Event-Driven Architecture

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EVENT-DRIVEN

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Time-Driven

Time-Driven

Customer places order on their iPhone
We convert the order to a telephone call, e-mail or fax
You handle the order as you normally would

Request-Driven

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We convert the order to a telephone call, e-mail or fax
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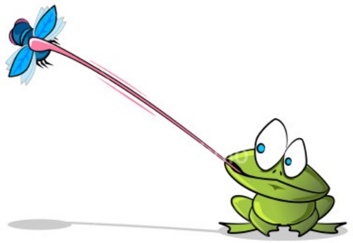
Request-Driven



Event-Driven

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Event Processing

- Modern world is dynamic, competitive, global
- EP motivated by modern enterprise requirements
  - Timeliness
  - Agility
  - Information availability

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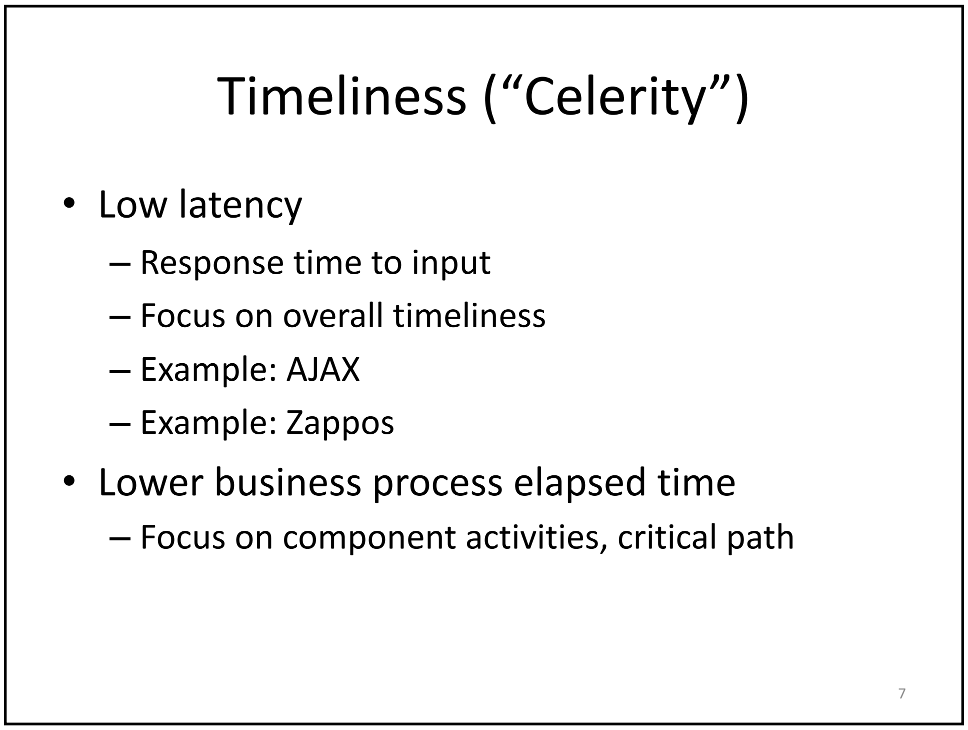

Timeliness (“Celerity”)

- Low latency
  - Response time to input
  - Focus on overall timeliness
  - Example: AJAX
  - Example: Zappos
- Lower business process elapsed time
  - Focus on component activities, critical path

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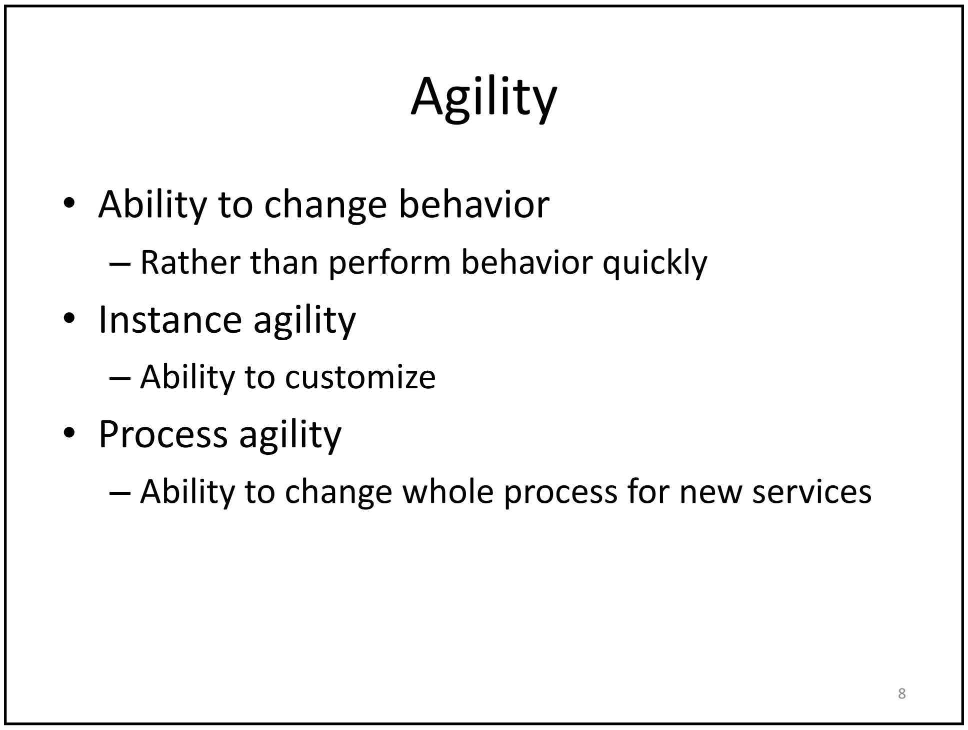

Agility

- Ability to change behavior
  - Rather than perform behavior quickly
- Instance agility
  - Ability to customize
- Process agility
  - Ability to change whole process for new services

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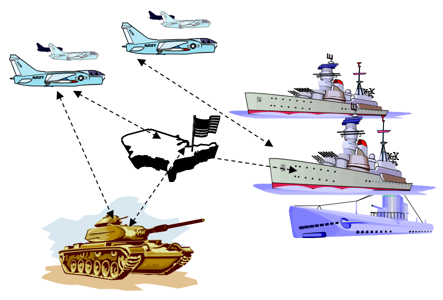
Information Availability

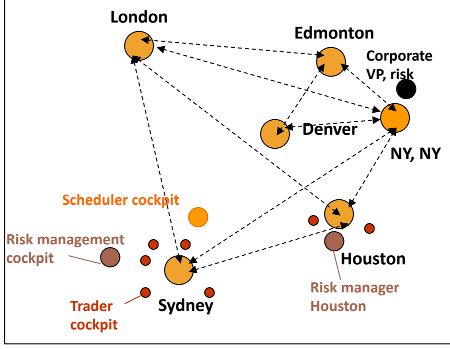
- Data consistency
  - Multiple redundant data repositories
  - How to synchronize contents?
- Information dissemination
  - MOM, text messages, tweets, alerts
- Situational awareness
  - Constant awareness of running operational activities
  - “Cut the fog:” identify and respond rapidly to new developments

Situational Awareness

Military situational awareness



Corporate situational awareness



INTERACTIONS

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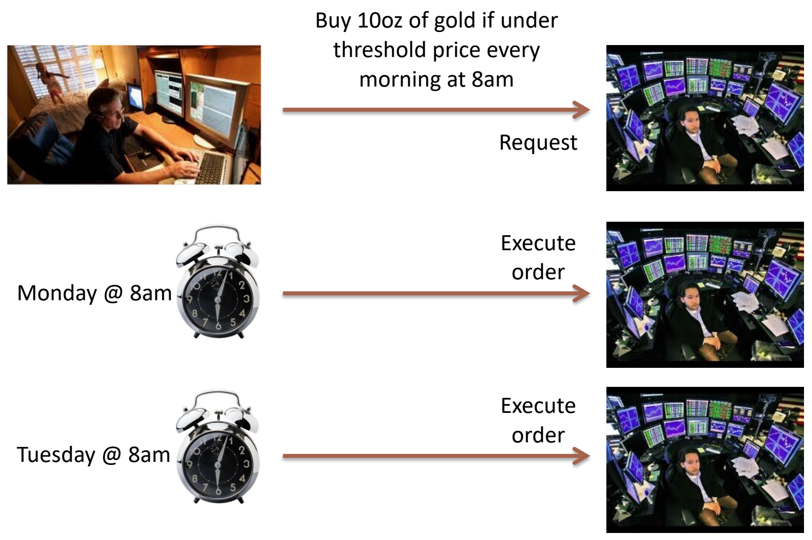
Time-Driven Interaction


Buy 10oz of gold if under threshold price every morning at 8am
Request
Monday @ 8am
Execute order
Tuesday @ 8am
Execute order

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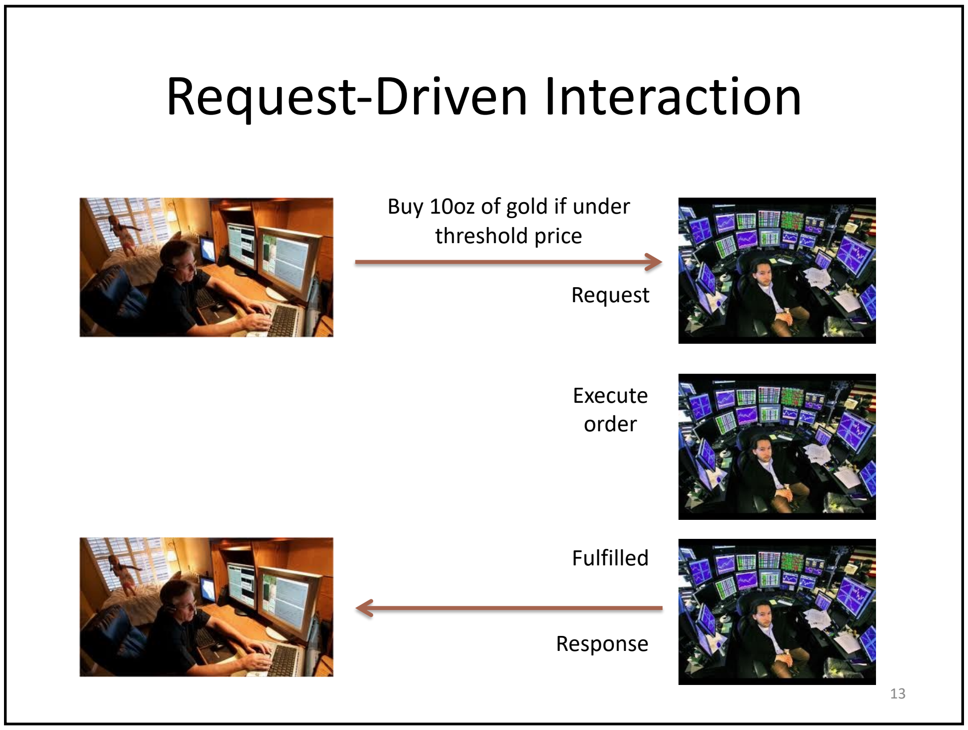

Request-Driven Interaction

Buy 10oz of gold if under threshold price

Request

Execute order

Fulfilled

Response

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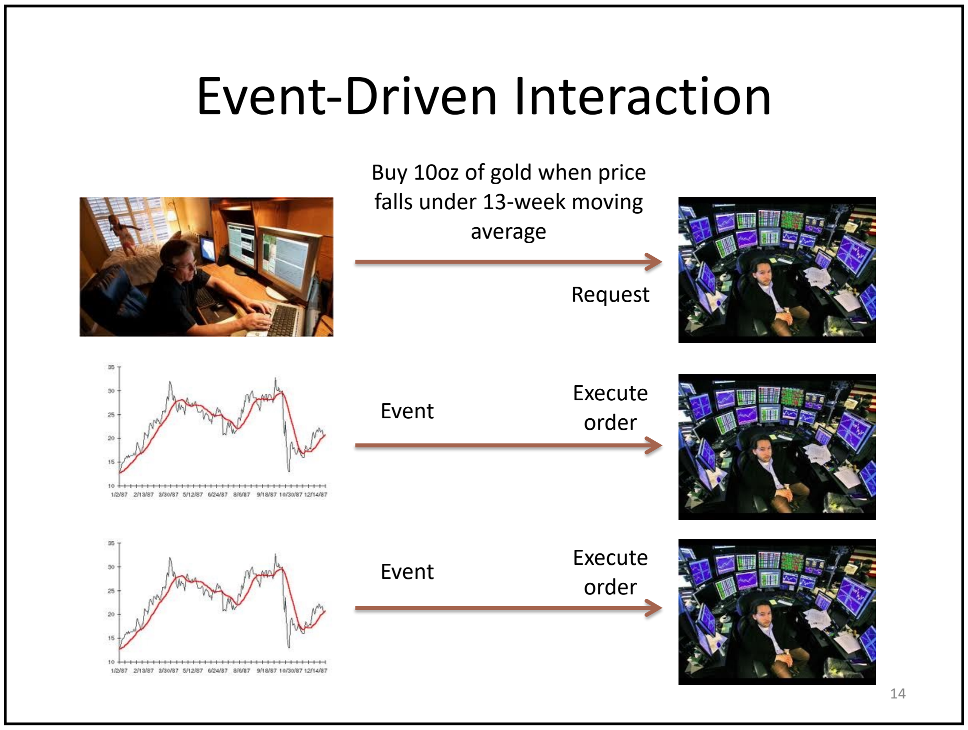

Event-Driven Interaction

Buy 10oz of gold when price falls under 13-week moving average

Request

Event

Execute order

Event

Execute order

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Time-Driven Interaction

- Advantages
  - Scheduled interaction: efficient sharing
  - Heartbeat mechanism
  - Regular measurements produce time series for analysis
  - Energy saving
- Not sustainable across large enterprises
  - Hybrid: event-driven with local time-driven

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Request-Driven Interaction

- Short-term, perhaps stateless, interaction
- Clearly defined initiation and termination points
  - Client focus on a particular service
- Celerity: others may need timely response
  - Hybrid of request-driven and event filtering
  - Personal information manager

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Event-Driven Interaction

- Long-term stateful interaction
- Bottom-up notification
- Drawing timely data from disparate sources

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Contracts

- Time-driven:
  - Relation between pre-conditions and post-conditions of all participating agents
- Request-driven:
  - Relation between client request and server reply *(logic coupling)*
  - Maybe real-time constraint on server, not on client
- Event-driven:
  - *“When-then” rules*

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Event-Driven Contract

- Contract is for an interval of time
- Contract is between agent and rest of system
  - Identity of notifier not important
- When-then rules
  - When pet is sick, call the vet
  - When child is sick, if fever then call doctor
- Rules should be executed in timely fashion
  - *Absence* of messages conveys information (cf situational awareness)

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Hybrid Systems

- Example: Personal information manager
  - Celerity: notifies you of significant events
  - Prevents interruptions otherwise
- Example: E-mail
  - Receipt is event-driven
  - Deposited in mail folder
  - Retrieval is request-driven

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Hybrid Systems

- Example: Location-based services
  - Location based on GPS, cell, wifi fingerprinting
  - Services based on location, profile
- Example: Emergency response
  - Emergency detection is event-driven
  - Dispatch of services is request-driven (SOA)

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EVENT PROCESSING

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Components of Event Processing

- Events
- Business events
- Event objects: discrete reports
  - “A message with an attitude”
- Event-driven
- Event-driven architecture
  - Loosely coupled: interaction between components is based only on events

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Principles of EDA

- Push architecture:
  - Don’t wait for event consumers to pull
- Timeliness
  - Client responds immediately
- Asynchronous
  - Notification is “fire-and-forget”
- Command-free
  - Notification is a report, not a request for specific action

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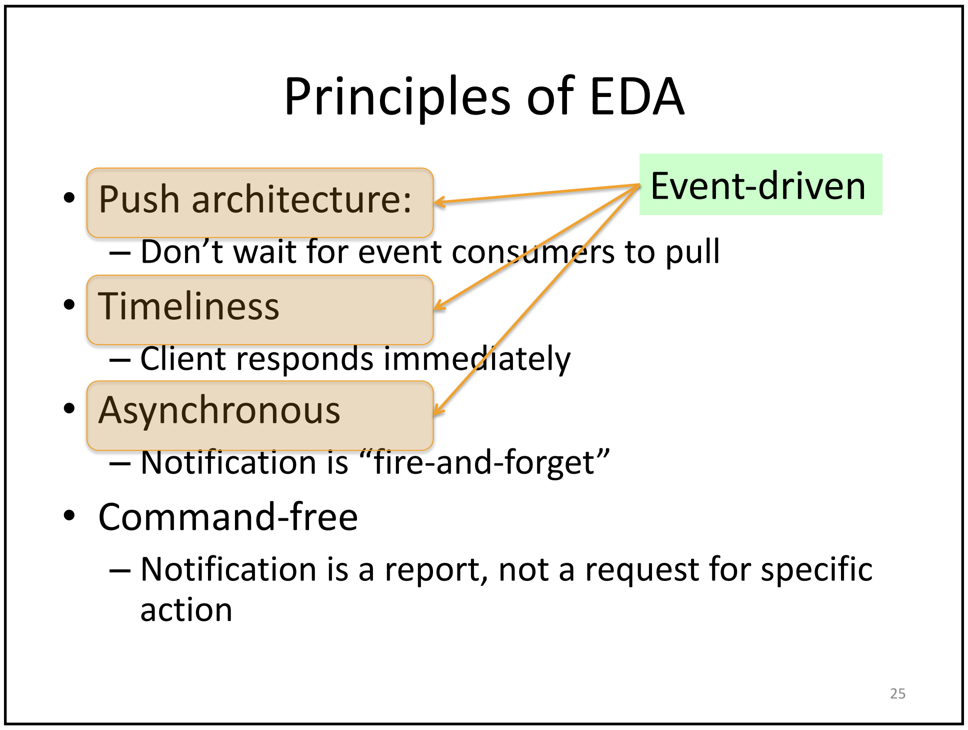

Principles of EDA

Event-driven

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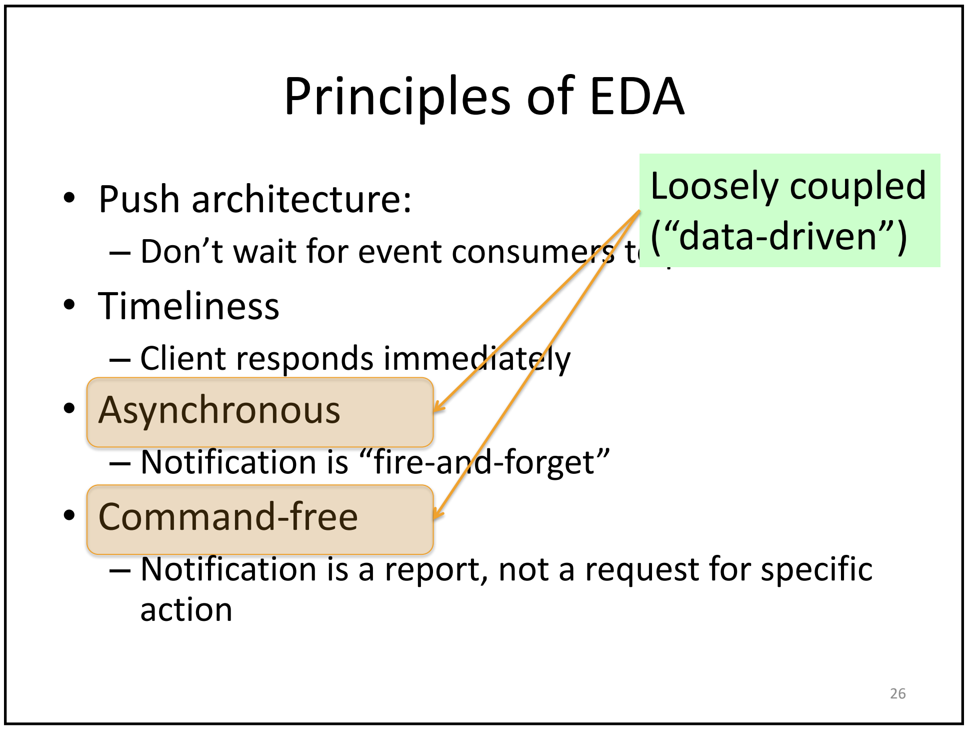

Principles of EDA

Loosely coupled (“data-driven”)

- Push architecture:
  - Don’t wait for event consumers to pull
- Timeliness
  - Client responds immediately
- Asynchronous
  - Notification is “fire-and-forget”
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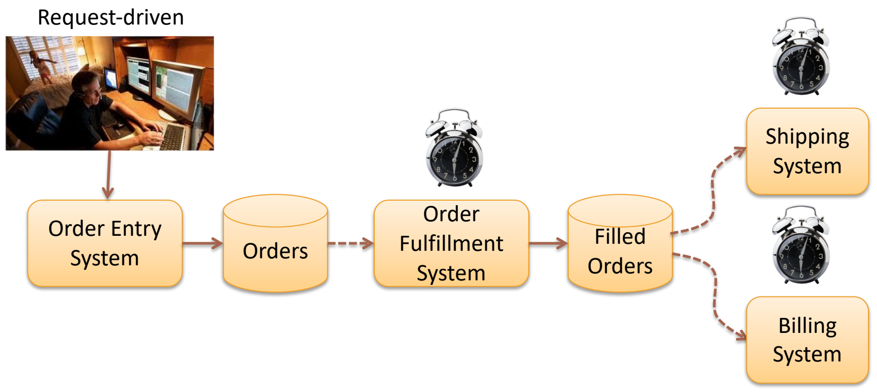
Timeliness



Time-driven batch process

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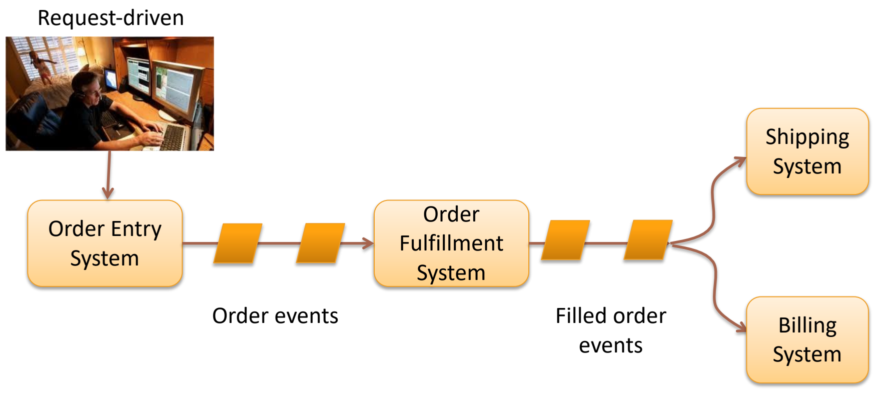
Timeliness



Event-driven continuous process

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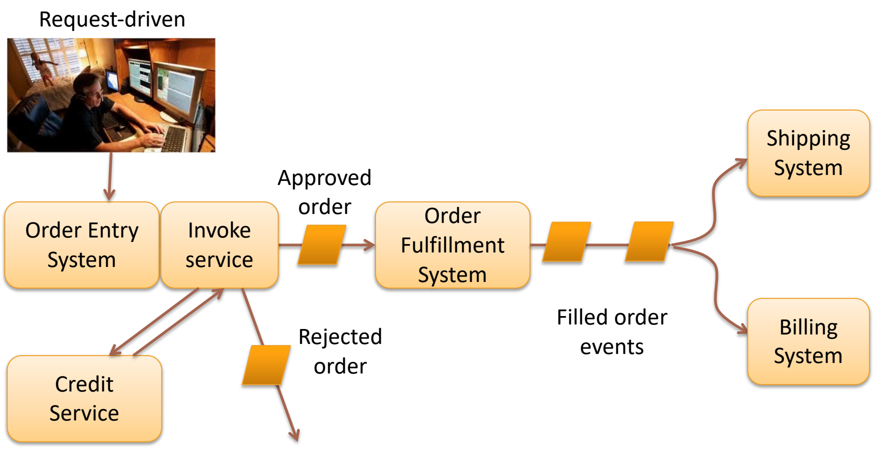
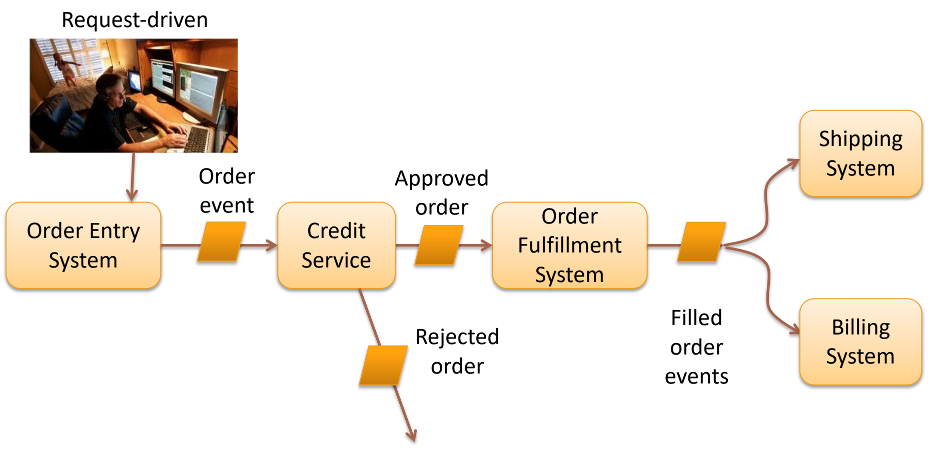
Agility



Inserting a request-driven process

Agility



Inserting an event-driven service

Agility

- Event-driven services:
  - Loose coupling
  - Accommodate piecemeal change
  - Reduce inter-component dependencies
- Request-driven services:
  - Accommodate feedback in interaction
  - Ex: notification of credit problem

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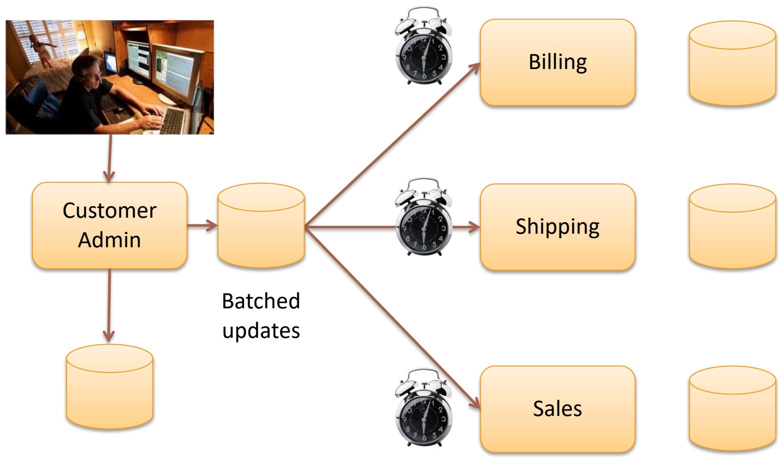
Information Availability



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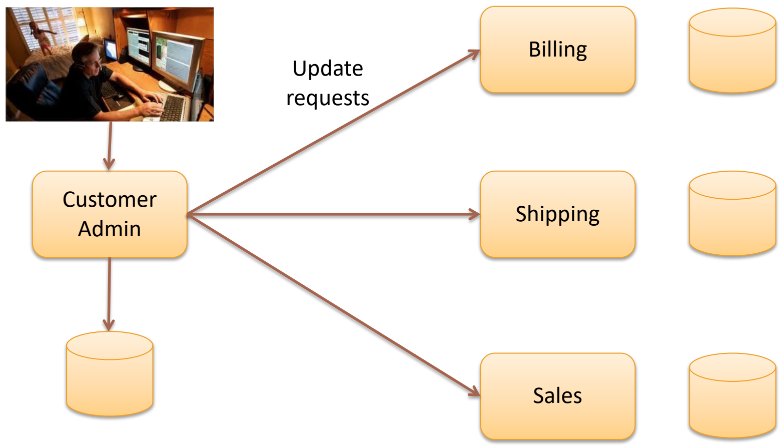
Information Availability



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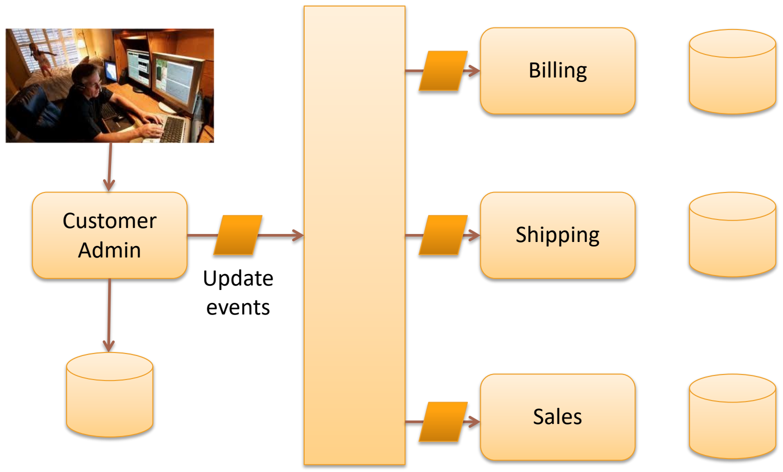
Information Availability



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COMPLEX EVENT PROCESSING

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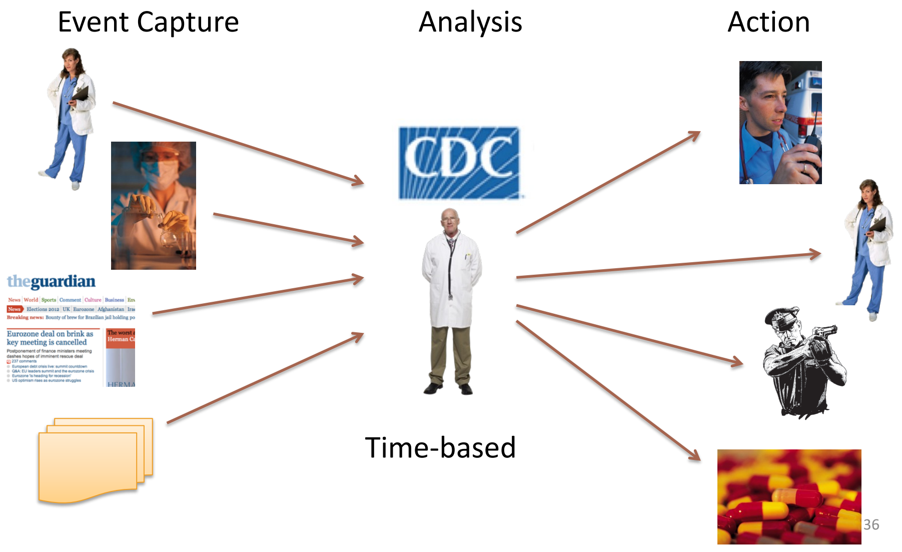
Manual CEP



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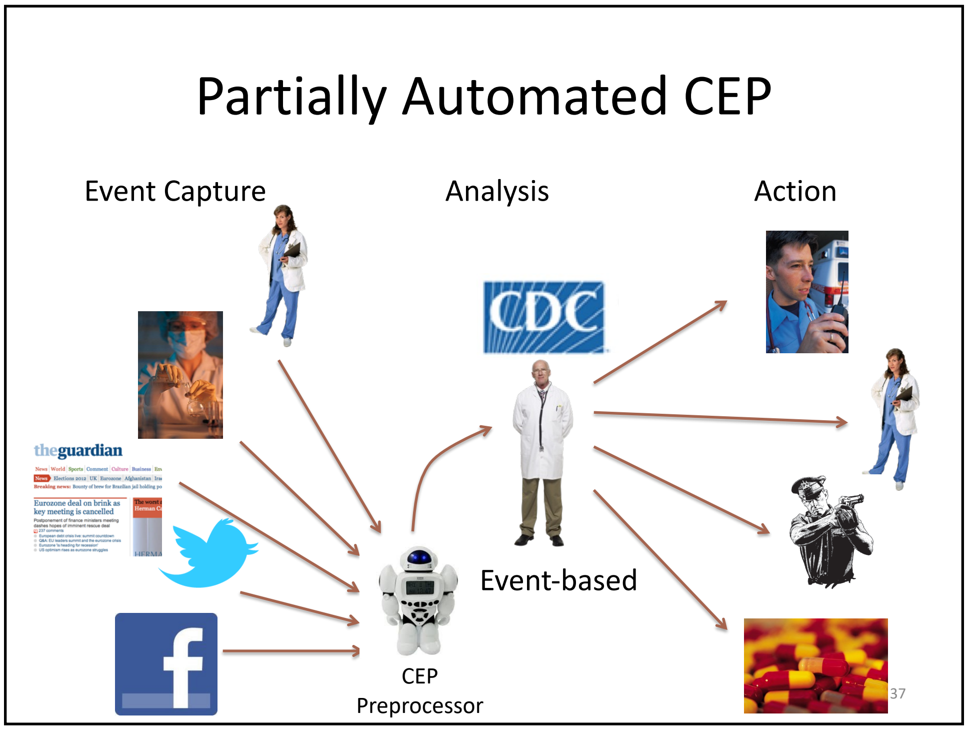

Partially Automated CEP

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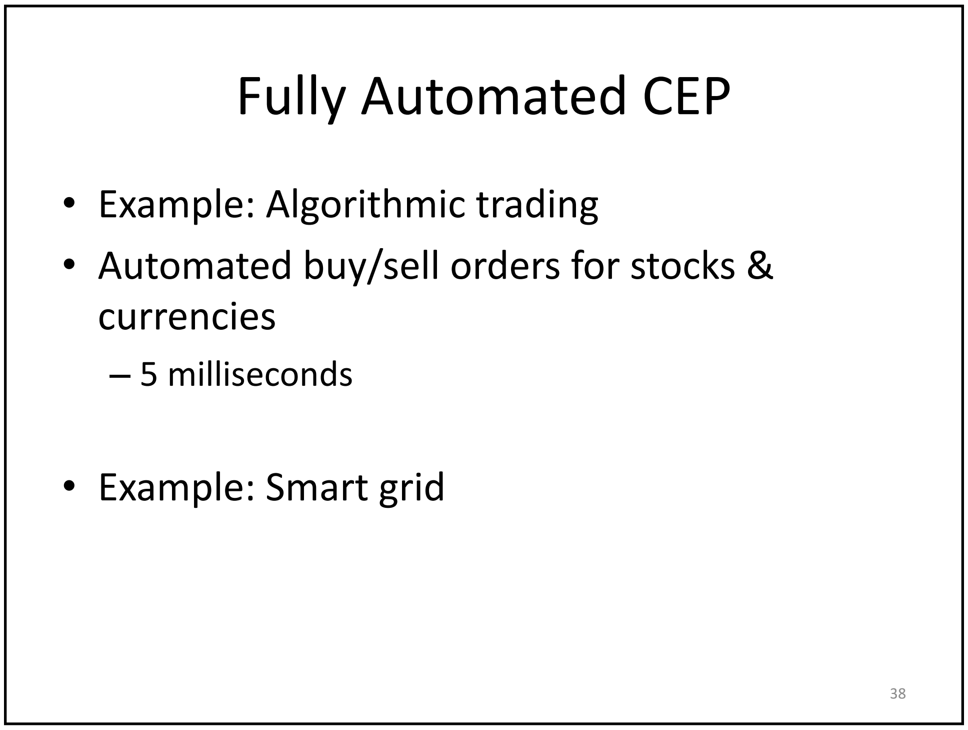

Fully Automated CEP

- Example: Algorithmic trading
- Automated buy/sell orders for stocks & currencies
  - 5 milliseconds
- Example: Smart grid

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CEP Pattern Detection

- Example: correlating two event streams

```
NewsArticle(About Stock X) followed by
StockPriceRise(Stock X, > 5%) within 3
minutes.
```

- Note: StockPriceRise is itself result of CEP-based continuous analytic pre-processing
- Causality:
  - Vertical: Agent_1 Login $\rightarrow$ Agent Available
  - Horizonal: Agent_1 Login $\rightarrow$ Agent_1 Logout

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Variations on Complex Events

- Uncertain events
  - Diagnostic
  - Predictive
- Absent events
- Complexity is relative
  - Example: stock trade reports
  - Short summary of complex interaction

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EVENT PROCESSING ARCHITECTURE

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Contracts

Request-driven

- Client request initiates, “consumed” by provider
- Service provider expected to respond to client requests
- Service client has no obligation to provider

Event-driven

- Event notification initiates, “consumed” by consumer
- Event producer expected to emit event whenever something happens
- Event consumer has no obligation to producer
  - Obligation at higher level

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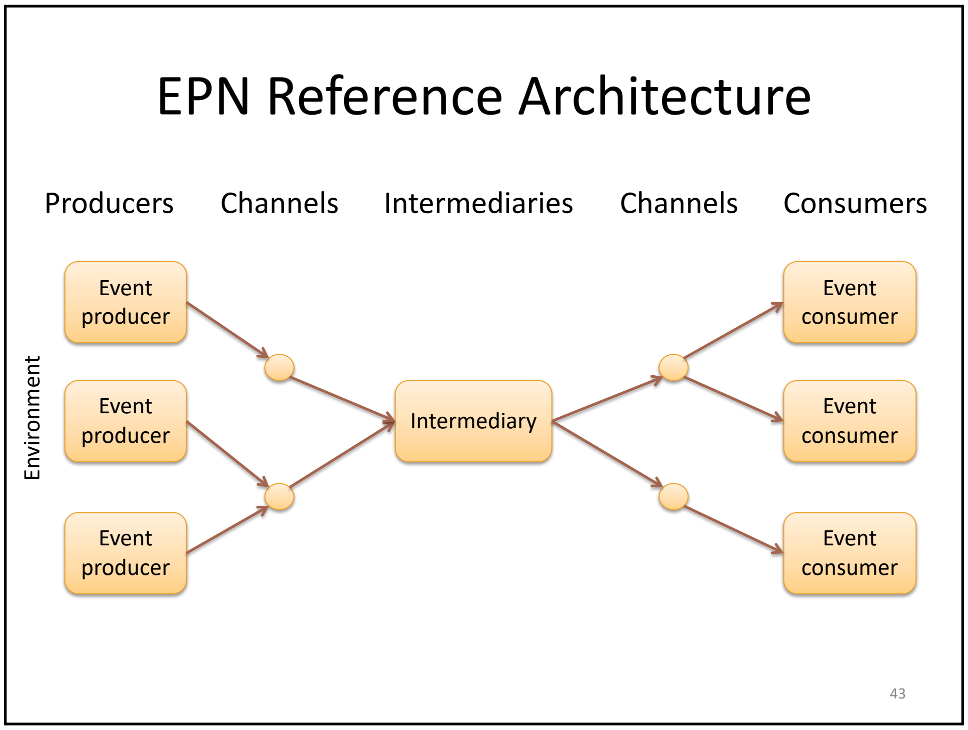

EPN Reference Architecture

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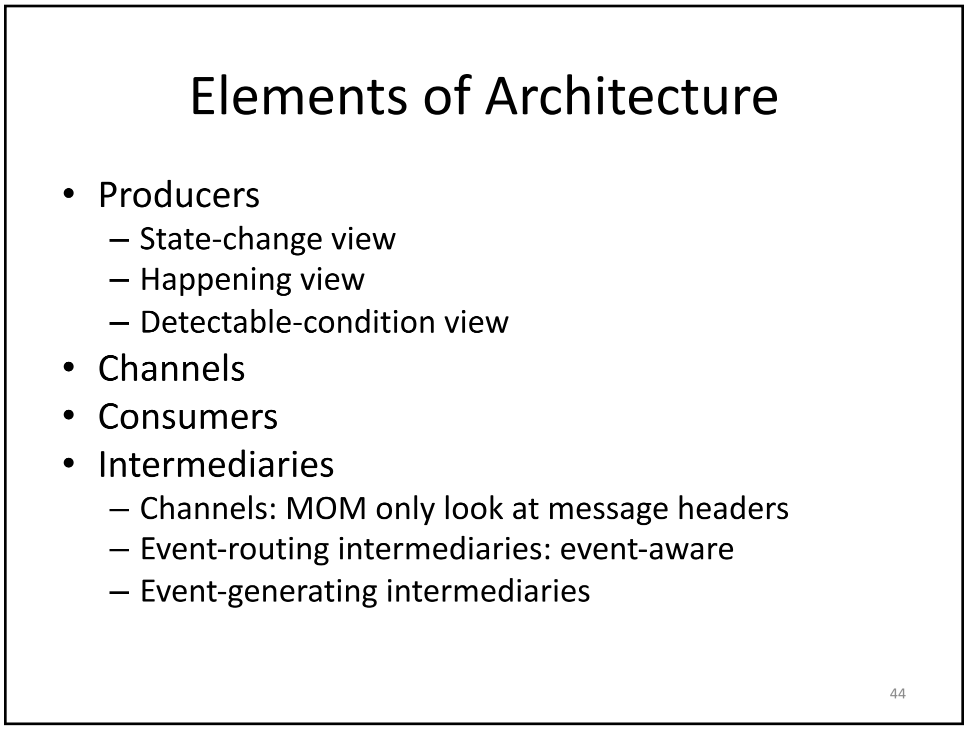

Elements of Architecture

- Producers
  - State-change view
  - Happening view
  - Detectable-condition view
- Channels
- Consumers
- Intermediaries
  - Channels: MOM only look at message headers
  - Event-routing intermediaries: event-aware
  - Event-generating intermediaries

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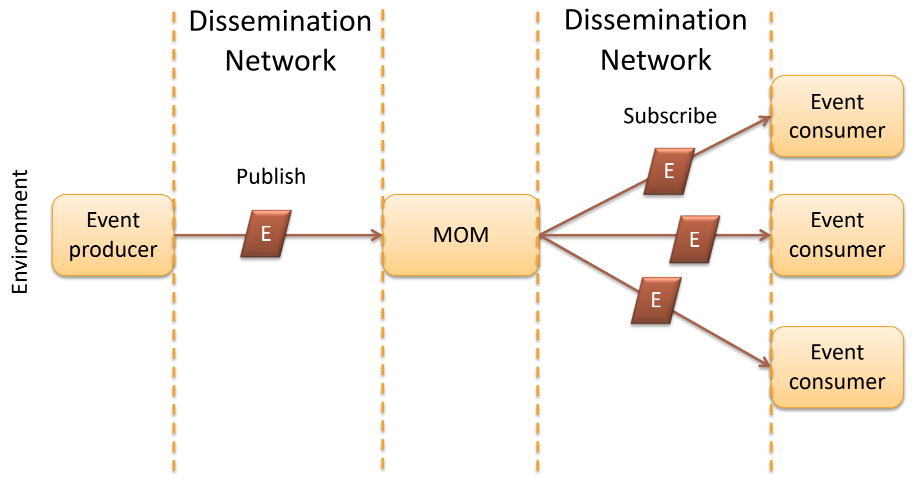
EPN for Information Dissemination



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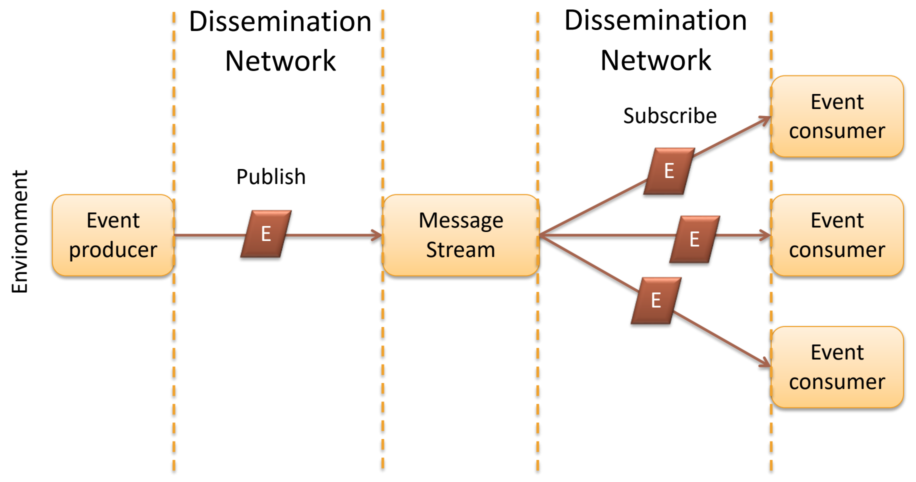
EPN for Information Dissemination



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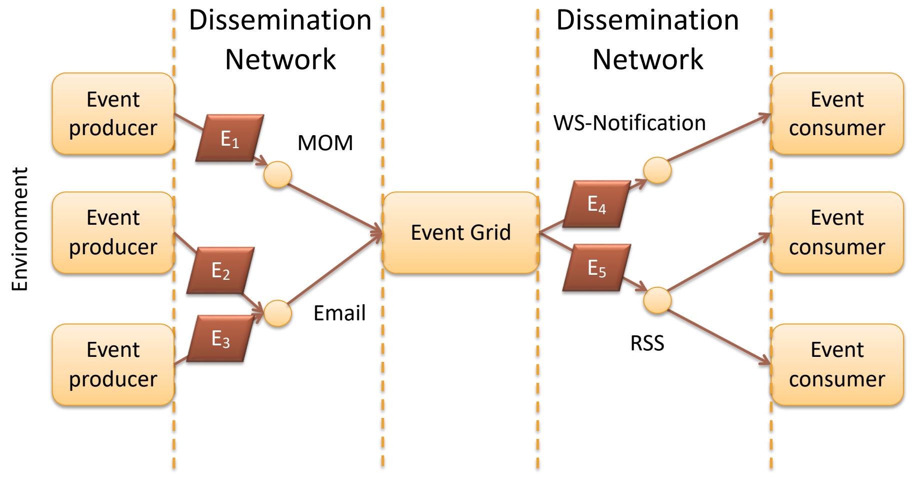
EPN for Situation Awareness



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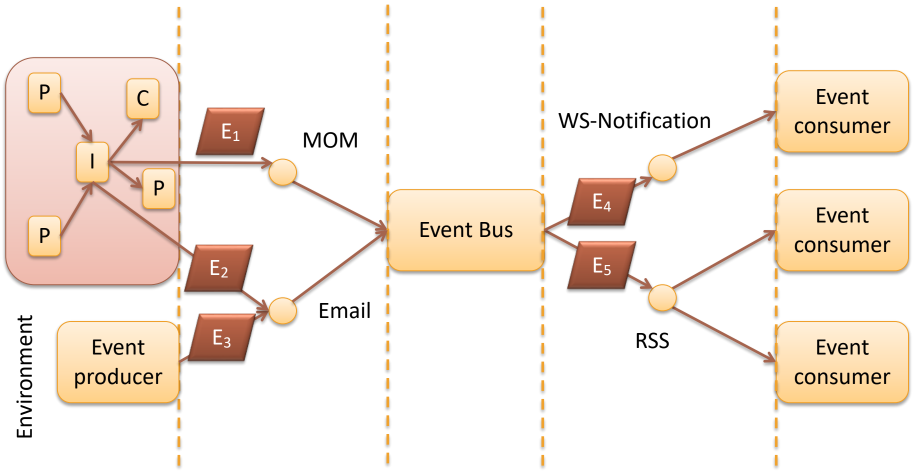
EPN for Application Integration



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