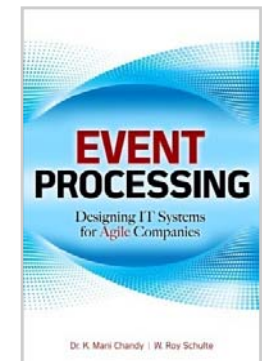# Event Processing

W. Roy Schulte

Event Processing: Designing IT Systems for Agile Companies
Book by K. Mani Chandy and W. Roy Schulte, McGraw-Hill (ISBN: 978-0-07-163350-5), 2010

Gartner.

Key Issues

1. Define events

2. Using events in event-driven architecture (EDA)

3. Using events in complex-event processing (CEP) for "real-time" operational intelligence

4. Implementation issues and futures

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"Event" Is Defined Differently, Depending On How It Will be Used

- An event is a detectable condition that can trigger a notification.
- A notification is a signal, triggered by an event, sent to a run-time-defined recipient.
- **Sample uses:**
  - GUI
  - Notification
  - Multistep business processes

Simple events exchanged among "minimally coupled" components

EDA

Coordinating complex, nondeterministic, asynchronous systems

EDA

Analytical discipline

CEP

- An event is a state change.
- An event object is a report of a state change.
- A notification is an event object packaged in a message.
- **Sample uses:**
  - Sophisticated forms of BPM
  - Operating system scheduling
  - Control multicore and multiprocessor systems

- An event is anything that happens, or is contemplated as happening.
- An event object is an object (usually a message) that represents, encodes or records anything that happen.
- **Sample use:** Enable situation awareness

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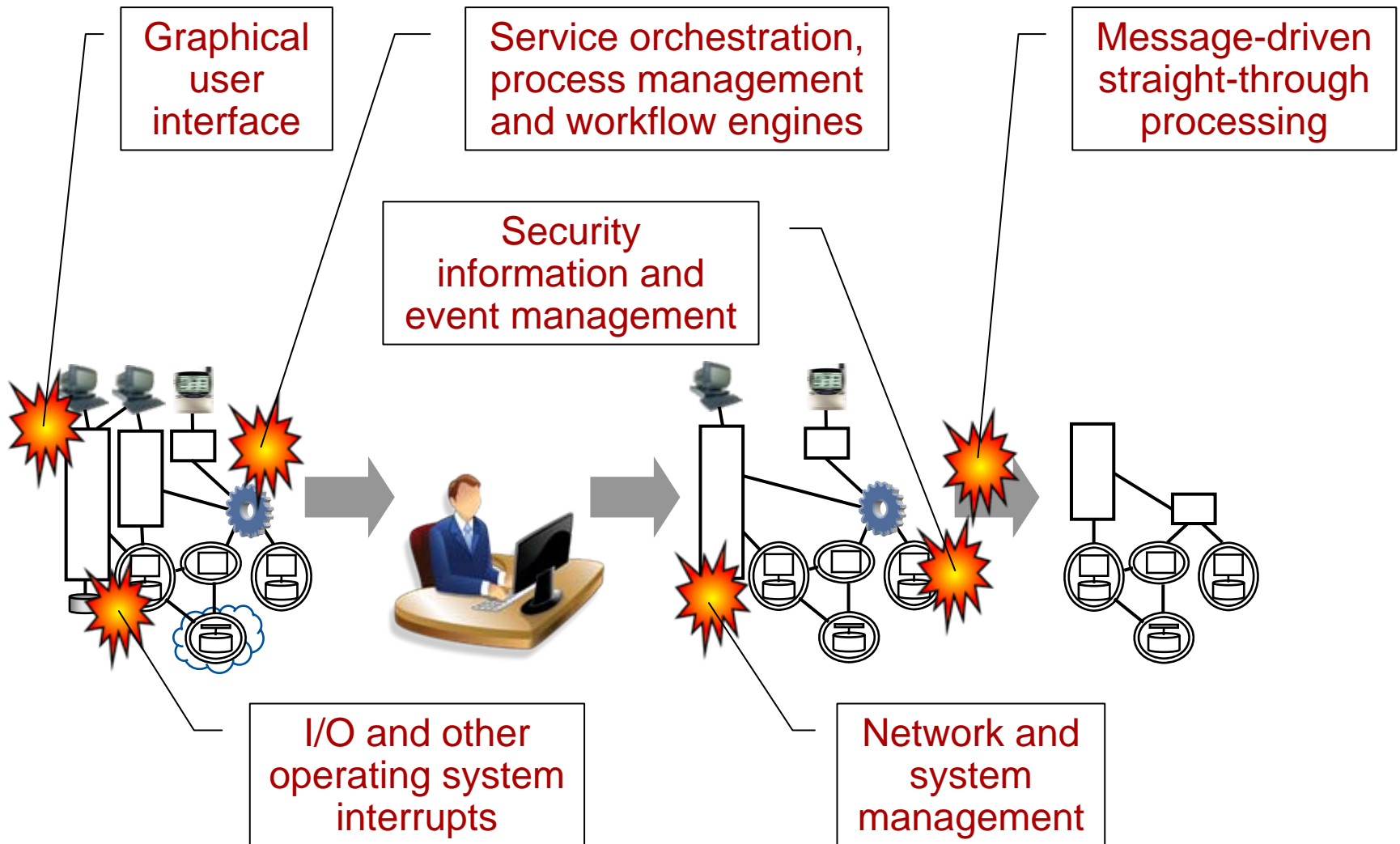
4. Implementation issues and futures

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Many Aspects of the Natural World and the Business World Are Event-Driven

Event-Driven ("Sense-and-Respond") Behavior
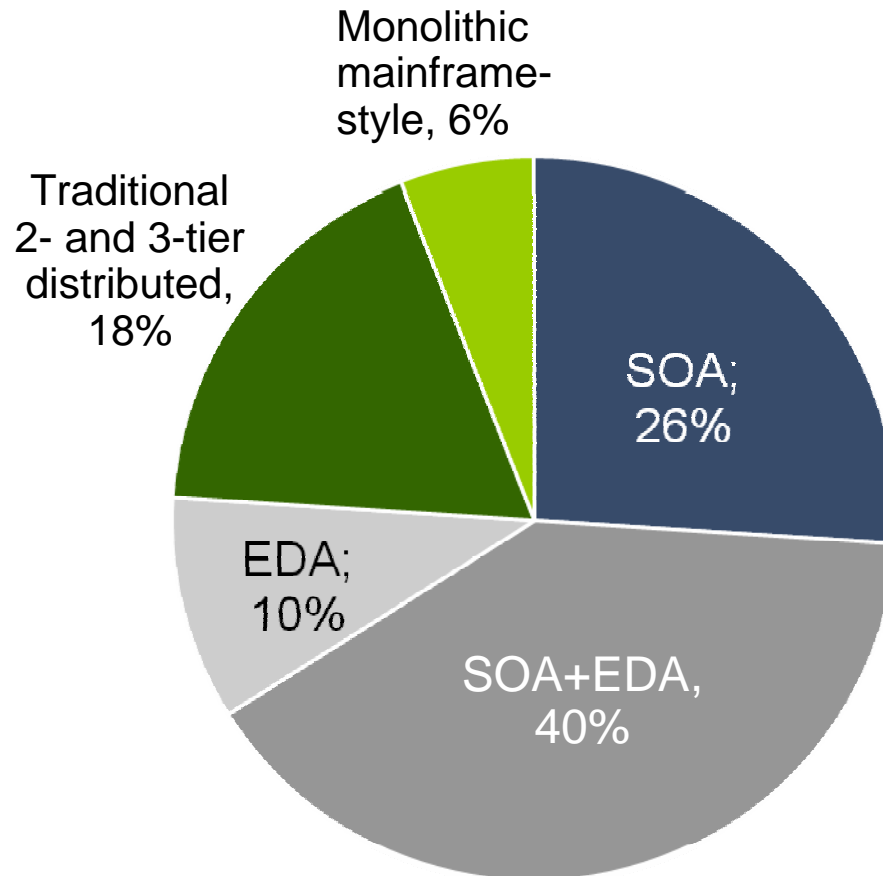
When a lion appears, *then* run away.
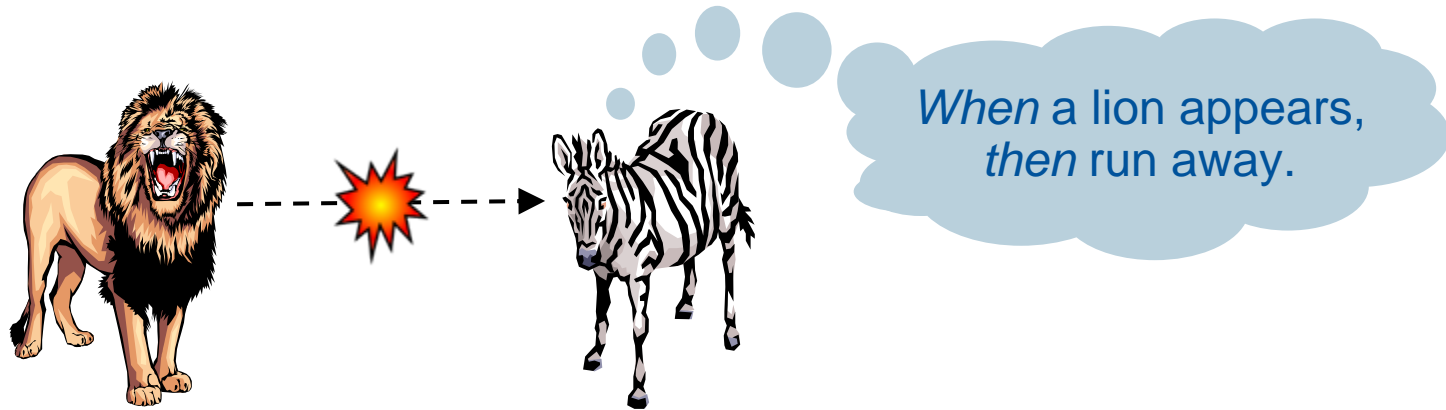
➢**Responsive companies, government agencies and other enterprises sense events in the environment and respond to serve the need of clients, citizens and others.**

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IT Systems Use Simple Events in Many Ways – Event-driven Architecture (EDA)

Graphical user interface

Service orchestration, process management and workflow engines

Message-driven straight-through processing

Security information and event management

I/O and other operating system interrupts

Network and system management

Most Large Companies List SOA as a Primary Architecture, and Many Also Now List EDA

Monolithic mainframe-style, 6%

Traditional 2- and 3-tier distributed, 18%

SOA; 26%

EDA; 10%

SOA+EDA, 40%

Which of the following best describes your organization's current primary IT architectural approach for new applications?

N = 125, April 2010-June 2010, Banks and Investment Companies

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CEP Provides the "Smarter" in Smart Devices and Application Systems

Simple-Event-Driven Heating Systems Are Smart

Heating system
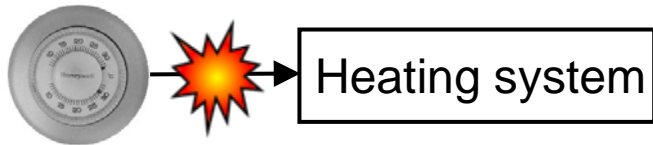
"*When* temperature < 19°, *then* turn heat on"

"*When* temperature > 21°, *then* turn heat off"

CEP-Based Smart Buildings Are Smarter

Sunlight intensity sensor

Motion detector

Temperature

CEP

Shades

Heating system

Date and time
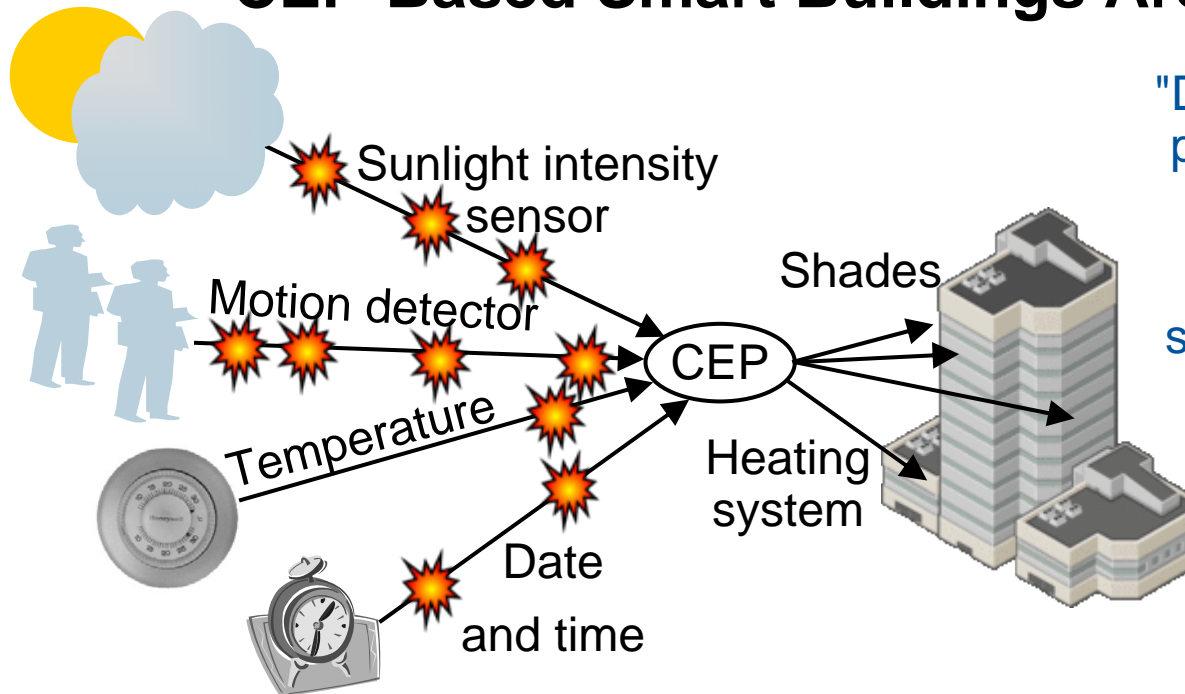
"During working hours or if people are present, keep temperature 67° to 69°"
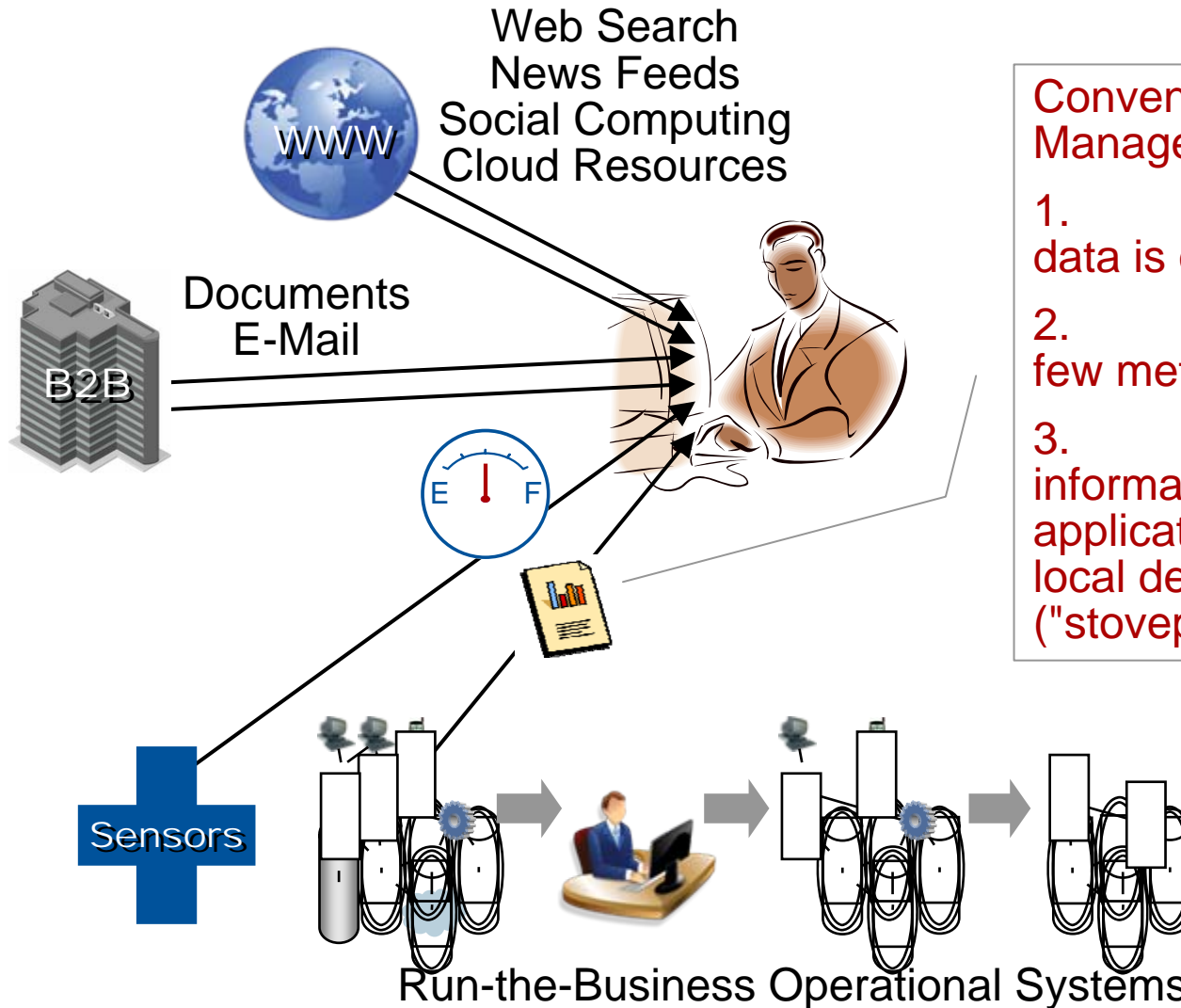
"Adjust shades on each side of building according to sunlight and people's presence"

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Event Processing Can Detect Patterns That Traditional Applications Don't See

> **Pattern discovery is used to generate pattern template**

> **Pattern detection is when incoming data matches the pattern template**

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Conventional Situation Awareness Is Based on Human Analysis of Data From Multiple Sources

Web Search
News Feeds
Social Computing
Cloud Resources

Documents
E-Mail

WWW

B2B

E F

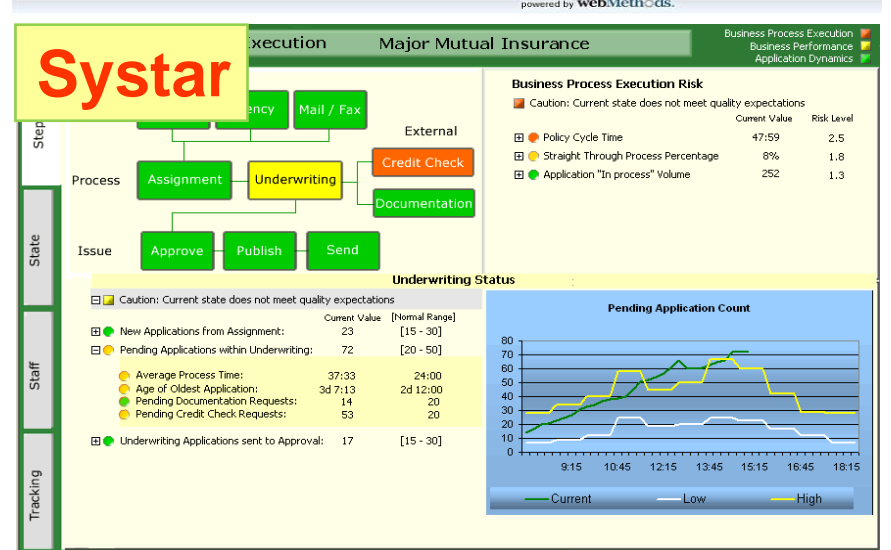Sensors

Run-the-Business Operational Systems
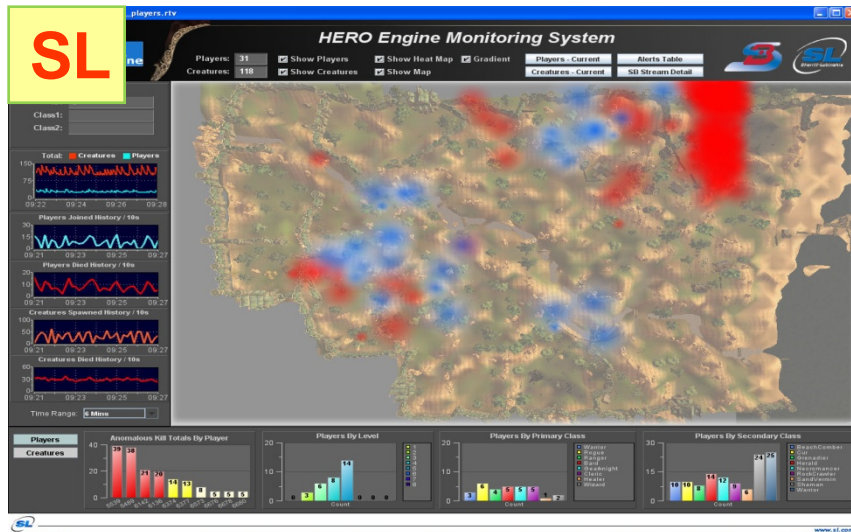
Conventional Management Reports

1.   Mostly batch, data is often stale

2.   Relatively few metrics

3.   Most information is from applications within the local department ("stovepipes")

"Real-Time" Operational Intelligence Enhances Situation Awareness and Response

Web Search
News Feeds
Social Computing
Cloud Resources

WWW

B2B E-Mail
Documents

B2B

CEP: Event
Processing
Agent

Sensors

Run-the-Business Operational Systems

Graphical Business Dashboards and Alerts

1.   Up-to-the-second

2.   Patterns, trends, management-by-exception

3.   Consolidates information from a wide range of internal and external sources

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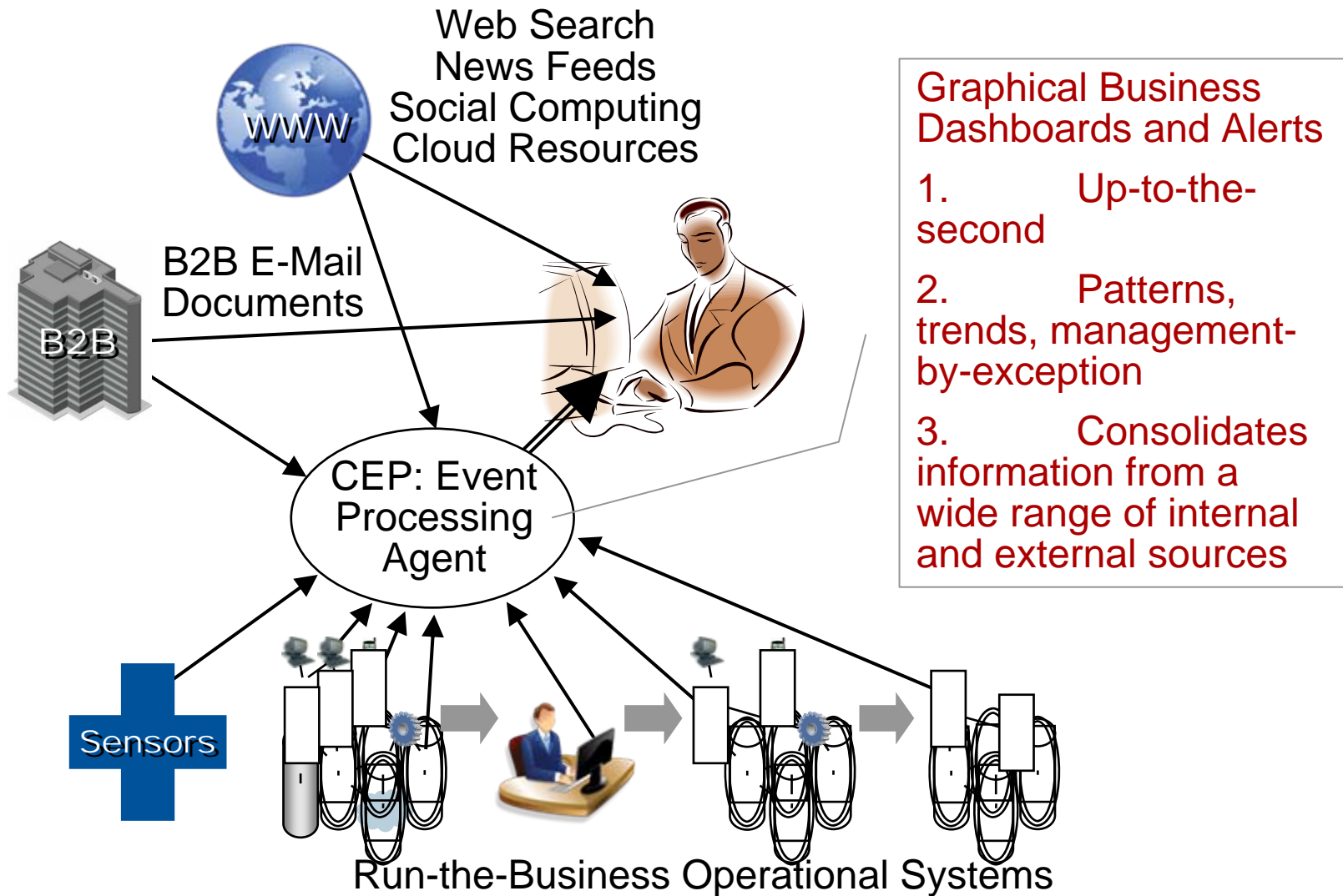
Business and Operational Dashboards Provide Visibility Into Operations

Progress/Apama

Software AG

SL
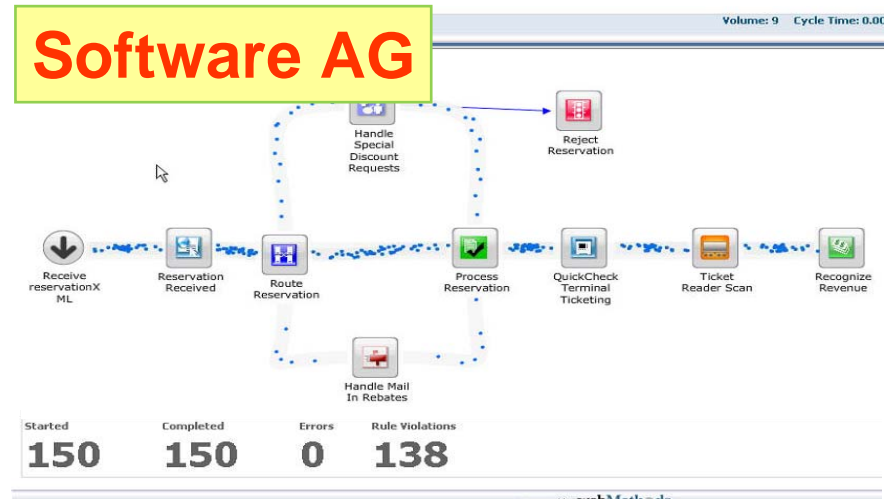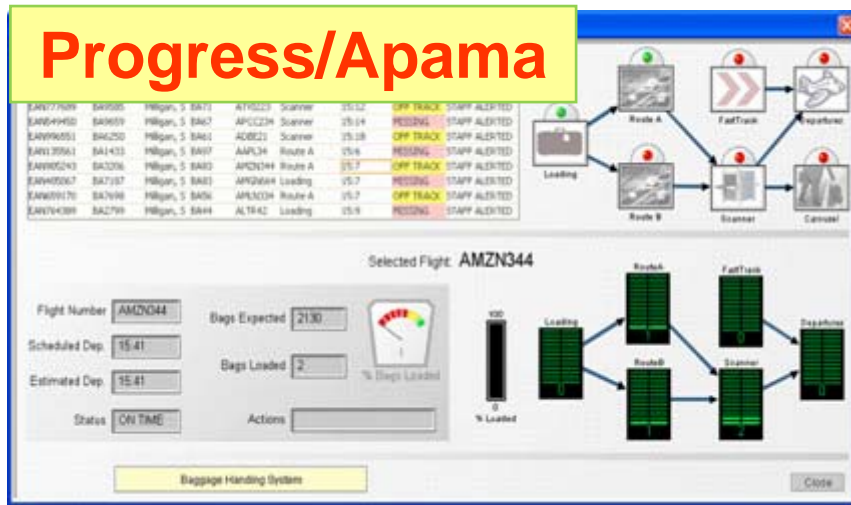
Systar

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Where is CEP being used?

- **"Operational Technology":** Manufacturing control systems; sensor networks; smart electrical grids, roads, bridges, buildings.

- **Location-based Services:** Emergency responders; social computing; transportation operations (planes, trains, trucks, ships).

- **Customer relationships:** Cross-sell/up-sell; loyalty programs; customer service; Web analytics.

- **Governance, risk and compliance:** Fraud detection; network intrusion; surveillance.

- **Trading systems:** Financial markets (trading is 30% of all use of commercial CEP platform products); electricity; online betting; Web auctions.

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Event Data Is Highly Diverse and Usually Requires Transformation Before Using It

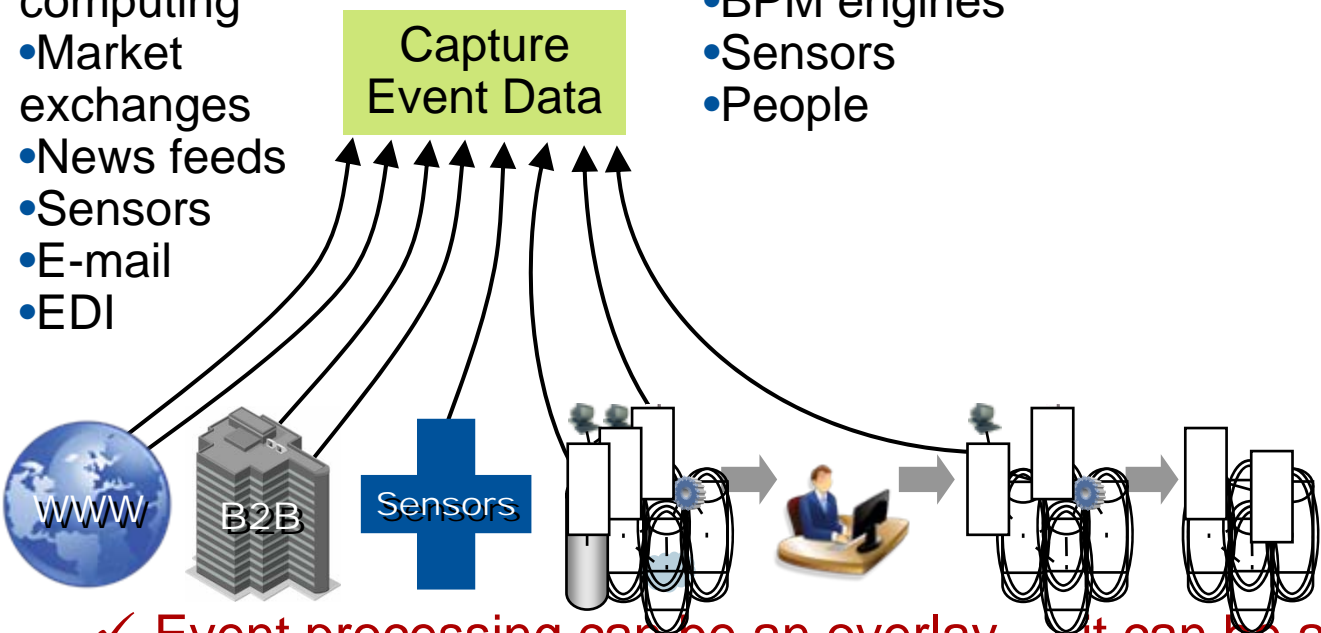**External Event Sources**
- Business partners
- Social computing
- Market exchanges
- News feeds
- Sensors
- E-mail
- EDI

Internal Event Sources
- Messages
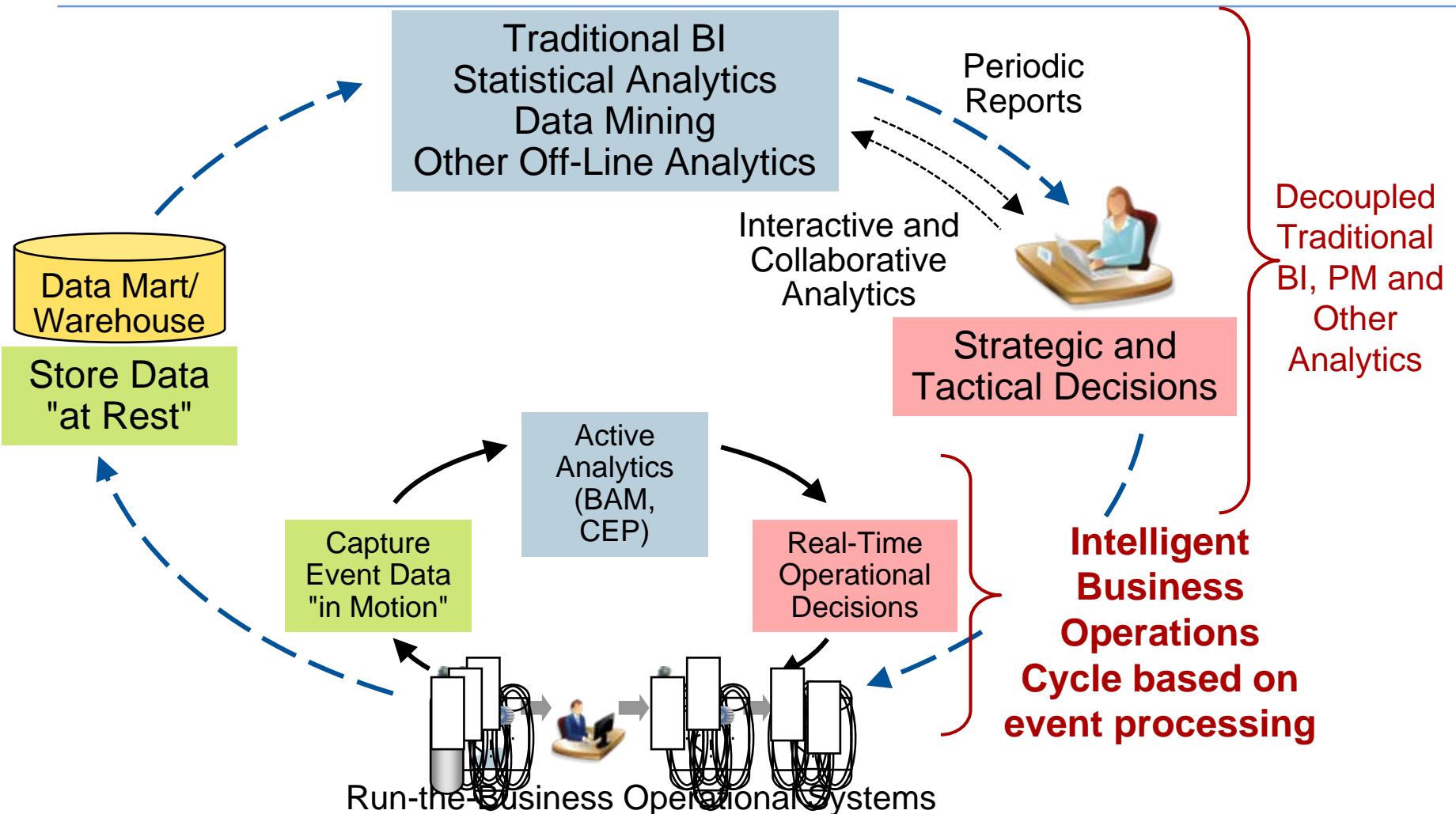- Applications
- Databases
- BPM engines
- Sensors
- People

Capture Event Data

WWW

B2B

Sensors

✓ Event processing can be an overlay — it can be added without replacing packaged applications, legacy SOA or any other applications.

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Life Cycle of Event Data is Different from Traditional BI and Analytics

Traditional BI
Statistical Analytics
Data Mining
Other Off-Line Analytics

Periodic Reports

Decoupled Traditional BI, PM and Other Analytics

Data Mart/ Warehouse

Store Data "at Rest"

Interactive and Collaborative Analytics

Strategic and Tactical Decisions

Active Analytics (BAM, CEP)

Capture Event Data "in Motion"

Real-Time Operational Decisions

Intelligent Business Operations Cycle based on event processing

Run-the-Business Operational Systems

✓ Traditional BI, PM and other decoupled analytics complement CEP-based continuous analytics; they do not compete.
✓ Quality of event data is often low – but that is usually OK

What Is In a Typical Event Object?

- Tag – event type

- Unique instance ID

- Time stamp for event object creation

- Time stamp for start and end time (interval events)

- Identifier for event producer

- Priority/urgency

- IDs of base events that contributed (if event is complex)

- Copy of base events that contributed (if event is composite)

- Attributes (null, few or many) …..

➢ No generic industry standards

➢ Domain-specific standards exist especially for B2B transactional events (HL7, Acord, SWIFT, FIX are "transactional" event objects)

➢ Transactional events vs. observational events

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Issues in Event Object Design

- An event object is just a kind of data with certain characteristics

- Real-world event: Fred sold his house
  - Event object 1: Report in the newspaper
  - Event object 2: Transaction summary in XML document from real estate agent to real estate industry clearing house
  - Event object 3: Deed filed at County Government office
  - Event object 4: Fred sends email to a friend

- ➤ Same real event but each event object has different attributes, event source, time stamp for origin of event object, semantics

- ➤ Pass by reference vs. pass by value

- ➤ Binary vs. XML

Standards for CEP Are Immature

Work toward industry standards for event object schemas

- ❑ Oasis Web Services Distributed Management Web Event Format (WSDM's WEF (e.g., implemented in IBM's Common Base Event (CBE))

- ❑ Mitre Corp.'s Common Event Expression (CEE)

- ❑ OMG has an Event Metamodel and Profile RFP to enhance UML support for events - the Event Processing Technical Society (www.ep-ts.com) may support this.

- ➢ **Event object design is less mature than Semantic Web. microformats and some other metadata-based programs but needs to catch up and can leverage them**

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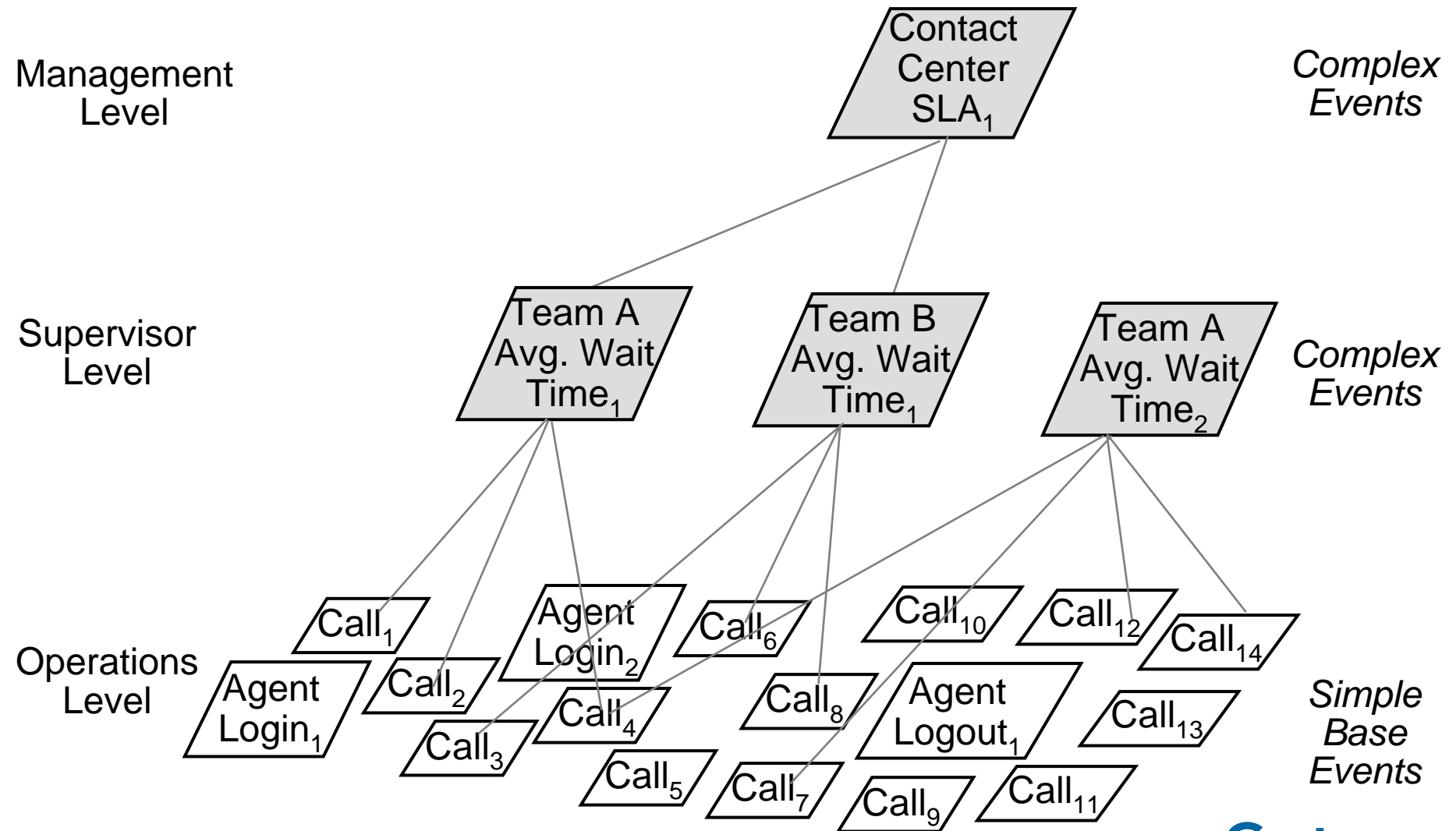# Semantic Web Technology Has An Overlap With Event Processing

Semantic Web

- Linked Data – "Giant Global Graph"

- Data is more or less permanent

- Browseable links (two directions - subject or object)

- Request-driven – pull data to follow links to search and discover

- Data formatted as RDF/XML and serialized as N3 or Turtle

- Machines (agents) can process it

- Registered metadata, semantics and agreed protocols are essential

Event Processing (CEP)

- Event-processing networks (EPNs) are directed acyclical graphs

- Data is emphemeral (it expires)

- Links sometimes are browseable in only one direction (where from)

- Event-driven - Subscribe to event sources that push (publish) events

- More primitive formats - data formatted as XML or binary

- Machines (agents) can process it

- Registered metadata, semantics and agreed protocols are essential

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CEP Concepts: Event Causality and Event Hierarchy

Management Level

Supervisor Level

Operations Level

Contact Center SLA$_1$

Team A Avg. Wait Time$_1$

Team B Avg. Wait Time$_1$

Team A Avg. Wait Time$_2$

Agent Login$_1$
Call$_1$
Call$_2$
Call$_3$
Agent Login$_2$
Call$_4$
Call$_5$
Call$_6$
Call$_7$
Call$_8$
Call$_9$
Agent Logout$_1$
Call$_{10}$
Call$_{11}$
Call$_{12}$
Call$_{13}$
Call$_{14}$

Complex Events

Complex Events

Simple Base Events

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Examples of Event-Processing and BAM Platform Products

19 Event-processing Platform Products

- Codehaus/EsperTech's Esper
- FeedZai Pulse
- HStreaming Cloud, Enterprise
- IBM InfoSphere Streams
- IBM WebSphere Business Events
- Informatica's RulePoint
- LG CNS' EventPro
- Microsoft's StreamInsight
- Oracle CEP
- Progress Software's Apama Event Processing Platform
- RedHat Drools Fusion/JBoss Enterprise BRMS
- ruleCore's Reactive CEP Rule Server
- SAP Sybase Aleri Stream Processor
- SAP Sybase CEP
- SAP Sybase Event Stream Processor
- Software AG webMethods Business Events
- StreamBase Systems' Event Processing Platform
- Tibco BusinessEvents
- Vitria Technology's M3O Analytic Server

BAM Platform Products

- Actimize Platform
- Axway Synchrony
- Fujitsu Interstage BAM
- IBM Cognos Real-time Monitoring
- IBM WebSphere Business Monitor
- iWay Activity Monitor
- Oracle BAM
- S.L.'s Enterprise RTView
- Software AG webMethods BAM
- Systar's BusinessBridge

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Best Practices for Event-Processing and BAM Applications

- ✓ Involve business users in the design of alerts, rules and responses.
- ✓ Avoid alert fatigue by setting thresholds for alerts to avoid excessive false positives.
- ✓ However, you should set alert thresholds low enough to avoid false negatives if the consequences of a missed alert are significant.
- ✓ Provide drill-down capabilities for users to explore origins of alerts.
- ✓ Implement automated sanity checks (circuit breakers) to minimize "fat finger" mistakes or errors due to faulty automated rules.
- ✓ Display a dashboard to monitor all fully automated processes.
- ✓ Put an "emergency stop" icon on every dashboard that monitors intelligent decision automation processes.

Every Company Has a Growing Amount of Event Data

OLTP Applications

Orders

Airline reservations

Insurance claims

ATM transactions

Inquiries

Other Transaction Streams

Telco CDRs

Financial trade "ticks"

Credit card authorizations and transactions

Micropayments

Sensor Networks ("OT")

Digital control systems

Satellite, GPS

Bar code scans

Telemetry

RFID

Web, Net including B2B

News feeds

Web auctions

Click streams

Social computing

RSS, Atom feeds

E-commerce processes

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Event Processing

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