Conversations between Loosely Coupled Systems

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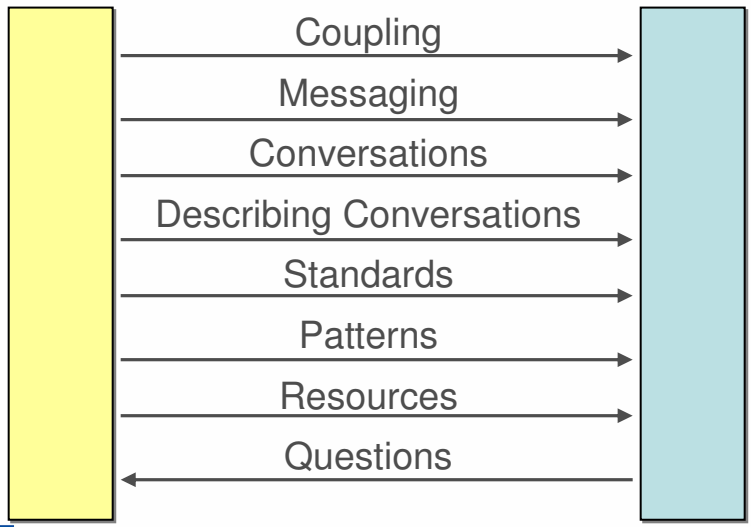
Today's Conversation



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Coupling (Once Again)

Looser Coupling
= Fewer Dependencies
= More Independent Variability

"How do you make two systems loosely coupled? Don't connect them."

-- David Orchard, BEA

- Technology Dependency
- Location Dependency
- Data Format Dependency
- Semantic Dependency
- Temporal Dependency
- Interaction Style Dependency

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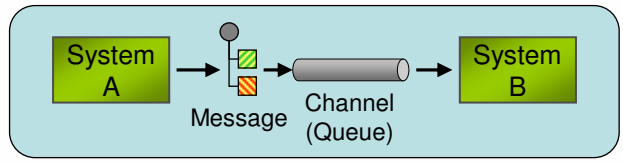
Messaging



The Poster Child of Loose Coupling

- Systems communicate via Channels → Level of indirection
- Location-independent channel names → Location decoupling
- "Fire-and-forget" → Temporal decoupling
- Simplified interaction → Conversational decoupling

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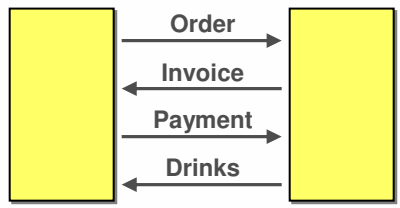
So Far, So Good, But…

- Messaging is loosely coupled, composable, elegant, scalable etc.
- But is sending a simple message enough?
- Multi-step Interactions
  - quote, order, shipment, invoice, payment, refund
- Distributed Transactions
  - 2-phase commit, long-running transactions
- Error handling
  - compensation, retry

Conversation = Series of Related Messages



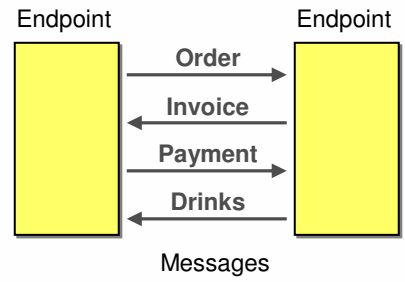
- Conversations can span seconds, hours, days
- Multiple conversation instances at the same time
- Messages belonging to one conversation are correlated (typically through identifier)

Why Do We Care?

- OOAD focuses on structural aspects of the solution (inheritance, composition, aggregation)
- SOA shifts attention to interaction (messaging, stateless servers)
- Messages are expensive
- Part of an expressive contract between parties
- Conversation rules impact coupling

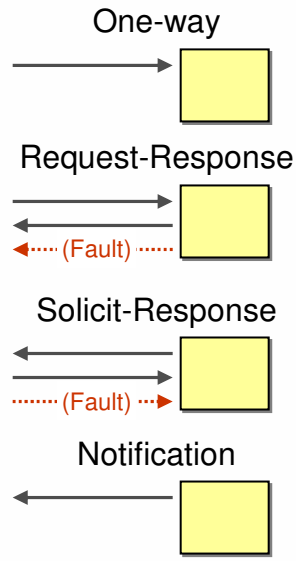
Describing Conversations

- Message Exchange Patterns
- Endpoint Process
- Choreography
- Temporal Logic



Message Exchange Patterns

- Perspective of Service Provider
- Single Requestor
- Described as linear sequence of input-output elements
- Documented by Example
- Part of WSDL 1.1
- More in WSDL 2.0



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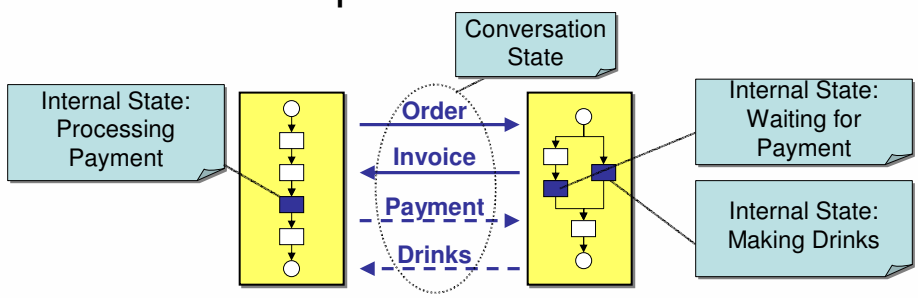
Endpoint Processes



- A process supports the desired exchange of messages through send and receive activities
- Each conversation corresponds to one process instance
- Each participant has a (potentially different) process definition

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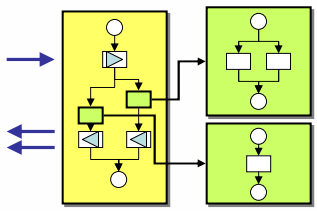
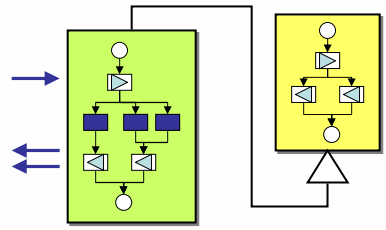
Public and Private Processes

- The private process is more complex than the public process
- Details of the private process may not be shared



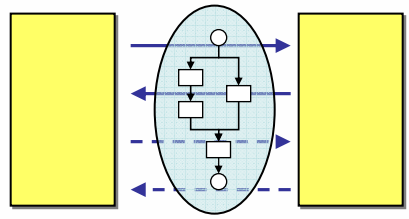
Public process sends & receives messages and invokes private processes through orchestration



Process "Inheritance" – verify compliance of a private process with a public process template (Wil v.d. Aalst)

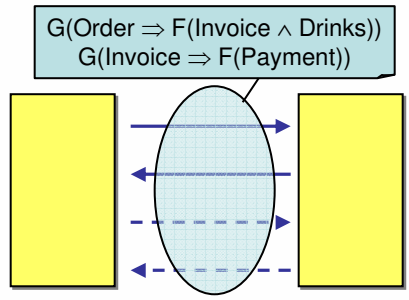
Choreography

Conversation State



- Describe the interaction as a flow of messages: sequence, parallel, choice
- Conversational state machine
- Generate endpoint processes from the conversation model
- Not limited to 2 participants

Temporal Logic



- Describes rules of the conversation as predicates
- Operators X (next), G (globally), U(until), F(eventually)
- Declarative
- Can be used to verify message exchanges

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Standards – WS-BPEL

- Business Process Execution Language
- Process-oriented Composition
- Describe endpoint processes
- Executable through process engine
- Composite service exposed via WSDL
- Sending and receiving of messages, control constructs, control links
- Correlation, compensation, dead path elimination

```
<process/>
<partnerLinks/>
<correlations/>

<invoke/>
<receive/>
<reply/>

<sequence/>
<switch/>
<flow/>
<while/>
<pick/>

<catch/>
<compensate/>
```

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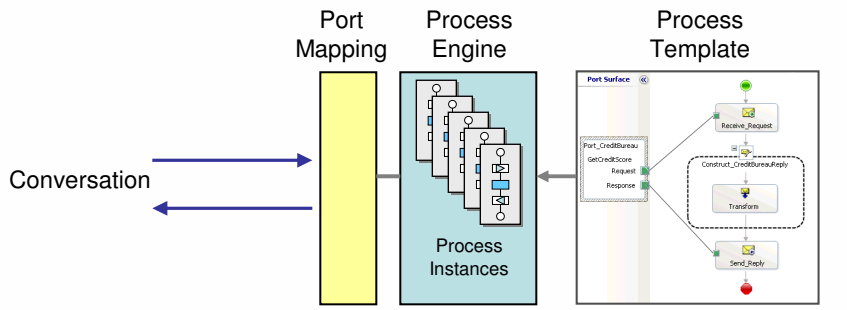
Standards – WS-BPEL




```
<process name="service">
  <sequence>
    <receive partnerlink="…"/>
    <assign …/>
    <reply partnerlink="…"/>
  </sequence>
</process>
```

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Standards – WS-CDL

- Choreography Description Language
- Used to describe conversation "activities"
- Declarative, not executable, can be used to validate
- Generate endpoint processes
- Global view of all interactions between participants
- Time-out, extracting tokens from messages

- Roles
- Relationships
- Work Units
- Activities
  - Sequence
  - Parallel
  - Choice
- Interaction
  - Channel
  - From / To
  - Operation

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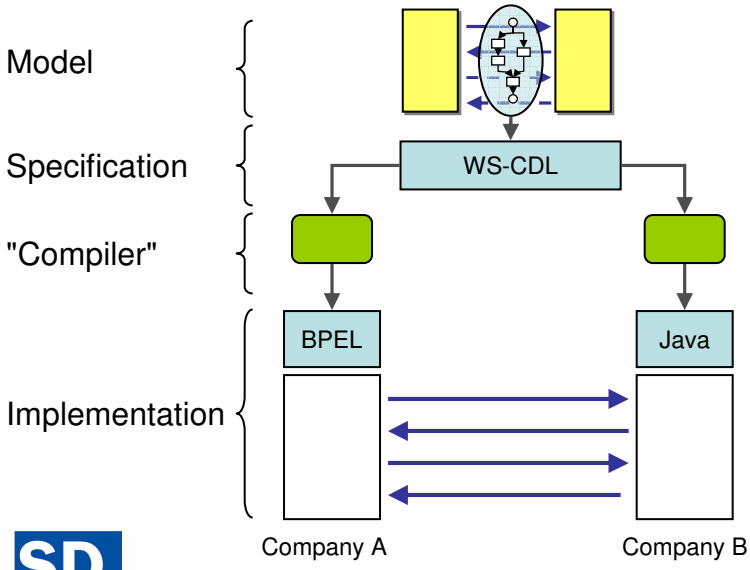
Standards – WS-CDL



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Specification - SSDL

- SOAP Service Description Language
- Multiple Protocol Frameworks
  - MEP
  - CSP
  - Rules
  - Sequencing Constraints
- www.ssdl.org

```
<rls:rule>
  <ssdl:msgref ref="Invoice" direction="out" />
  <rls:condition>
    <rls:and>
      <ssdl:msgref ref="Order" direction="in" />
      <rls:not>
        <ssdl:msgref ref="Invoice" direction="out" />
      </rls:not>
    </rls:and>
  </rls:condition>
</rls:rule>
```

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Description Languages

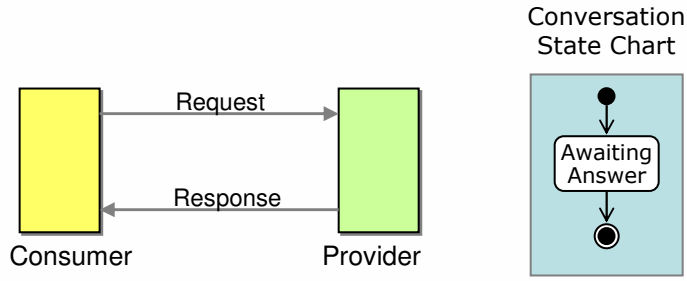
- Provide syntax and base vocabulary to express conversations
- Are intended for consumption by machines
- Enable a broad range of solutions
- Do not tell us how to design a "good" conversation
- Or for that matter, what distinguishes a "good" conversation from a "bad" one

Conversation Patterns

- Provide vocabulary at a higher level of abstraction
- Are intended for consumption by humans
- Investigate a specific usage scenario at a time
- Catalog common scenarios and offer solutions
- Focus on design intent and trade-offs

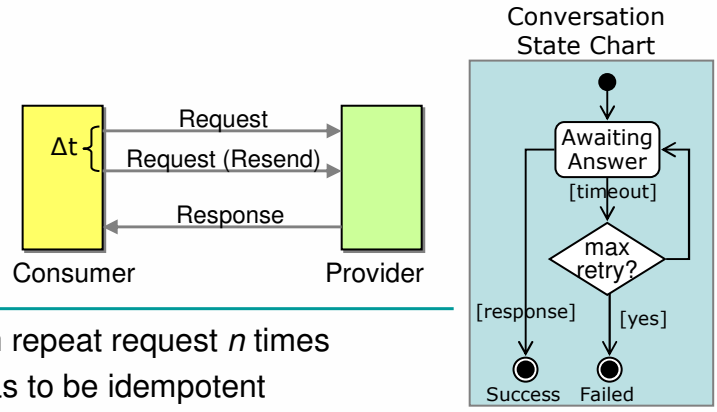
> *"A pattern is a mind-sized chunk of information"*
> --Ward Cunningham

Request-Reply



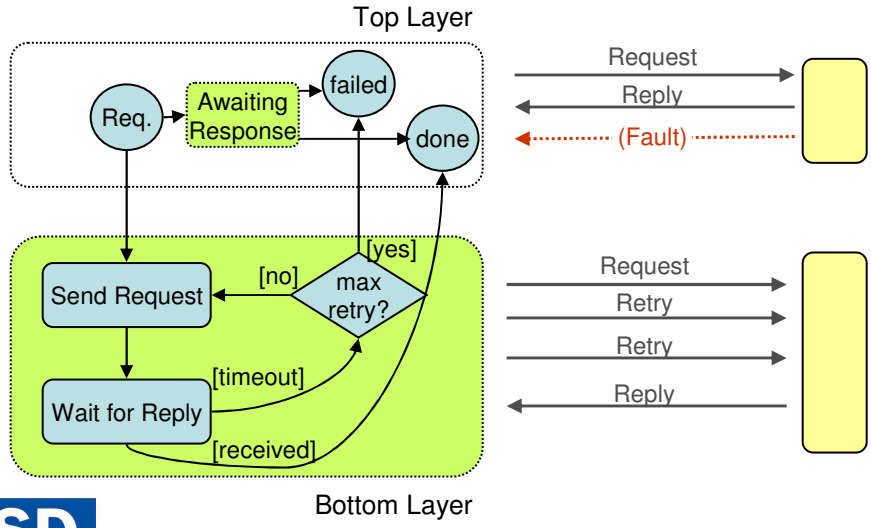
- Simplest conversation
- Single Conversation state: waiting for reply, complete
- More complicated once error conditions considered

Request-Reply with Retry



- Sender can repeat request *n* times
- Provider has to be idempotent
- Sender might receive responses after it gave up
- Example: RosettaNet Implementation Framework (RNIF)

Layered Conversation Protocols



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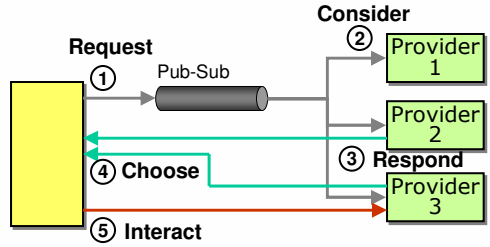
Dynamic Discovery



1. Broadcast request for provider
2. Provider(s) consider whether to respond (load, suitability)
3. Interested providers send responses
4. Requestor chooses “best” provider from responses
5. Requestor initiates interaction with chosen provider

- Examples: DHCP, TIBCO Repository discovery

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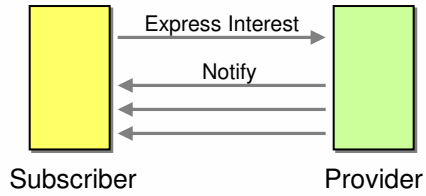
Subscribe-Notify (Multi-responses)

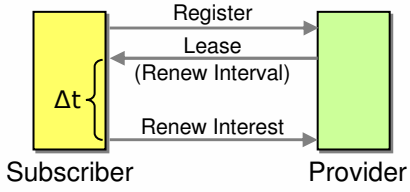


- Subscriber expresses interest in receiving notifications
- Subscriber receives messages until a stop condition is reached:
  - Subscriber sends a stop request
  - A deadline is reached without the subscriber renewing interest
  - Subscriber does not respond to requests from provider
  - Provider notifies subscriber of end of transmission

Example: WS-Eventing, WS-Notification

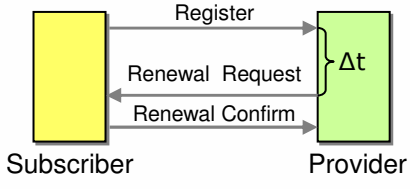
Renewing Interest

Automatic Expiration



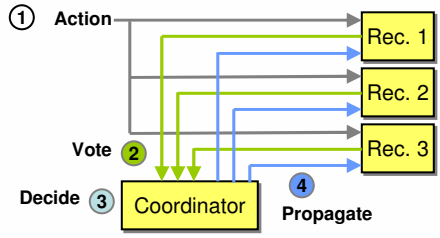
- "Lease" model
- Heartbeat / keep-alive
- Subscriber has to renew actively
- Example: Jini

Renewal Request



- "Magazine Model"
- Subscriber can be simple
- Provider has to manage state for each subscriber

Reaching Consensus



- Coordinated conversation
- Coordinator tracks responses from each participant, makes a decision and then broadcasts the decision
- Example:
  - Two-phase commit

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Summary

- Interaction steps into the foreground
- New languages to describe conversations
- Process-focused or declarative
- New set of design patterns
- Focus on motivation and forces over language syntax

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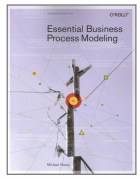
Resources - Print

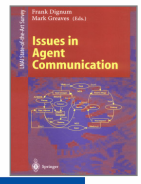
Enterprise Integration Patterns
Gregor Hohpe, Bobby Woolf
Addison-Wesley, 2004

Web Services
Alonso et al.
Springer, 2004



Essential Business Process Modeling
Havey
O'Reilly, 2005

Service-Oriented Architecture
Erl
Prentice Hall, 2005



Issues in Agent Communication
Dignum (Ed.)
Springer, 2000

Business Process Execution Language
Juric
Packt, 2006

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Resources - Online

- www.eaipatterns.com/ramblings.html
  - My Blog
- www.serviceinteraction.com
  - Animated interaction patterns
- www.conversationpatterns.com
  - To go live soon
- www.ssdl.org

I'm Feeling Lucky

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