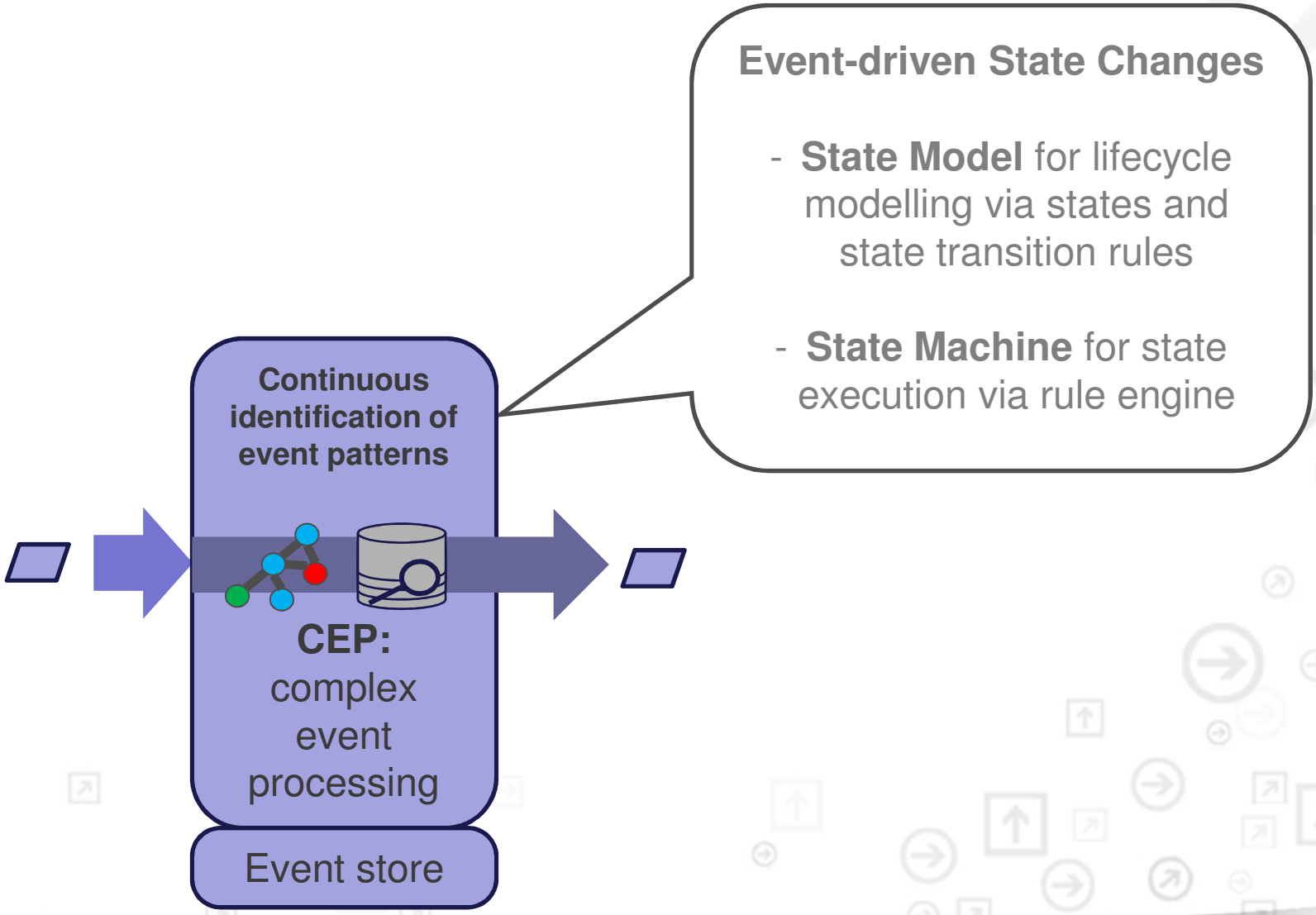
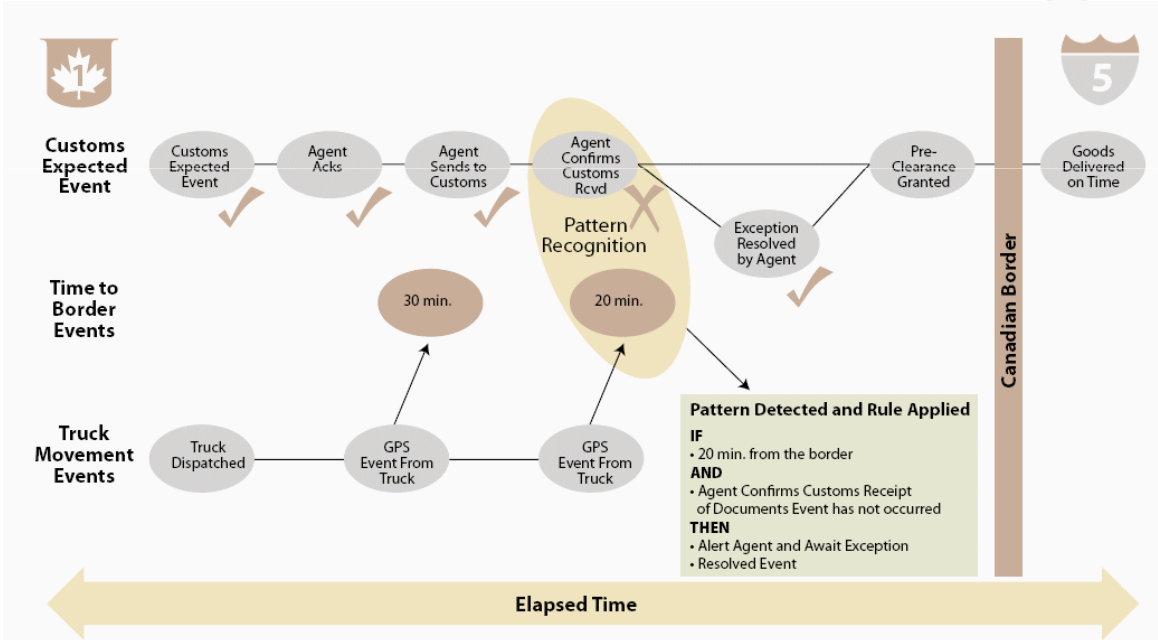
# Patterns in CEP: event lifecycles via states



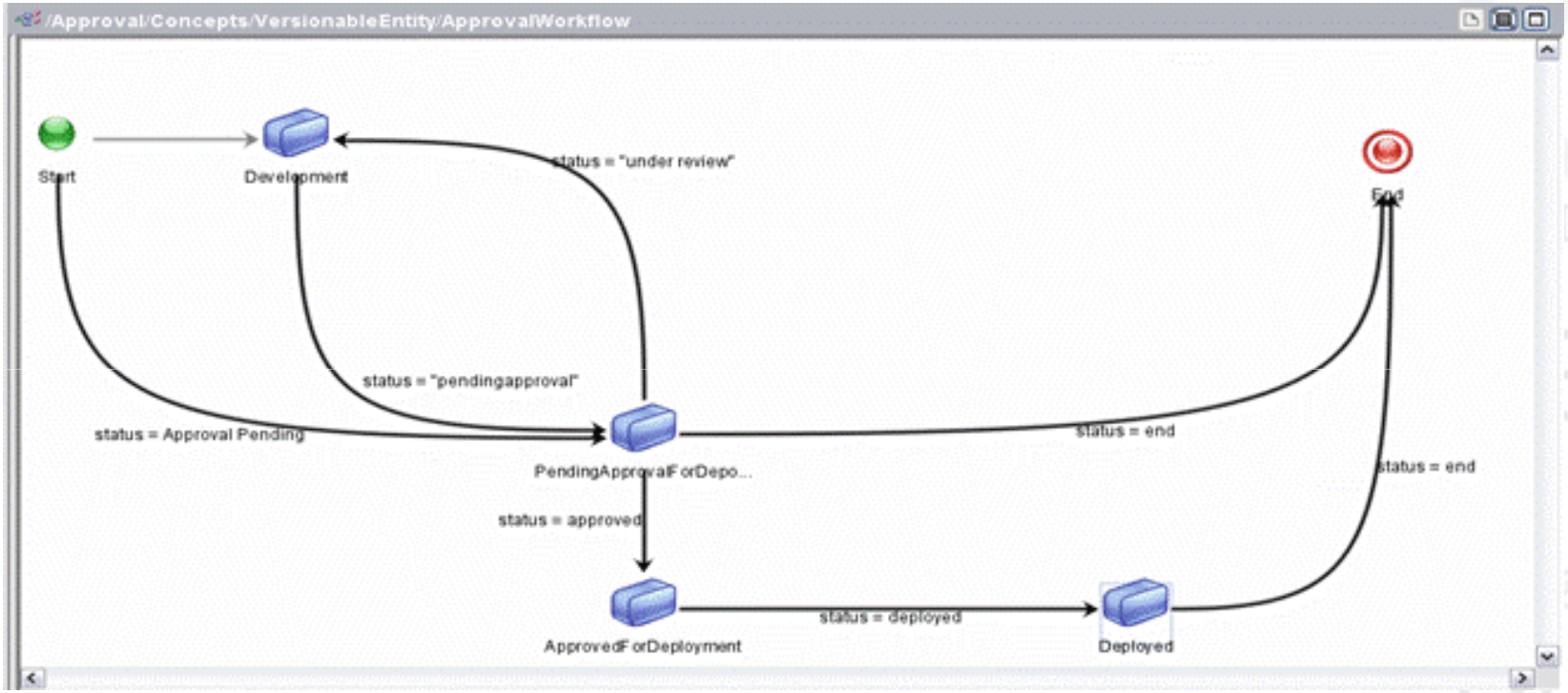
# State Model advantages

1. **Visual modeling metaphor**
   - State diagram / flow diagram is simple to follow
2. **State / flow transitions can be time-related**
   - Can model missing events through time-outs etc




This yields significant savings by eliminating driver man hours wasted waiting at the border. When a truck is dispatched, a conveyance report is transmitted to an agent. The truck's position is tracked via GPS events. When the truck is 20 minutes from the border, there must be a confirmation that customs has received the documents. If that hasn't occurred, an alert is sent to the agent and the problem is remedied before it can cause a costly problem, incurring fines and wasting man hours.

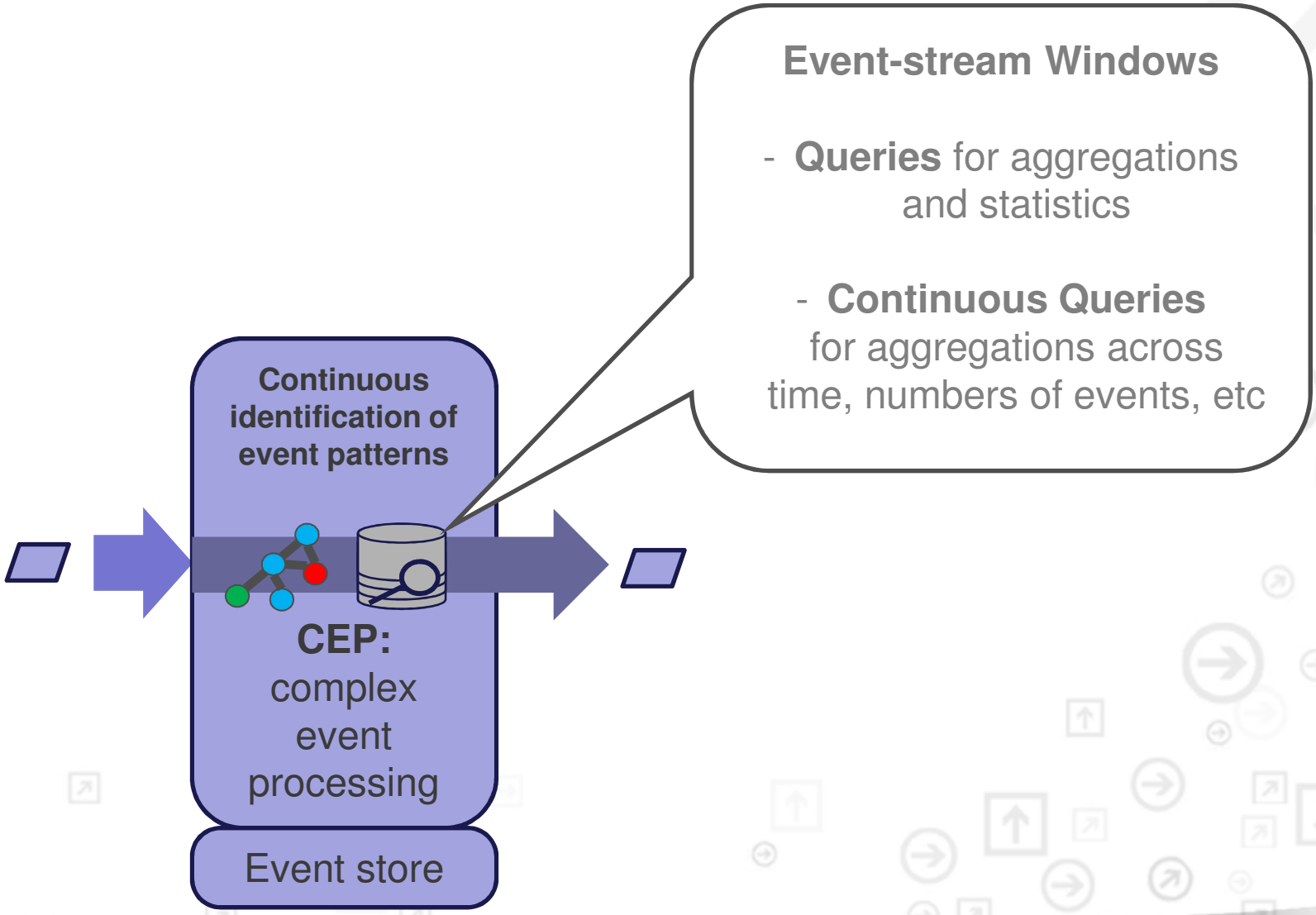
# Example: state of rule management...



# Example Rule Types (continued)

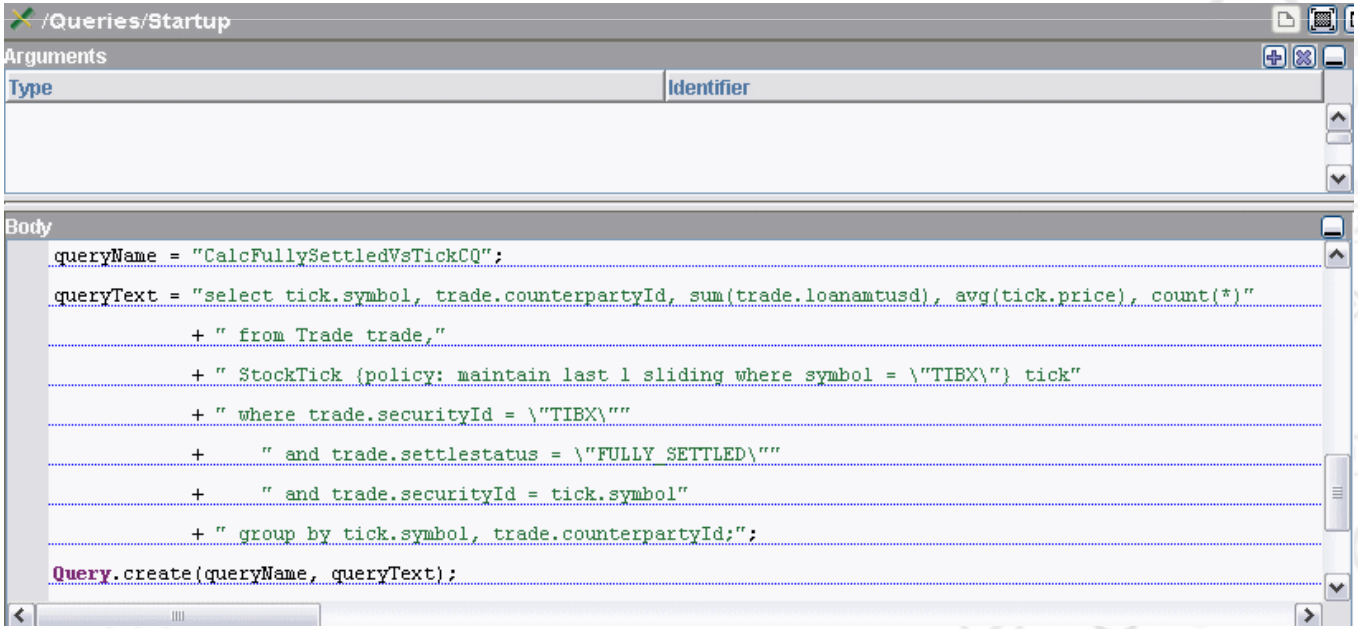
- **Basic:** Condition-Action
- **Triggers:** Event-Conditi
- **Timers/schedulers:** Tim
- **Event lifecycle:** TimeTo
- **State transition: Event-StateChange, Timeout-StateChange, StateEntry-Action, StateExit-Action**

# Patterns in CEP: continuous queries against streams



# Query advantages

1. **Query language**
   - Usually SQL-based – familiar to DB users
   - Result can be a derived event for other queries, rules etc
2. **Continuous operation**
   - Extensions support time windows for the query to operate over



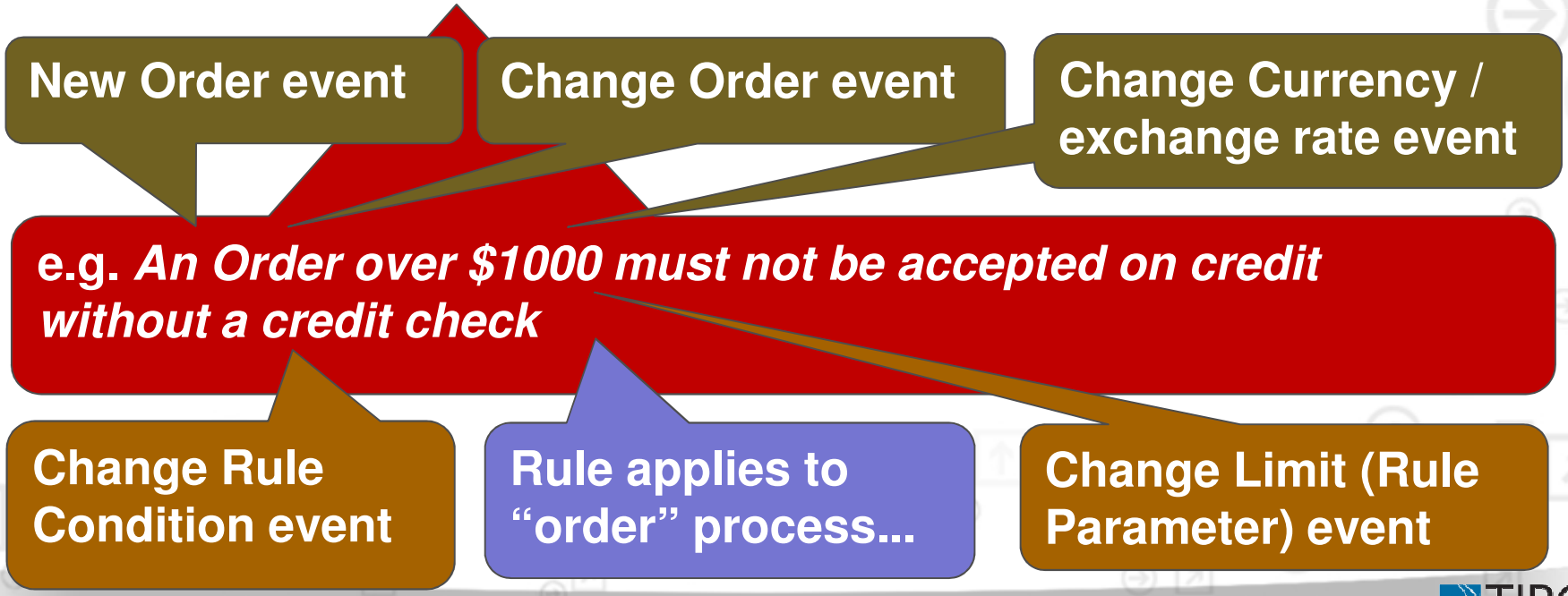
# Example Rule Types (continued)


- **Query:**
  Query-ResultSet-Action,
  Event-Query-ResultSetChange-Action

# CEP in Rules?

# Events are key to business rule enforcement / evaluation

- Business rules drive process definitions
- Business rules drive decisions made in business processes
- Mapping from business rules to processes and decisions is easier from an event perspective



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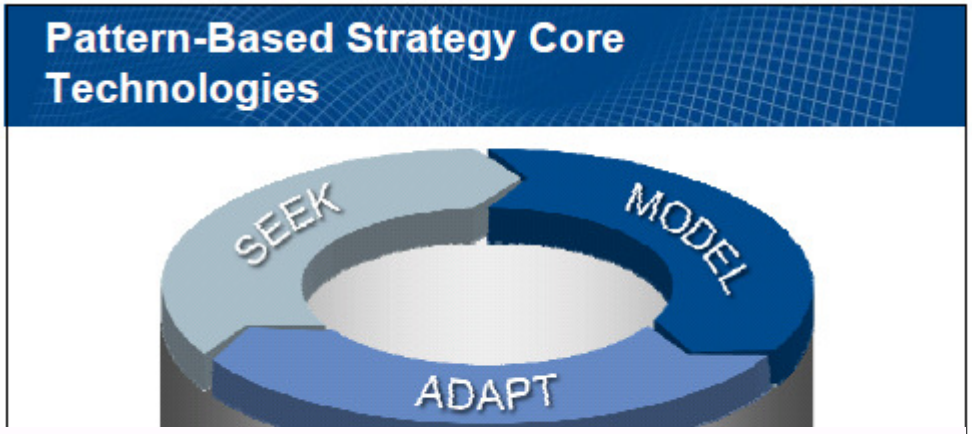
# Per Analysts, a Hot Topic




Wednesday | 8:00 AM – 9:00 AM | Breakfast with the Analysts Track

SESSION TITLE

The Difference between Complex Event Processing and Business Rules

SPEAKER(s):

Mike Gualtieri
*Senior Analyst*

Wednesday | 9:00 AM – 10:00 AM

KEYNOTE PRESENTATION

Keynote: BRMS at a Cross Roads: The Next Five Years

SPEAKER(s):

Stephen D. Hendrick
*Group Vice President, Application Development & Deployment Research*
IDC

MAIN FOCUS OF PRESENTATION: Business & IT
FAMILIARITY WITH SUBJECT: None

**"Saved my 401K by identifying an economic pattern via the metric of counting railway trucks"**

**"Future of business rules is CEP"**

**" DM platform needs data preparation and decision refinement and also state ie combining with CEP ... Why not bring them together in active on / always on rule processing? "**



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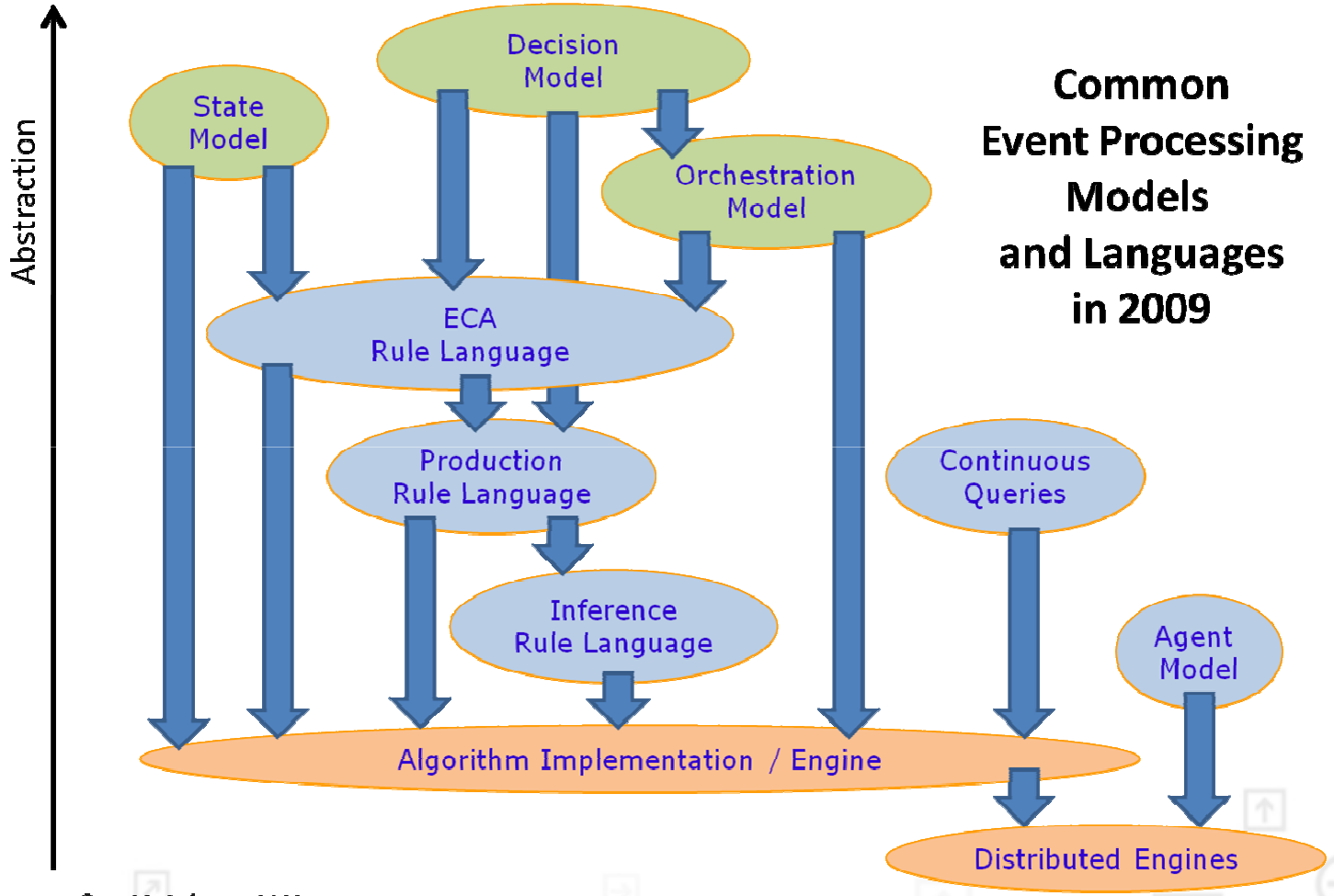
# Final Remarks

# Summary of Basic CEP Rule Types



# Concluding remark: Decisions are Event-Driven

## 'Dumb' American criminals attempt robbery with 'permanent marker pen disguises'

Two hapless robbers in America, Matthew McNelly and Joey Miller, have been arrested with the "worst disguises ever" after trying to hide their faces with permanent marker pen

By Andrew Hough
Published: 9:25AM GMT 30 Oct 2009

Matthew Allan McNelly and Joey Lee Miller were caught in Iowa with permanent marker pen scrawled over their faces. Photo: AP

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