

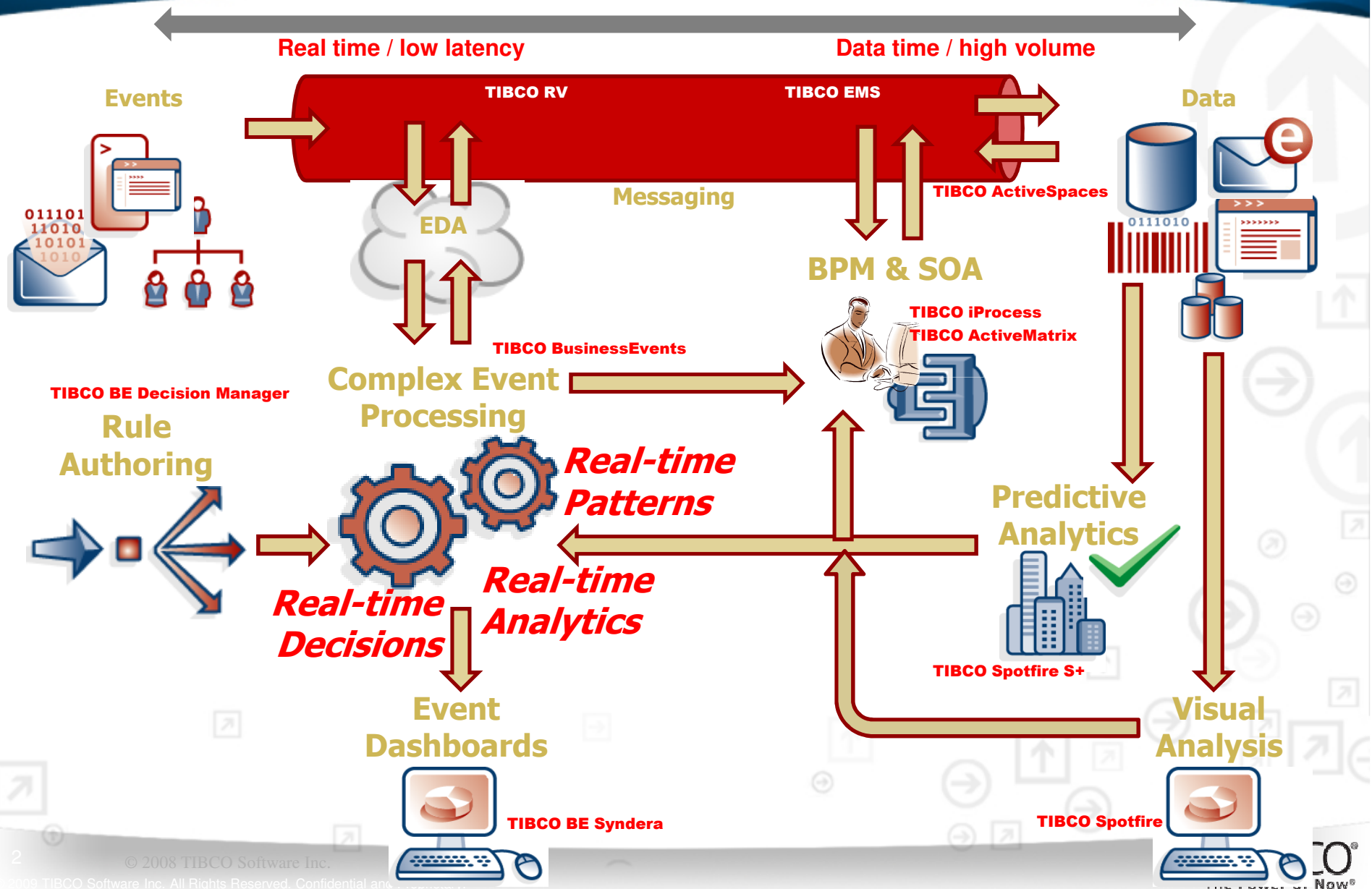
The Role of Rules in CEP

^ and vice versa

Paul Vincent,
CTO Business Rules and CEP, TIBCO Software



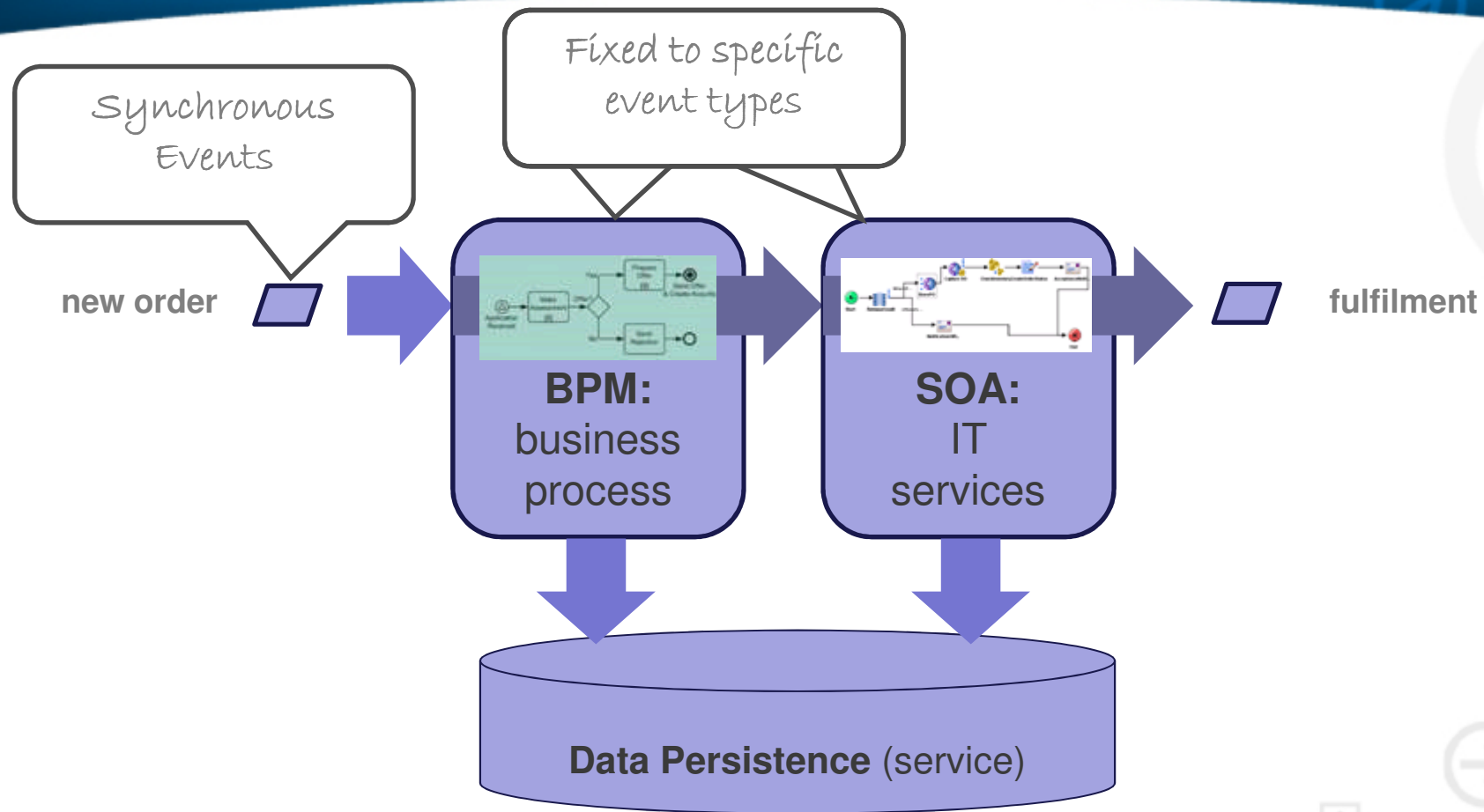
Introduction - TIBCO



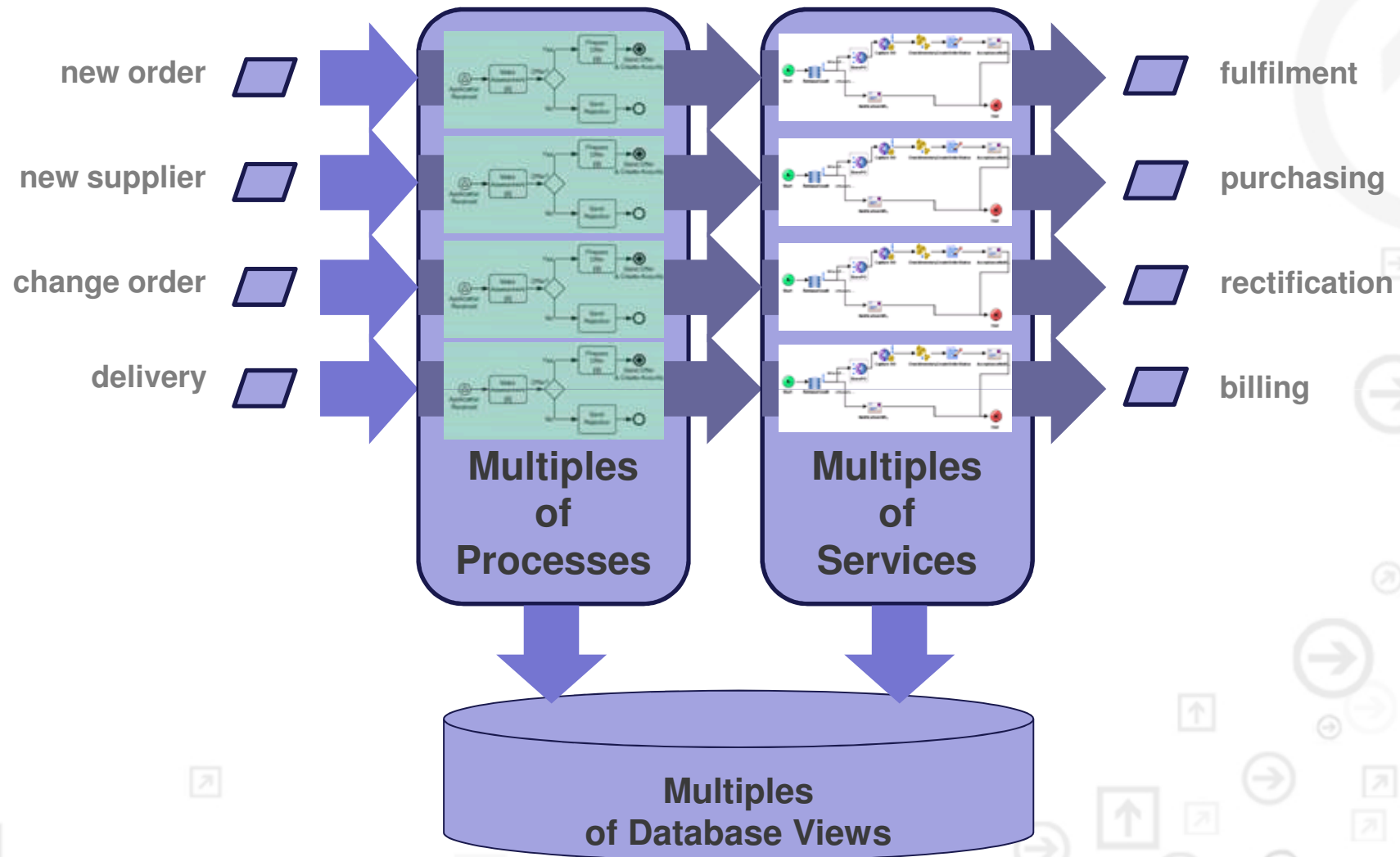


What is CEP?

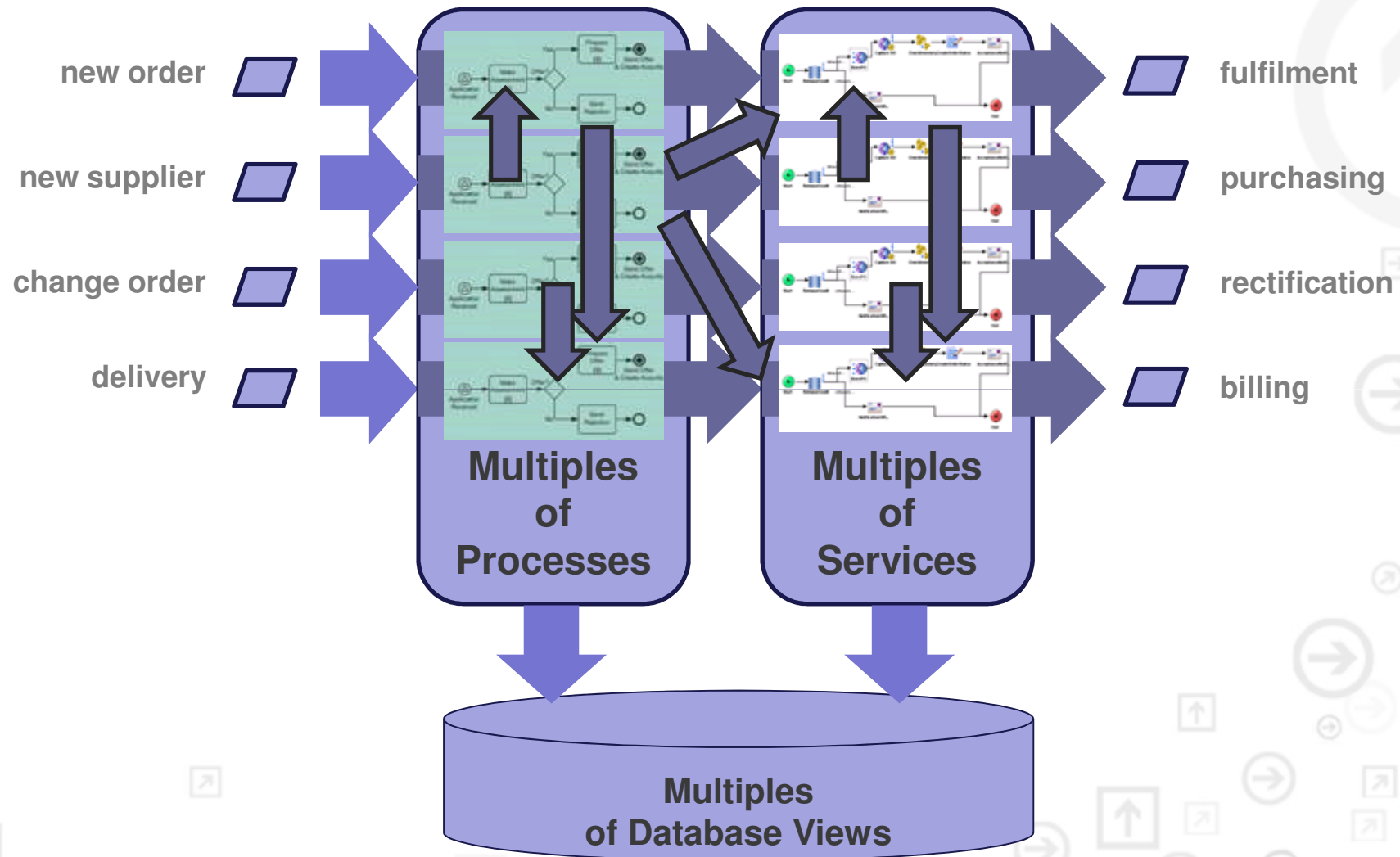
Simple Event Processing




Multiple Simple Event Processing



Multiple Simple Event Processing (theory)



Simple EP = default IT Model, 1950-now



**This model does NOT exploit
ALL the information / data / events
ALL the time**

Behaviour (and business logic) is silo'd

Real-world Events

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

**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**

**Employee
Over hours**

**Compliance
Limit
Approached**

**Cell phone
fraud alert**

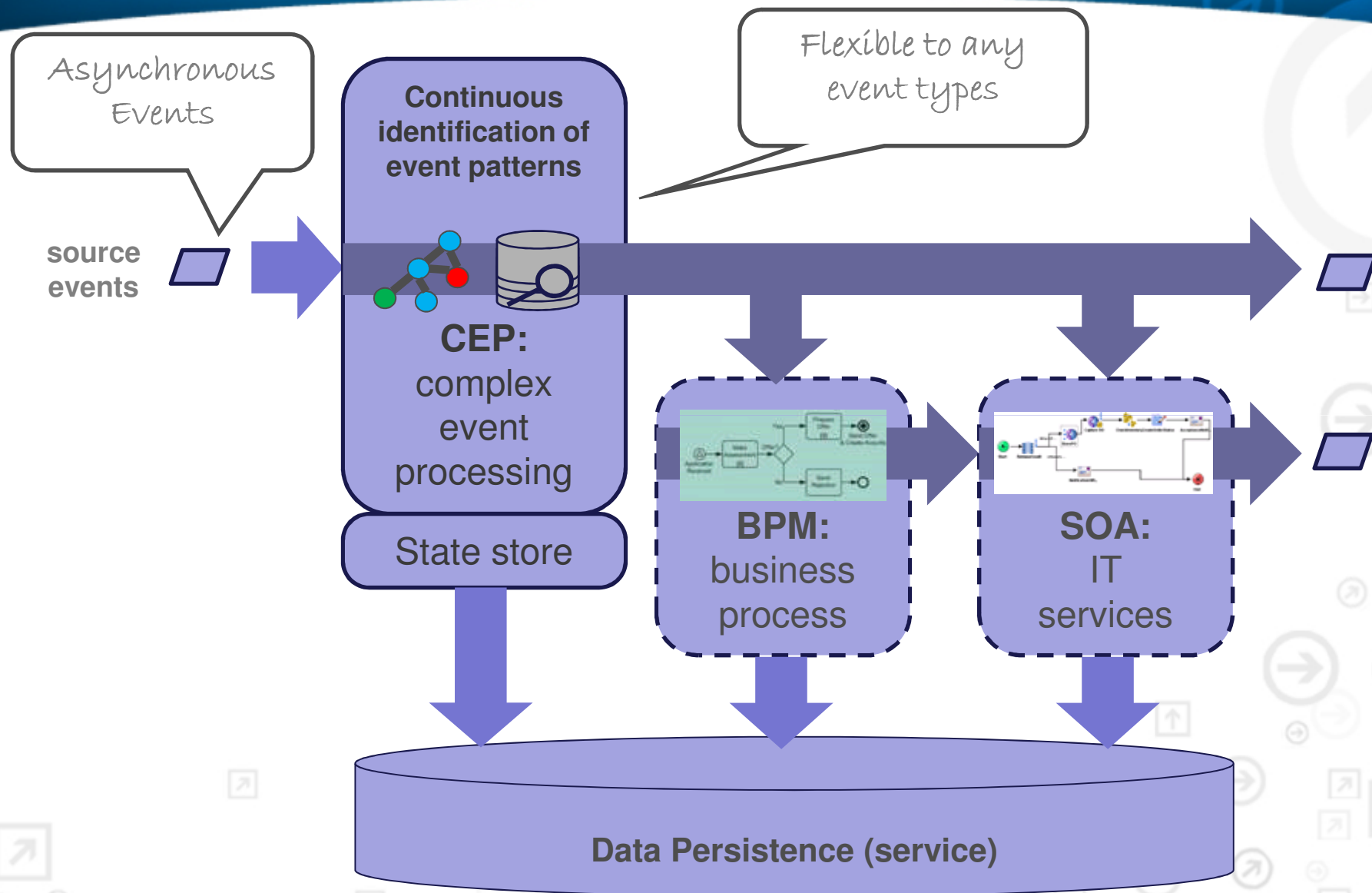
**Contract
Validated**

**Rental
Contract
Complete**

**Customer
now rated
Gold**

**Contract
Valid**

Complex Event Processing



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

OPPORTUNITY
HIDDEN
IN THREATS

CEP's terminology



Event Processing Technical Society

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Home Forum Document Management About Us

 <http://www.ep-ts.com/>

Categories

Documents

Order by : Name | Date | **Hits** | [Ascendant]

 ***EPTS Event Glossary latest version hot!*** 

Hits: 3325
Date added: 07/14/2008

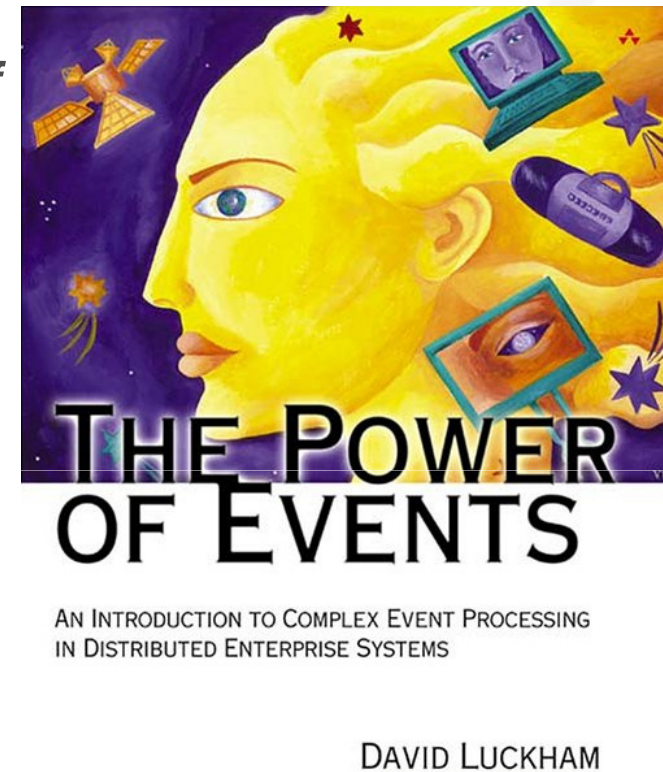
Event Processing Glossary is the latest official version of the Glossary of event processing terms for the Event Processing Technical Society. The Glossary was edited by David Luckham and Roy Schulte. This glossary covers a small set of basic terms related to event processing. It will be frequently updated with additional terms in response to suggestions from the event processing community for improvements and additions. Our approach is to define each term independently of any particular implementation, product, or domain of application.

[Download](#) [View](#) [Details](#)

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



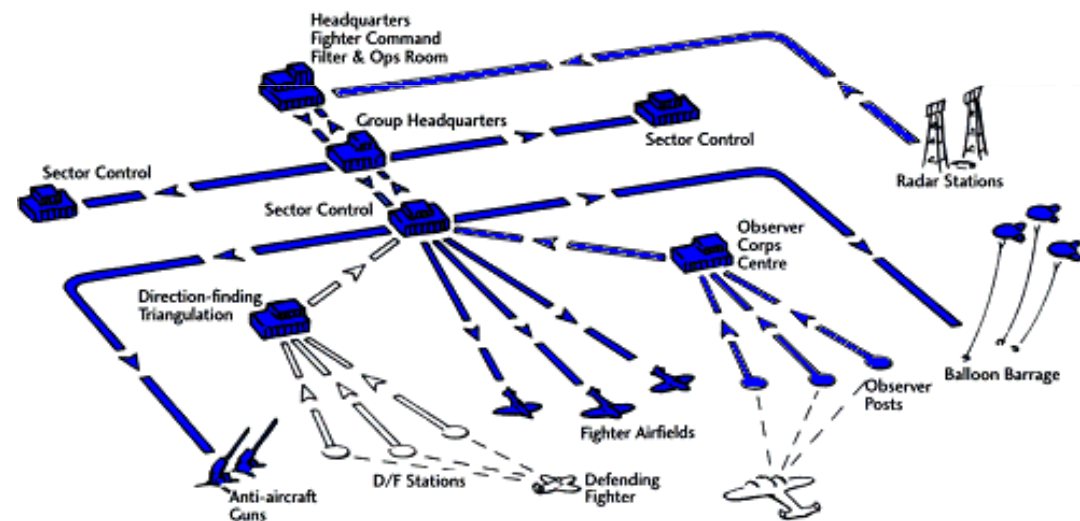
The Power of Events, Addison Wesley, ISBN: 0-201-72789-7, 2002

Historic Background to CEP

Command and Control

□ Command and Control

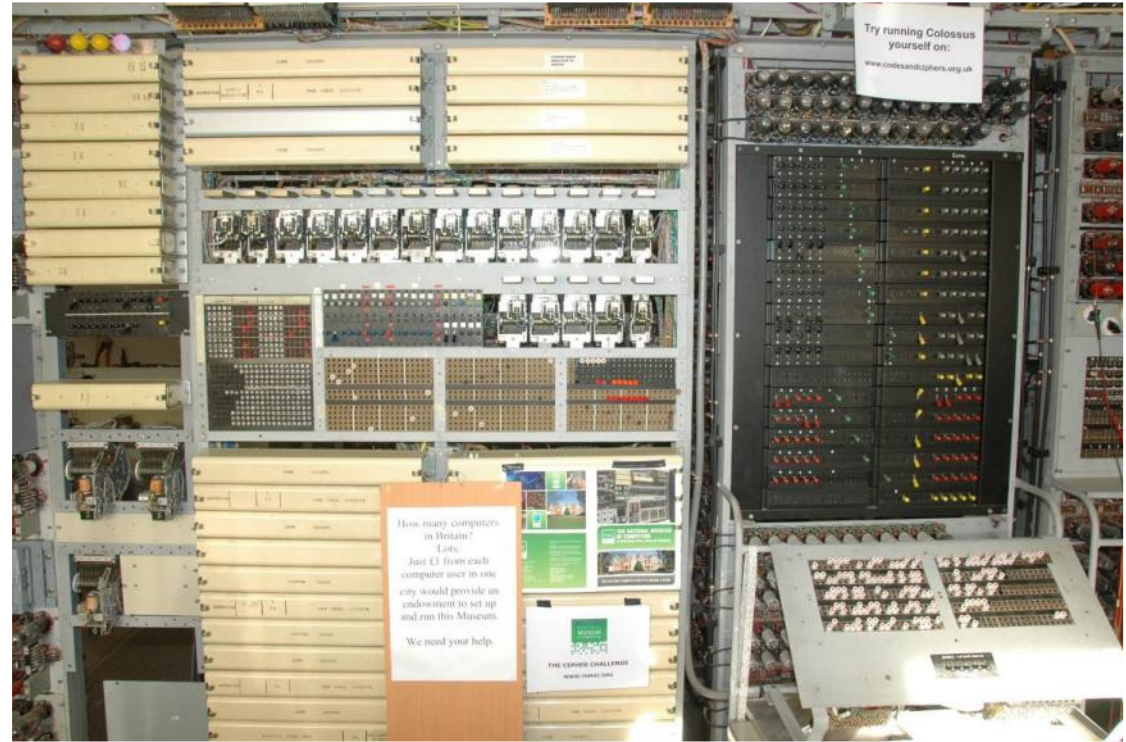
- Correlate all available information
- Determine tactics based on strategy and up-to-date information



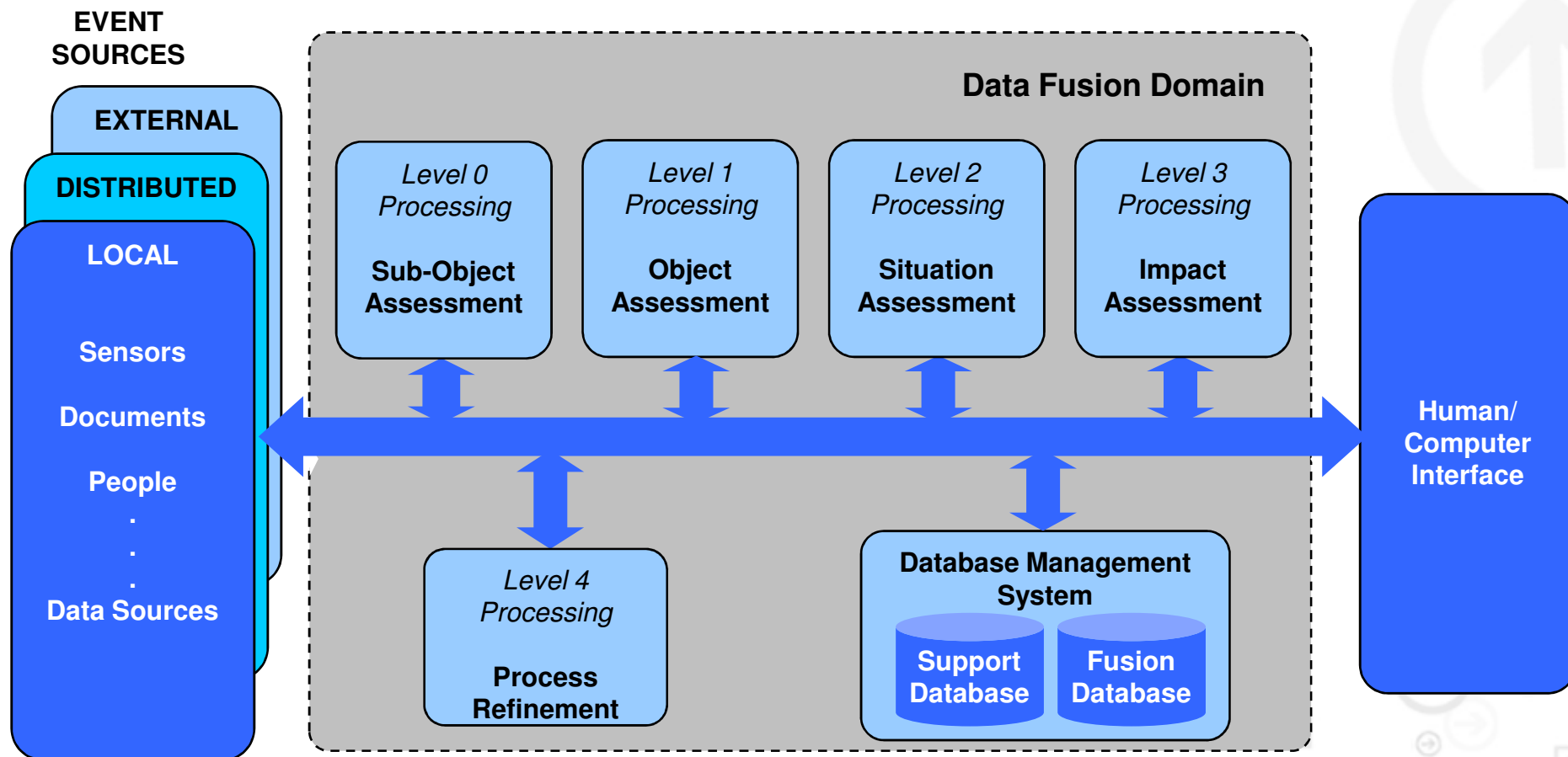
-- from RAF Battle of Britain Fighter Control System 1940

Message process automation

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



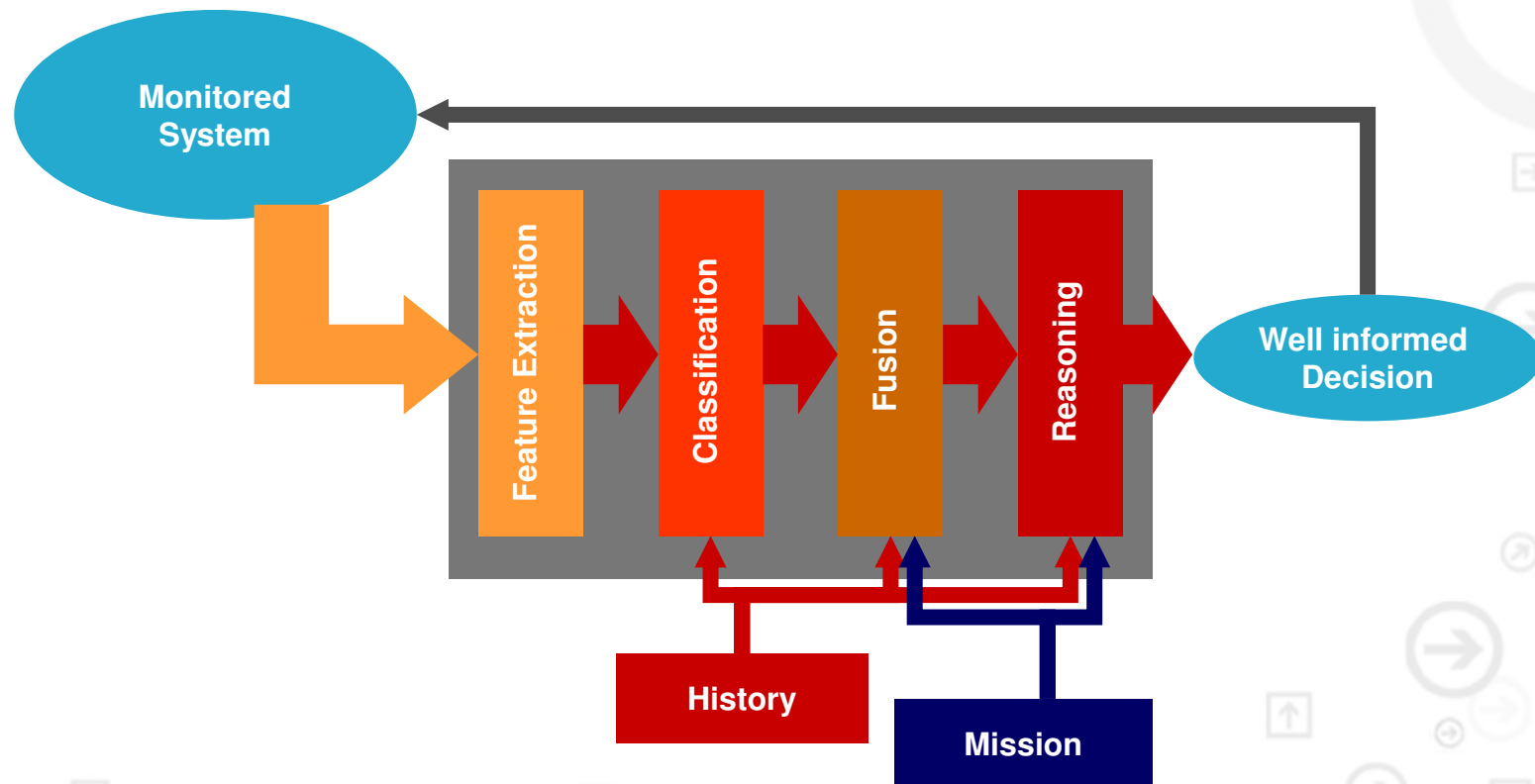
Data Fusion



-- 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

**Military,
Logistics etc
systems**

*High cost / analog
Low re-use*

**Financial investment
etc
systems**

*High cost
High value*

**Commercial
systems**

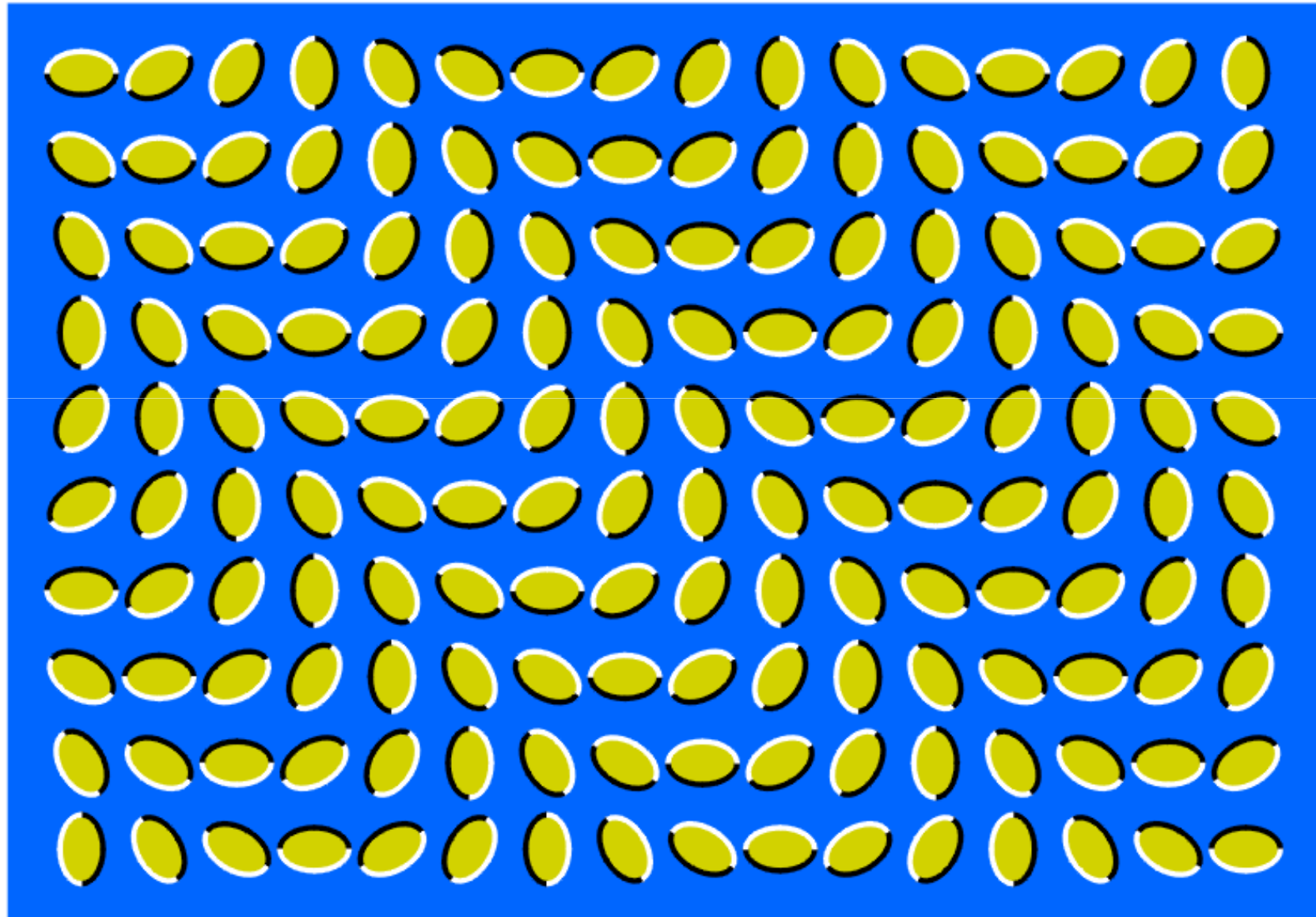
*Lower cost
ROI*

**Generic CEP
tooling**

**Custom CEP
implementations**

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?

Relevant event of interest



□ 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

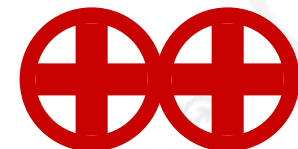
- Product item X arrives at Production station S from Store T
- Production worker Y arrives at Production station S
- Production contract for item Z by time T is posted

□ 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

Incident

Observation

IT 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

Queries, rules

Event Store, State

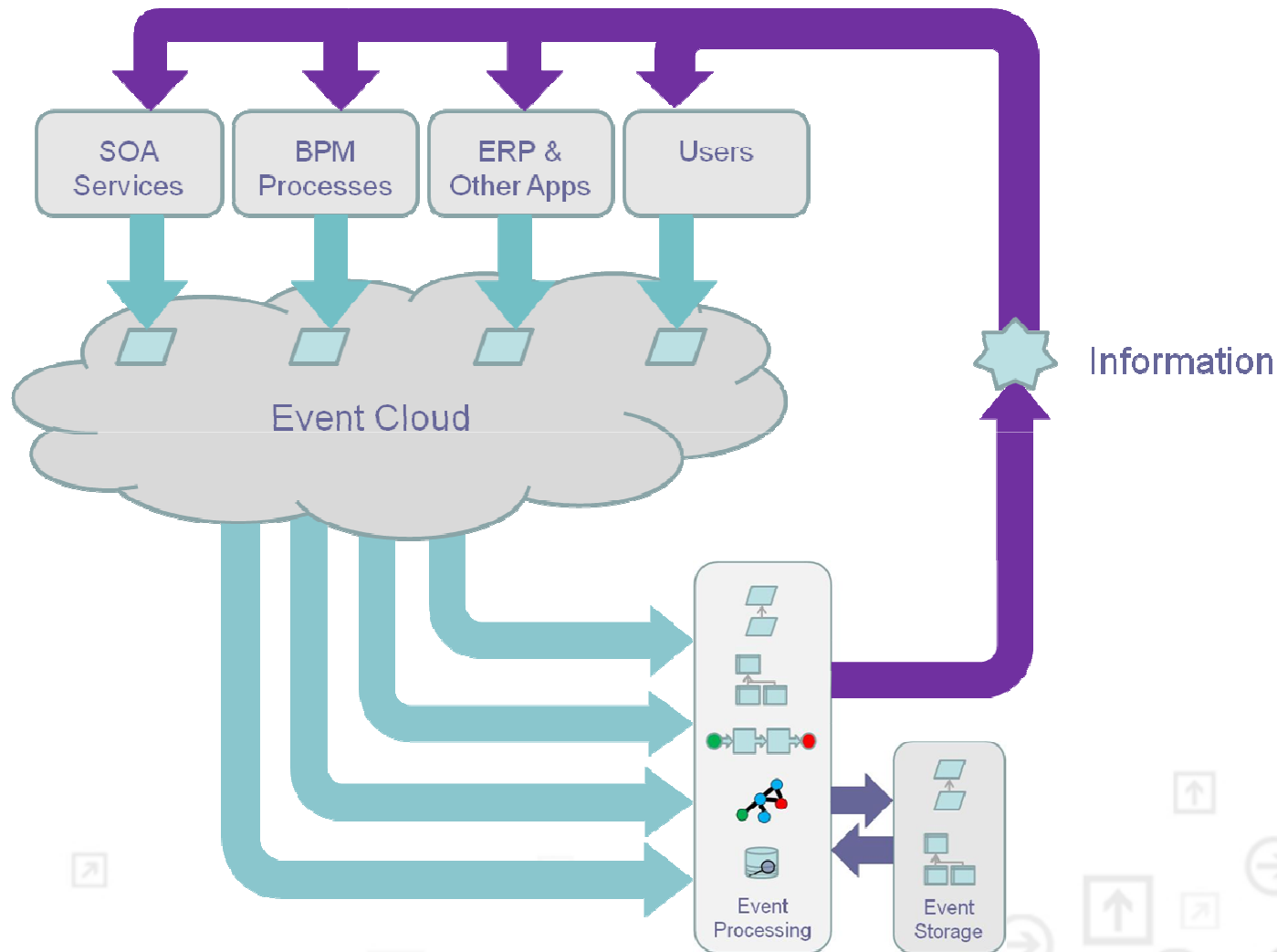
State

Collections

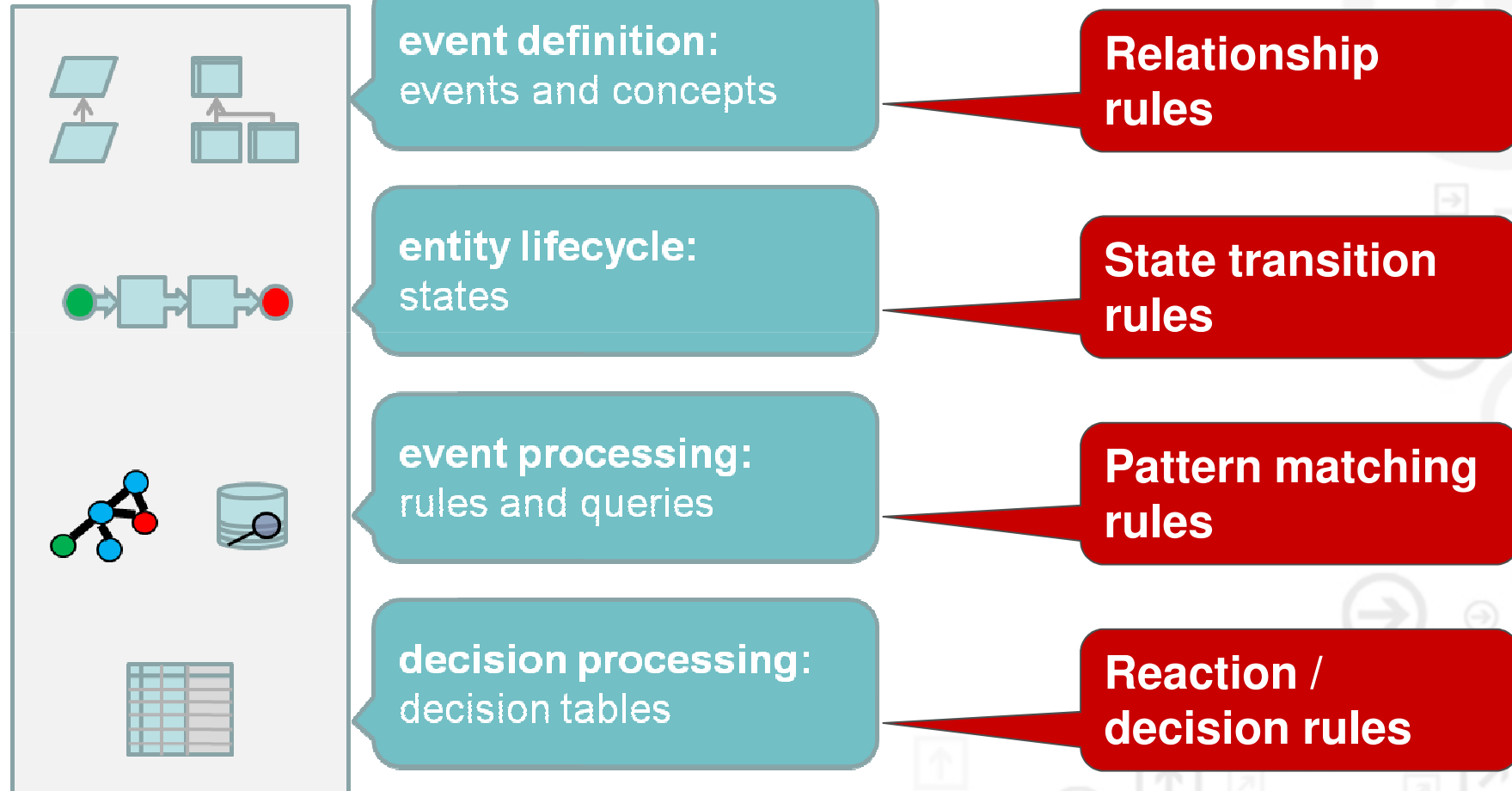
OO paradigms / facts

Queuing etc policies

CEP, a “technology”



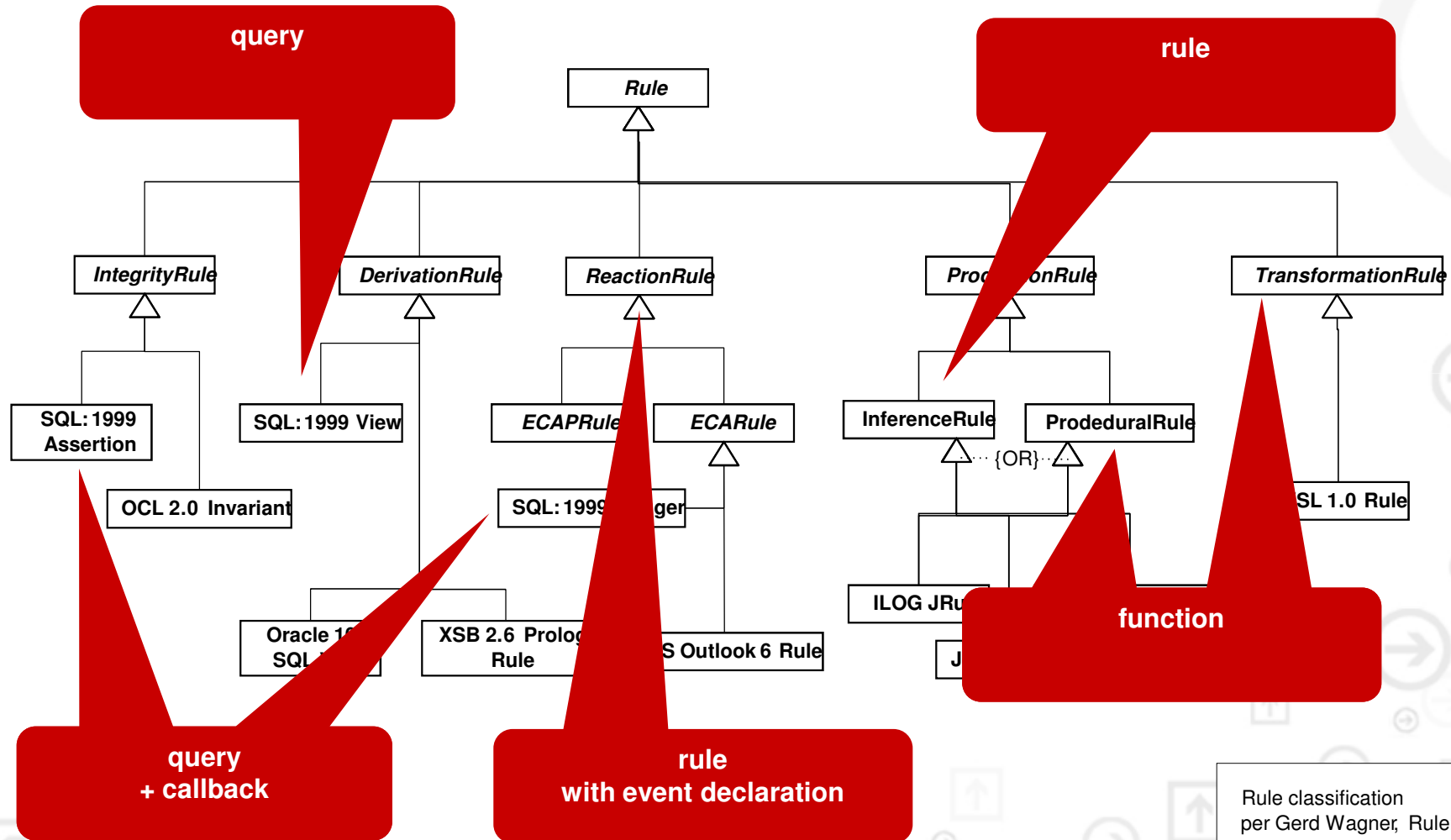
CEP = various technology components



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

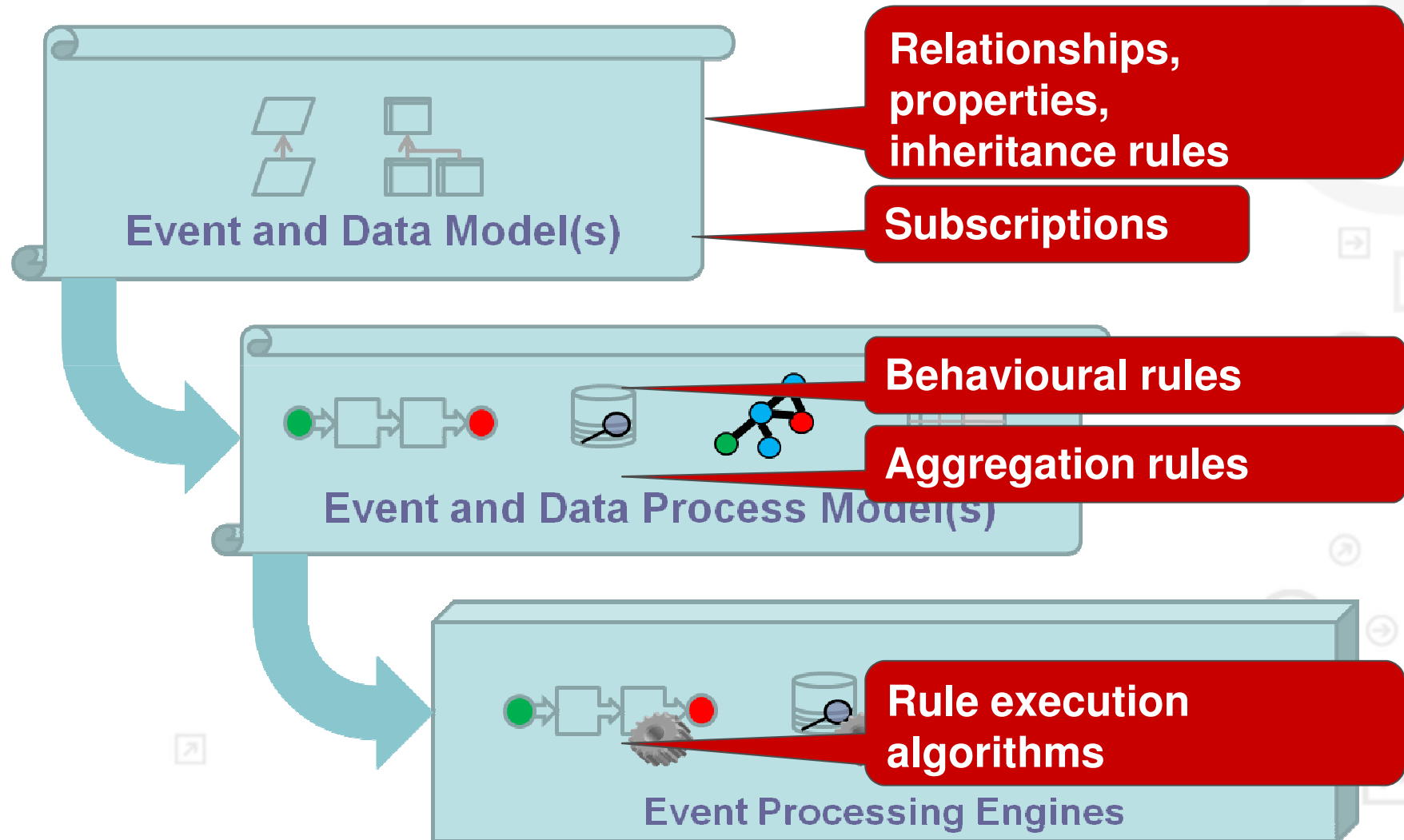


Rule classification
per Gerd Wagner, RuleML

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 data
- Joins across data

□ Actions

- What to do for each event that satisfies the conditions...

□ Inference

Event-by-event but not set semantics

Declarative

Performance

Scalable...

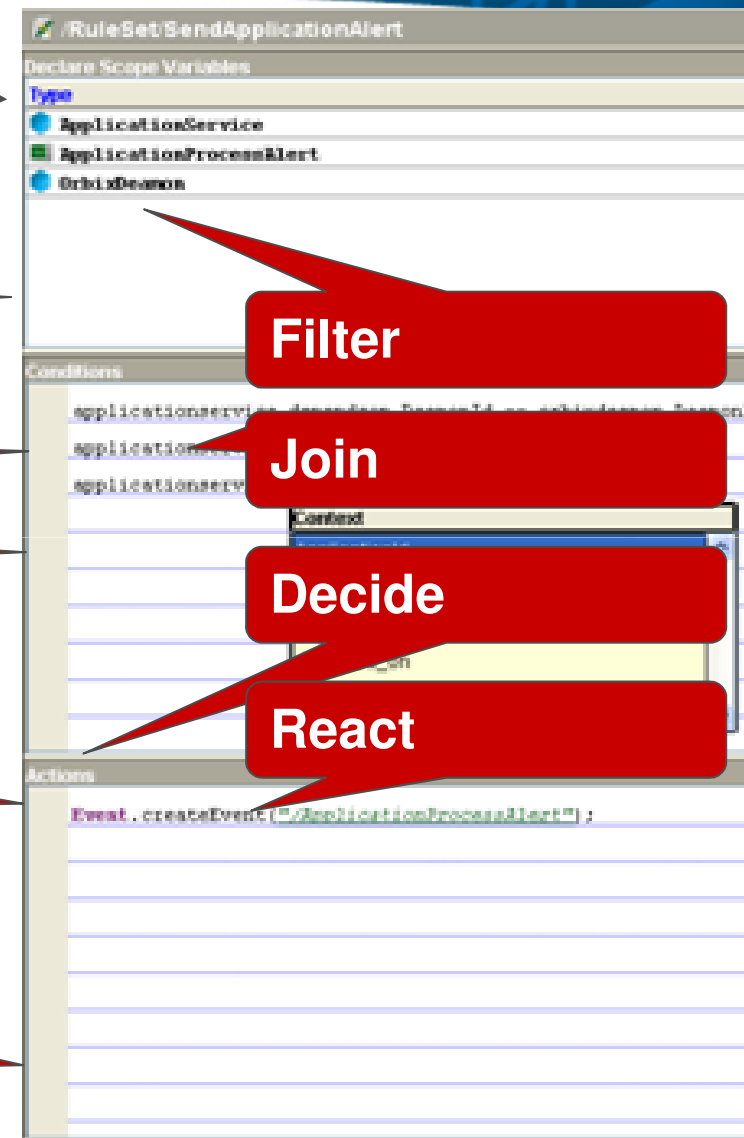
Inference = knowledge

Filter

Join

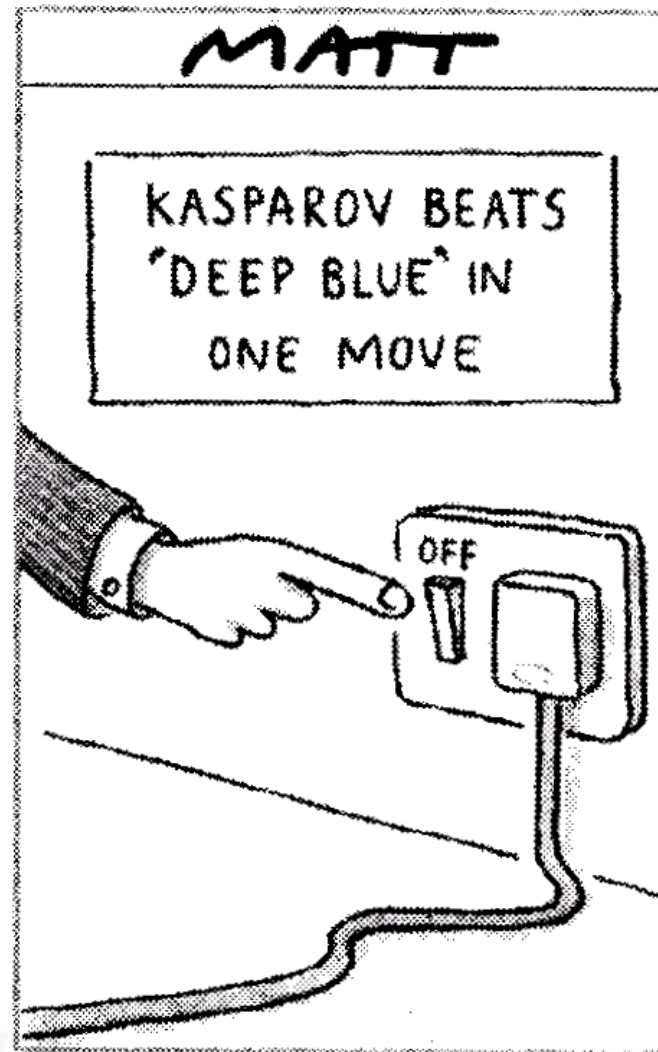
Decide

React

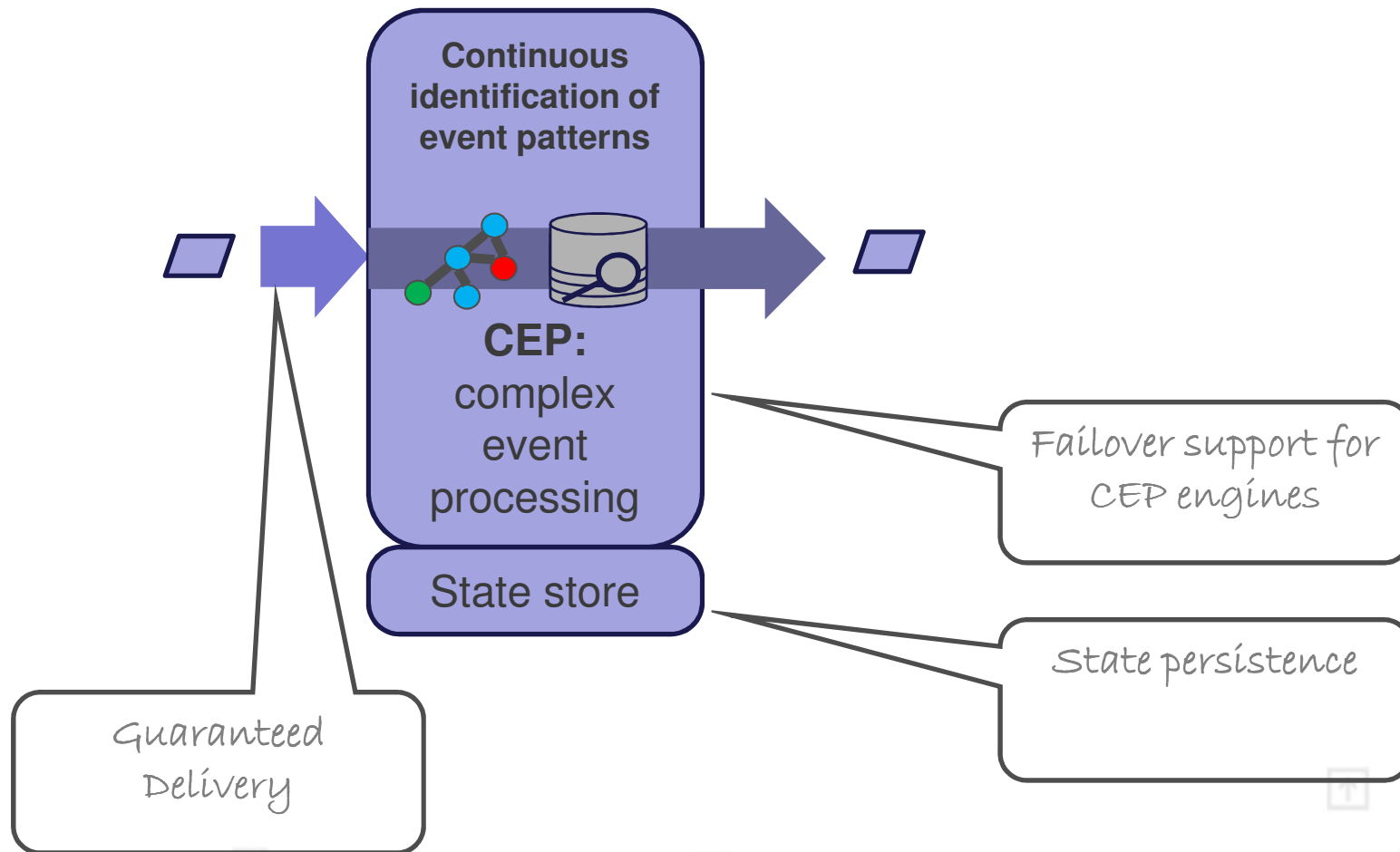


What do
CEP rules require?

CEP Rules need to handle temporal logic



CEP is a Stateful process

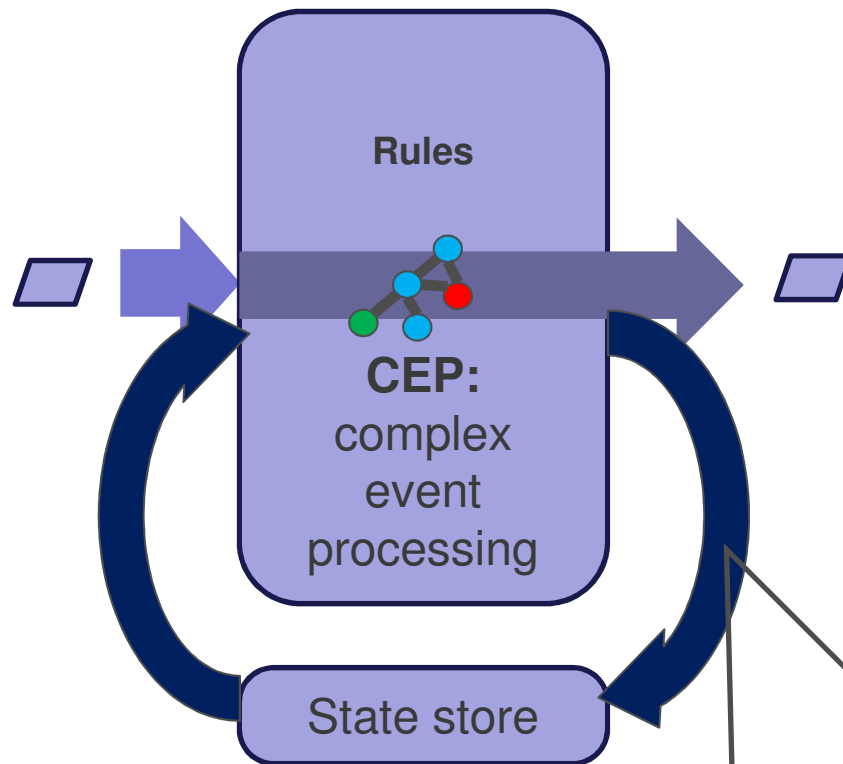


Example Rule Types

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



... also Low latency, Scalability



Event performance is dependent on
minimizing RTC times

Example: fraud event processing

/Channels/RV

DebitTransaction

DebitTransaction (Destination)

Configuration

TIBCO Rendezvous

Name: DebitTransaction

Description:

Default Event: /Events/Debit.event

Serializer/Deserializer: com.tibco.cep.driver.tibrv.serializer.T

Subject: BE.DEBIT.TXN

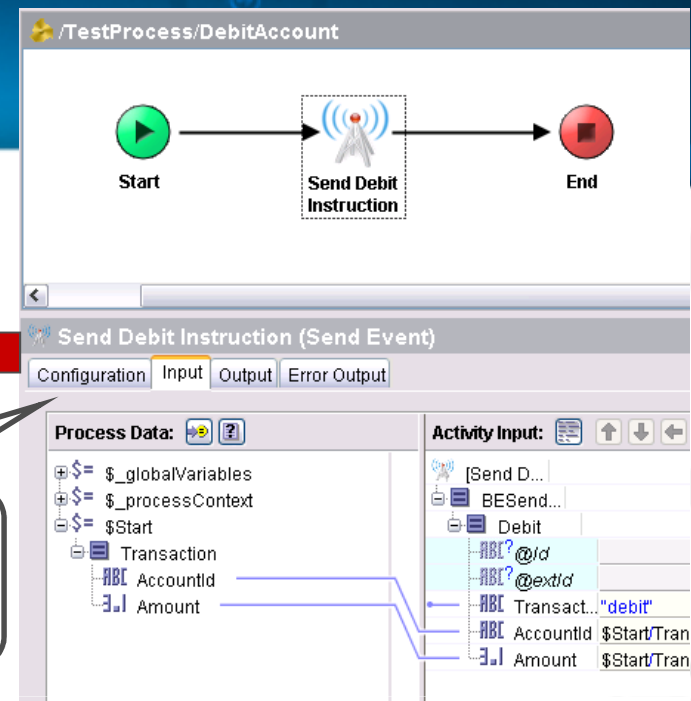
RVCN Pre Registration:

LimitPolicy: DISC

MaxEvents:

DiscardAmount:

Source Event definition / transform



Event definition:
Fire n' forget

Debit (SimpleEvent)

Configuration Properties Payload ExtendedProperties

Name: Debit

Description:

Time To Live: 0 Seconds

Inherits From:

Default Destination: /Channels/RV.channel/DebitTransaction

Expiry Action:

Example: fraud event processing rules

/Rules/ProcessDebits/ApplyDebit

Term	Alias
/Events/Debit	debit
/Concepts/Account	account

Conditions

```
//Checks whether the extId of an Account in  
//matches the incoming event's account ID  
account@extId == debit.AccountId;
```

Actions

```
//If Account Status is not Suspended, debit  
if (account.Status != "Suspended") {  
    account.Debits=debit.Amount;  
    System.debugOut("##### Deb  
    account.Balan  
    ##### Acc
```

/Rules/ProcessDebits/CheckNegativeBalance

Term	Alias
/Concepts/Account	account

Conditions

```
//Checks that the balance is less than zero  
account.Balance < 0;  
//Checks that Account status is not set to Suspended  
account.Status != "Suspended";
```

Actions

```
account.Status="Suspended";  
System.debugOut("##### Account ID <"+
```

/Rules/ProcessDebits/FraudDetection

Term	Alias
/Concepts/Account	account

Conditions

```
//1. Checks the number of debits in the  
Temporal.History.howMany(account.Debits,  
    DateTime.getTimeInMillis(DateTime  
    DateTime.getTimeInMillis(DateTime  
    true)  
    > FraudCriteria.num txns;  
  
//2. Checks the percentage of the average  
Temporal.Numeric.addAllHistoryDouble(accr  
    DateTime.getTimeInMillis(DateTime  
    > FraudCriteria.debits_percent*accou  
  
//Check whether Account status is not set  
account.Status != "Suspended";
```

Actions

```
account.Status="Suspended";  
System.debugOut("##### Account
```

Basic event processing

Event history processing / real time analytics

Name: ApplyDebit

Description:

Priority: 1 (Highest)

FraudDetection (Rule)

Configuration

44

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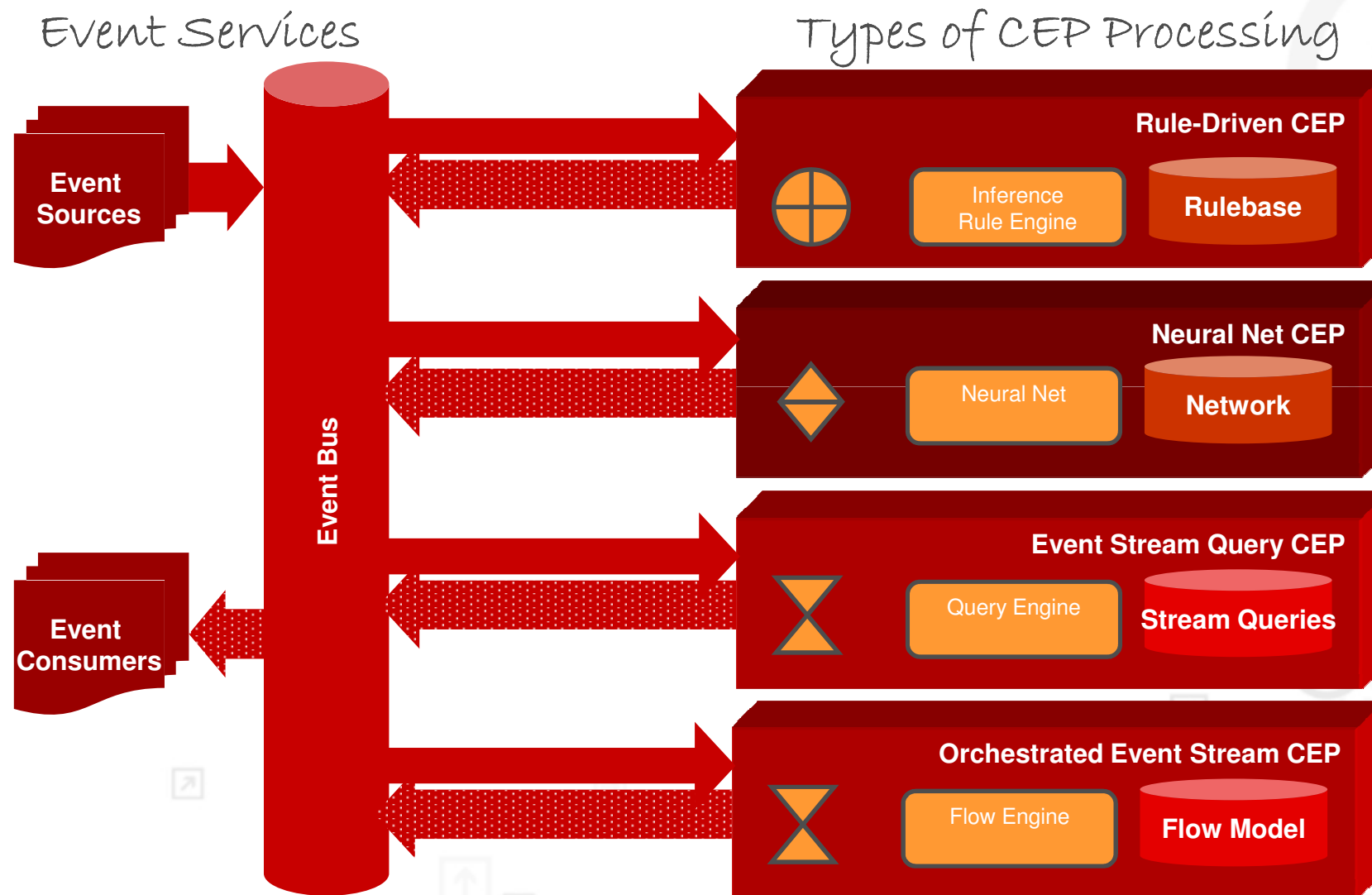
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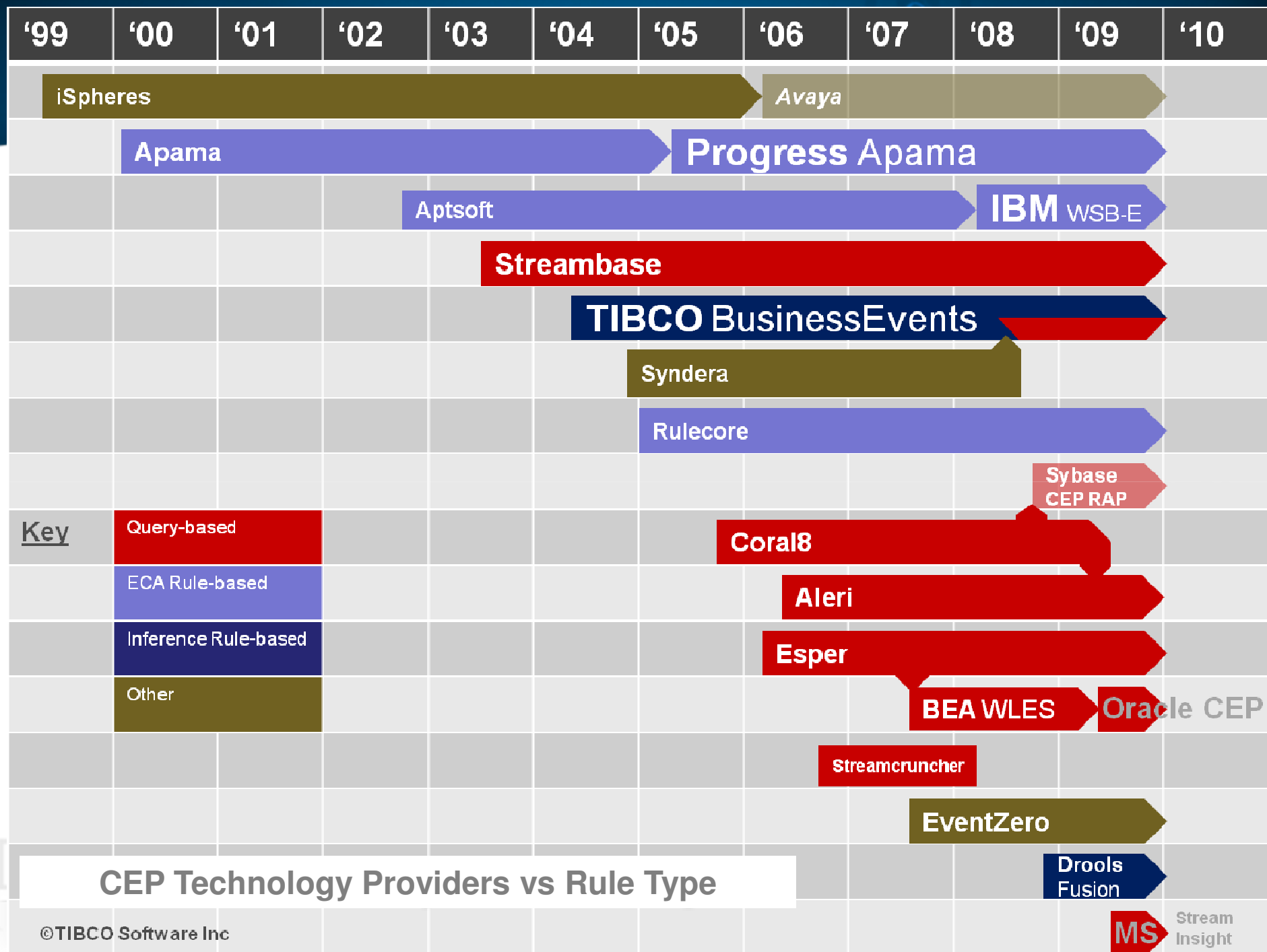
Alternatives to rules in CEP?

Some things are not meant to be

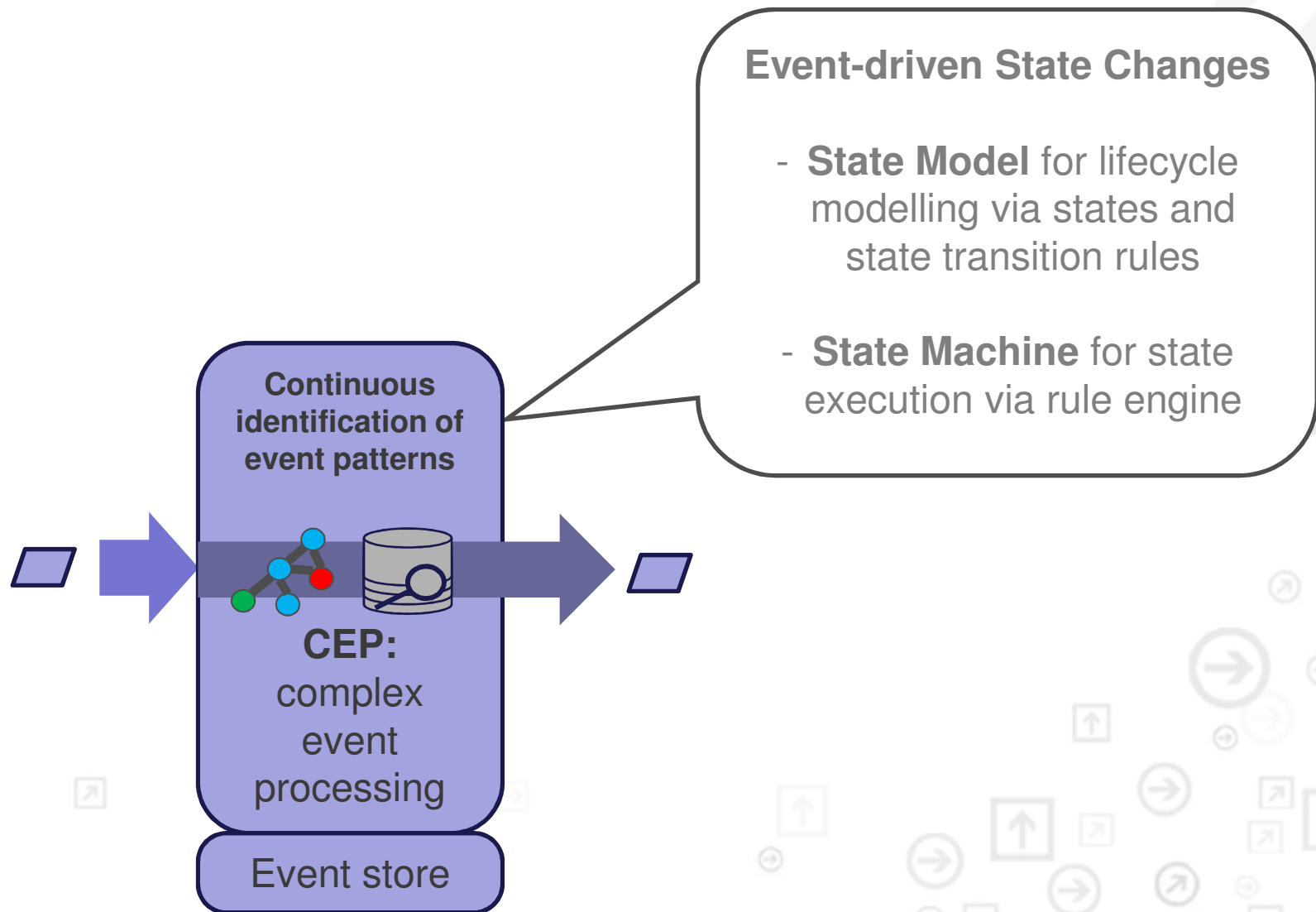


Example CEP Technologies





Patterns in CEP: event lifecycles via states



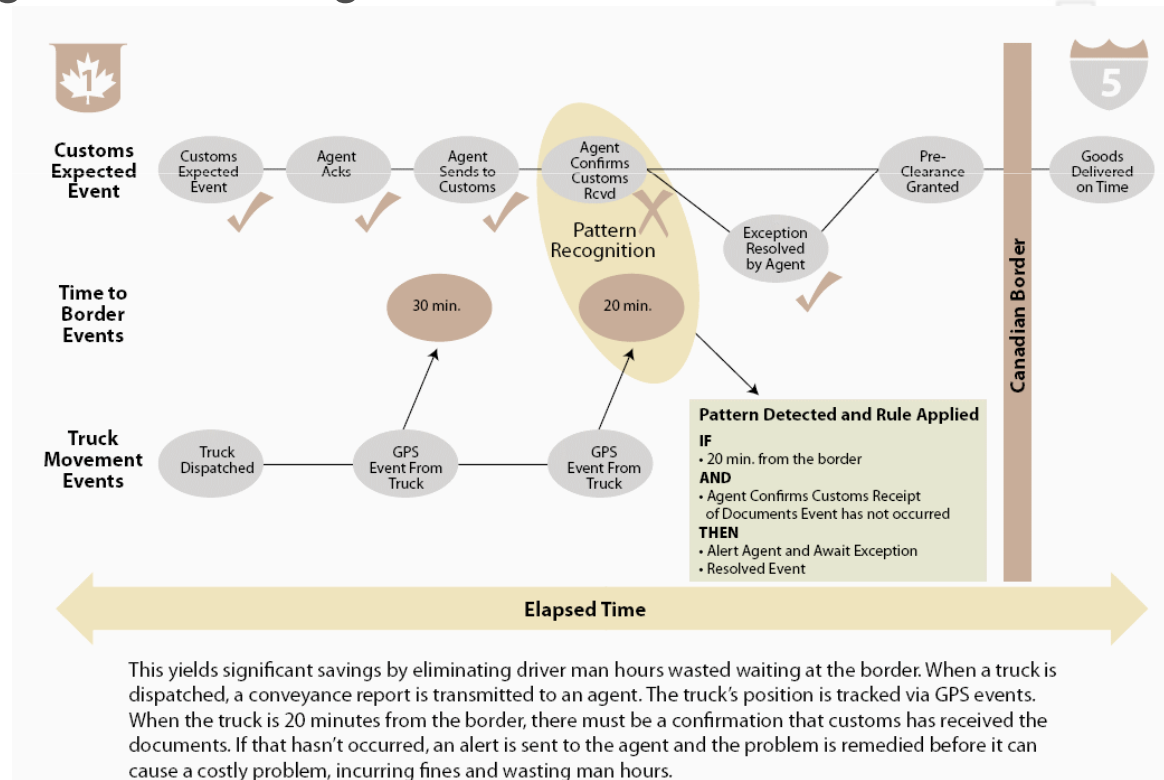
State Model advantages

1. Visual modeling metaphor

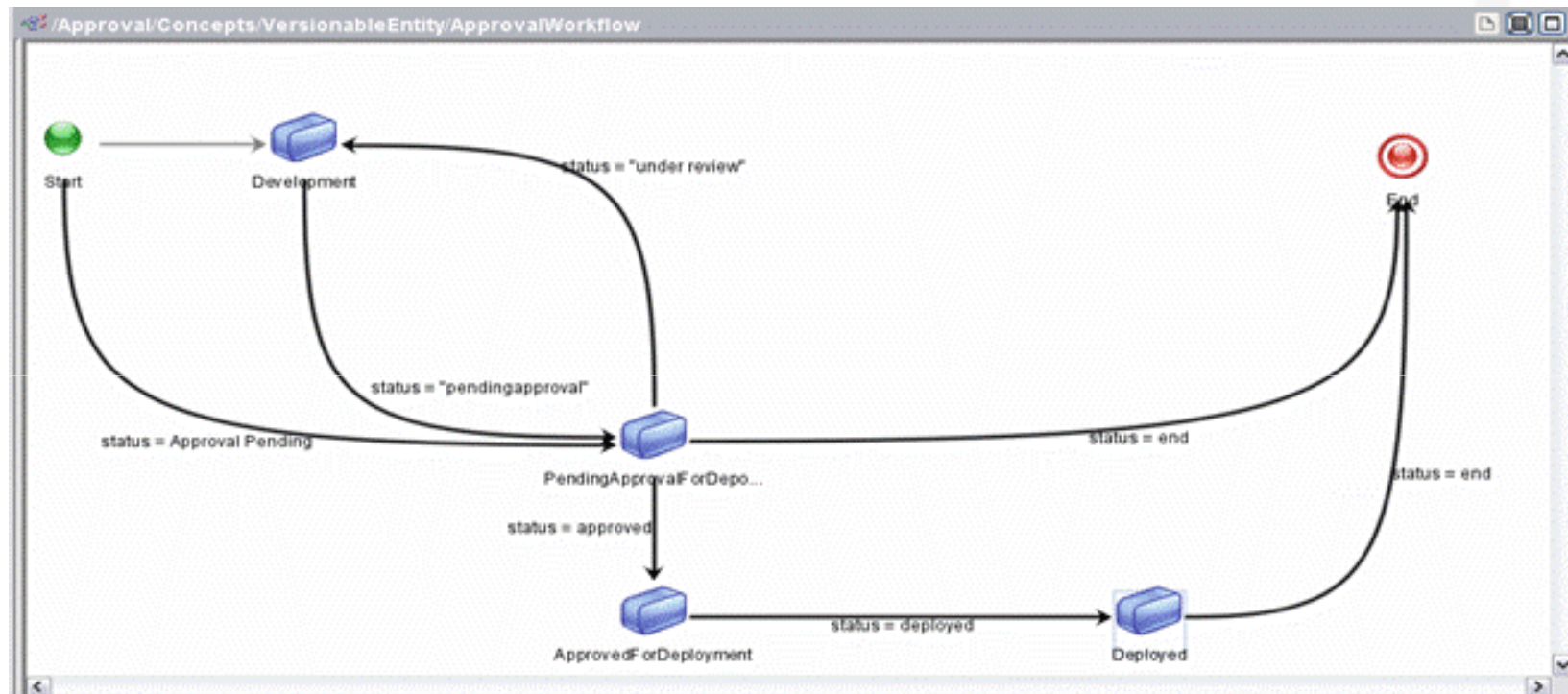
- State diagram / flow diagram is simple to follow

2. State / flow transitions can be time-related

- Can model missing events through time-outs etc



Example: state of rule management...

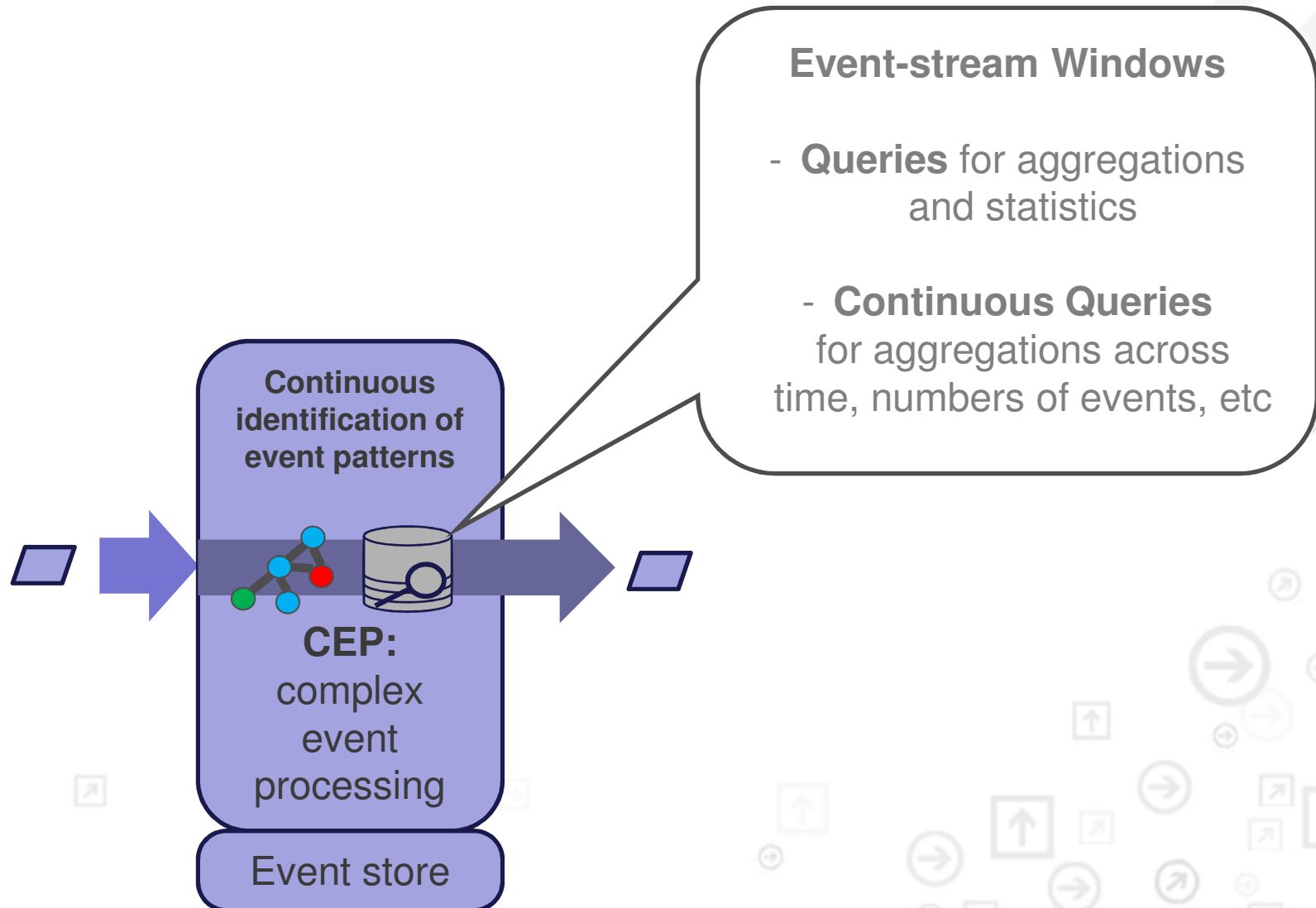


Example Rule Types (continued)

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



Patterns in CEP: continuous queries against streams



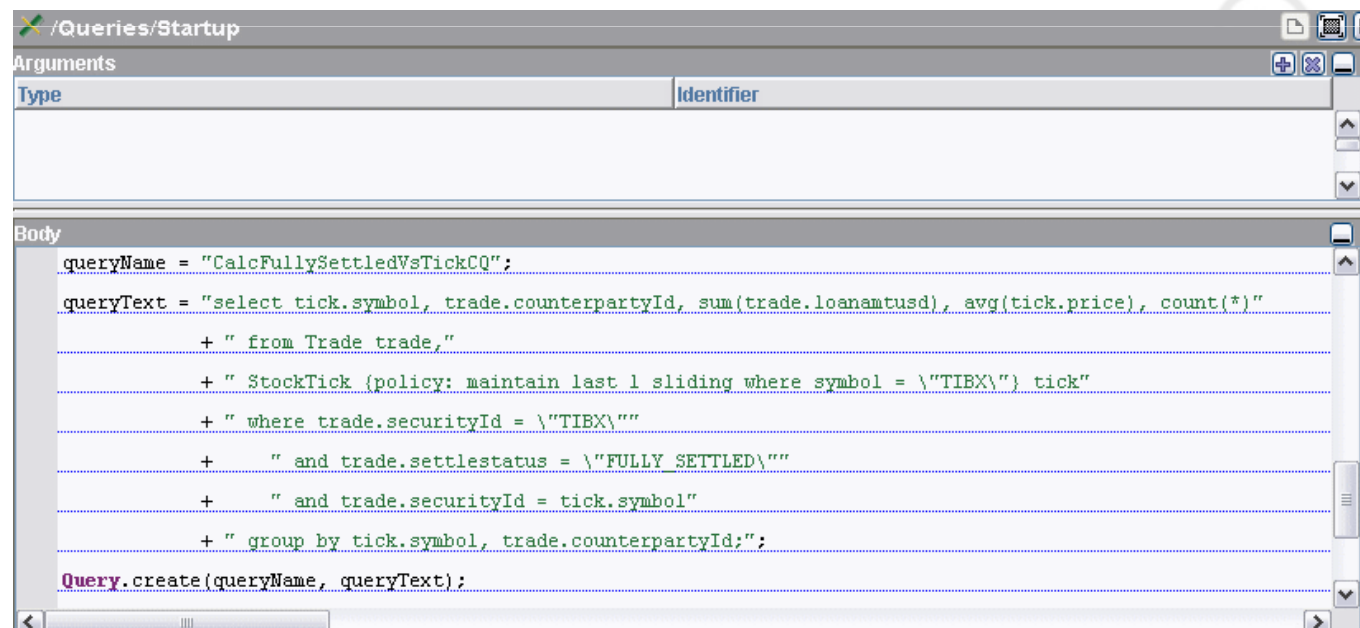
Query advantages

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



```
queryName = "CalcFullySettledVsTickCQ";
queryText = "select tick.symbol, trade.counterpartyId, sum(trade.loanamtusd), avg(tick.price), count(*)"
            + " from Trade trade,"
            + " StockTick (policy: maintain last 1 sliding where symbol = \"TIBX\") tick"
            + " where trade.securityId = \"TIBX\""
            + "       and trade.settlestatus = \"FULLY_SETTLED\""
            + "       and trade.securityId = tick.symbol"
            + " group by tick.symbol, trade.counterpartyId;";
Query.create(queryName, queryText);
```

Example Rule Types (continued)

 LIVE BBC NEWS CHANNEL

Page last updated at 11:45 GMT, Thursday, 19

 E-mail this to a friend

 Print

The mystery of Ireland

Details of how police in the Irish Republic finally caught up with the country's most reckless driver have emerged, the Irish Times reports.

He had been wanted from counties Cork to Cavan after racking up scores of speeding tickets and parking fines.

However, each time the serial offender v evade justice by giving a different address.



☐ 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

New Order event

Change Order event

Change Currency /
exchange rate event

*e.g. An Order over \$1000 must not be accepted on credit
without a credit check*

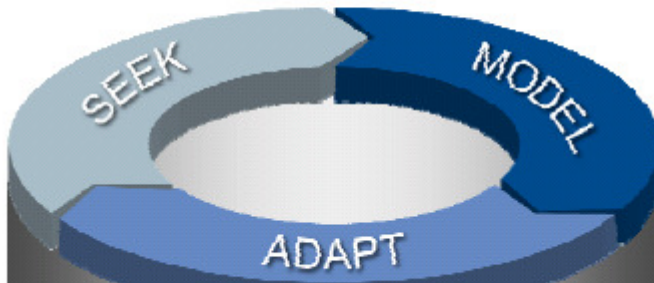
Change Rule
Condition event

Rule applies to
“order” process...

Change Limit (Rule
Parameter) event

Per Analysts, a Hot Topic

Pattern-Based Strategy Core Technologies



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"



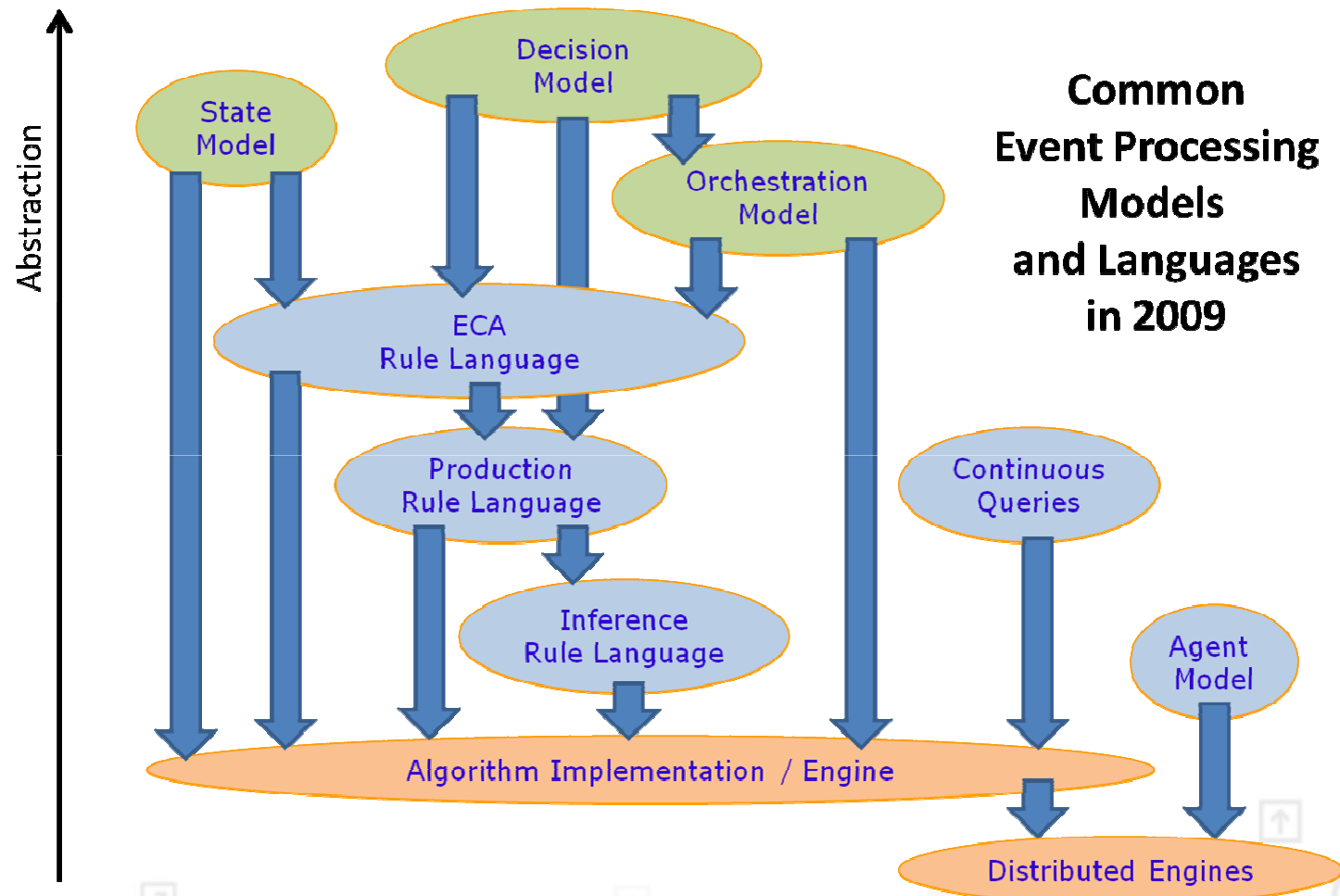
" DM platform needs data preparation and decision refinement and also state ie combining with CEP

...

Why not bring them together in active on / always on rule processing? "

Final Remarks

Summary of Basic CEP Rule Types



©TIBCO Software 2009

Key: = EP graphical model; = EP language; = Code level; ➡ = Transform

Note: imperative code / scripts subsumed into Production Rule or Engine concepts

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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