Enterprise and Networked Enterprise
Model Driven, Service-Oriented
Contract Systems

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SOA, MDA and Web Services Workshop:
Integrating the Enterprise, and Beyond
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Mathet Consulting, Inc.

- Integrated, Interoperable and Cooperative (Collaborative) Systems Architecture and Engineering
- Global and Local Perspectives
- “Business” and Technology Unification
- Networks of Systems / Systems of Networks including software, enterprises, networks of enterprises, and “open” / global systems
- Embed MDA, SOA, and WS
- “Unification” of a number of critical disciplines at the theoretical level and in systems architecture and engineering practice including economics, law, technology, knowledge

- Member IEEE and OMG
Abstract

• This presentation will focus on model driven, service-oriented, enterprise and networked enterprise contracts and contract systems. It will take a full-lifecycle systems approach to these systems showing how the synergy between the model driven approach and the service-oriented approach enables enterprises to maximize its value in constantly changing economic, legal and technology environments. Topics for discussion will include in the context of MDA and SOA:
  – Business and technology contracts / service level agreements
  – Mapping business services to technology services
  – Contract system services
  – Contract system infrastructure including trans-modal (inter-) enterprise service buses
  – Web Services technology for contract systems
  – Contract systems interoperability
  – Enterprise economic maneuverability, legal accountability and liability
Introduction and Background

MDA, SOA, and Web Services:
Delivering the Integrated Enterprise
Orlando, Florida
March 21-24, 2004
The Multi-context Integration, Interoperability and Collaboration Problem Within and Between Enterprise, Federation and Internet Systems

Community of Practice

Problem Domain

Knowledge Domain

Embedded Modeling Systems - may be shared or non-shared

Supply Chain

Problem Domain

Industry Domain
**Enterprise and Networked Enterprises**

**Model Driven, Service-Oriented Contract Systems**

- **Systems Oriented**, **Systems Based**, **Systems Driven**
  - Architecture and Engineering
  - Architecting for system adaptability, responsiveness, flexibility, etc.
  - Unifies the partial architecture descriptions

- **Partial Architecture Description**
  - aspects / views and viewpoints of a system (e.g. enterprise, federation, community) architecture

**System of Interest**
- Has an architecture
- described with an architecture description

**Model** Driven Architecture (and Engineering)
(Semi) Formal Architecture Description

**Model** Oriented Architecture (and Engineering)
Model Oriented Architecture Description

**Object / Component** Oriented Architecture and Engineering
Object Oriented Architecture Description

**Service** Oriented Architecture (and Engineering)
Service Oriented Architecture Description
- Obtained from an external view in abstraction of the underlying technology that implements the services
- A services viewpoint captures the rules of the view

**Process (task, activity)** Oriented Architecture and Engineering
Process Oriented Architecture Description

**Role** Oriented Architecture and Engineering
Relation Oriented Architecture Description

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- “An approach to IT system specification that separates the specification of functionality from the specification of the implementation of that functionality on a specific technology platform” (www.omg.org/docs/ab/03-01-03)
- Three senses:
  1. An architecture (description) for MDA Tool Sets (a platform for creating system architectures)
  2. An architecture (description) for OMG standards
  3. An (IT) system architecture (description) created using the MDA approach, standards and tool sets

1. An architecture exhibiting the service provider - registry - service requestor pattern and implemented with web services technology (e.g. SOAP, XML)
2. A partial architecture (description) of a system focused on services
   - An external view in abstraction of the underlying technology that implements the services.
   - the view is focused on the service products produced from sets of functions
   - A services viewpoint, which may be a metamodel, captures the rules of the view

Model driven, service oriented enterprise architecture (description):
- An architecture (description) for an enterprise system that exhibits model driven and service oriented features
(Business) Processes –
- Enterprise Threads of **Action**
- Represented by algorithms / heuristics
- “programming in the large”

“The (business) system defined by the executing process is the application”
The enterprise OS – SOA infrastructure / Technology Services
Large Grained Interfaces / Contracts

Networked System AB

Role

System A: e.g. Enterprise, Contract

Organic Technology Resource Layer

Intra-system contracts

Technology Systems

Information Technology Resource Layer

Communication Channel

Inter-System Contracts

Business Systems Interfaces

System B: e.g. Enterprise, Contract

Organic Technology Resource Layer

Technology Systems Interfaces

Enterprise System Interface

Large Grained Interfaces / Contracts
- “programming in the large” - process definition / execution
- Service Orchestration vs. Choreography

- Systems / components interact at peer levels and in terms of super - subsystems
- Contracts / agreements may exist for every interaction
- Many contracts / contract provisions may be in the form of parameterized templates (e.g. QoS) – enables dynamic configuration. Others may be more complex
Together they are an intersection point, within and between:

- economic systems
- legal systems
- (inter-) enterprise systems
- communities of practice
  locally and globally

- They define, constrain (inter-) enterprise “ecosystems”.
  The basis of a modern model of global and local competitive economy is the fulfillment of needs of the members of these economic communities (ecosystems).

- are unifying mechanisms: value, goals and objectives, processes and services, interfaces, agreements, security and privacy, quality, logic and language, law, economics, communities, etc.

- are a (the) key contributor for business – IT alignment within enterprises and between enterprises at the business and IT levels of interactions.

- are concerned with governance (authorities, duties, obligations, responsibilities, consequences, etc.: this is NOT management)

Contract systems and contracts may be considered to be a part of a larger Integration, Interoperability and Collaboration System that is ubiquitous and pervasive.
Contracts and Contract Systems
Contracts: Lifecycle

Contract System (MDA X SOA)

Contract Lifecycle Process

Contract Algorithms (Heuristics, Rules, Measures)
Policies and Procedures, Best Practices and Standards

Service / Product Discovery Algorithms
(Heuristics, Rules, Measures)
Policies and Procedures
Best Practices and Standards

Contract Negotiation Algorithms
(Heuristics, Rules, Measures)
Policies and Procedures
Best Practices and Standards

Contract Fulfillment Algorithms
(Heuristics, Rules, Measures)
Policies and Procedures
Best Practices and Standards

Service Discovery
Resources playing Roles with Responsibilities

Negotiation
Resources playing Roles with Responsibilities

Fulfillment
Resources playing Roles with Responsibilities

Service / Product Search / Discovery Step

Negotiation / Agreement Step

Fulfillment Step

Contract Resources playing Roles with Responsibilities

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Contracts: Lifecycle

A Process Instance

Part of Lower Level Transformation System *

Contract System Environment

Business Change / Drivers / Problems

Goals

Analysis

Requirements

‘Architecture Engineering’

Factory Floor

Analysis and Design

Design

Contract Drafting

Contract V and V

Design for Contract System

Testing

Test Contract System

Construct Contract System

Deployment

Integrate Contract System

Maintenance

Termination

Execution

Solutions

Negotiation / Agreement

Contract System Environment

Goals for Inter-system agreements

Analysis Current State of the Enterprise

Includes for Contract System

Integration

Interoperability Collaboration

Include requirements for Integration Interoperability Collaboration

Interoperability Collaboration

Contract System

Test Contract System

Contract System

Terminate Contract

-reallocate Resources

Construct Contract System

Execute Contract

Administrs, Monitor, Evaluate Contract Execution System

Terminate Contract

Solutions

Evaluate

Contract System

Integrate

Contract System

Test

Contract System

Testing

Factory Floor

A contract

A Product

Deployment

Maintenance

Termination

Business Change / Drivers / Problems

Goals

Analysis

Requirements

‘Architecture Engineering’

Factory Floor

Analysis and Design

Design

Contract Drafting

Contract V and V

Design for Contract System

Testing

Test Contract System

Construct Contract System

Deployment

Integrate Contract System

Maintenance

Termination

Execution

Solutions

Negotiation / Agreement
# Contracts: Perspectives

<table>
<thead>
<tr>
<th>Perspective</th>
<th>‘Contract’ Semantics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Object / Component Perspective (including applications)</td>
<td>E.g. “Design-by-Contract’. ‘Contracts’ as pre- and post-condition assertions that are placed within classes. The ‘contract document’ is part of the class specification.</td>
</tr>
<tr>
<td>Service Oriented Perspective</td>
<td>E.g. Service / Service Level Agreements, ITIL. Business Services – Technology Services Mapping. External view of components operating in context with other components. May deal with assertions associated with output between components. The ‘contract’ document is external to components.</td>
</tr>
<tr>
<td>Process (task, activity) Perspective</td>
<td>Organization work process. Mapping organization goals / objectives with business services</td>
</tr>
<tr>
<td>Project (task, activity) Perspective</td>
<td>Service provider contracts with Statements of Work. E.g. Contracts with technology vendors</td>
</tr>
<tr>
<td>Role Perspective</td>
<td>A ‘contract’ specifies the expectation of behavior in a purposeful interaction with consequences for failure to fulfill role</td>
</tr>
<tr>
<td>Economic / Finance Perspective</td>
<td>Finance contracts, Business contracts</td>
</tr>
<tr>
<td>Legal Perspective</td>
<td>Legal Rights, Obligations, duties, authorities, consequences. A ‘contract’ in the Role sense with legal consequences. Business contracts, statute, trade, etc.</td>
</tr>
<tr>
<td>Systems Perspective</td>
<td>All of the above integrated into a whole – contract ontology utilized by contract systems within and between enterprises</td>
</tr>
</tbody>
</table>

Modified from Abrahms and extended
Contracts: Interaction Representation

Object / Component Perspective (including applications)
Service Oriented Perspective
Process (task, activity) Perspective
Project (task, activity) Perspective
Role Perspective
Economic / Finance Perspective
Legal Perspective
Role Perspective
Systems Perspective

- A concrete agreement which includes consequences for violation.
- A concrete (shared) representation of an abstract agreement expressed with some language

Contract Document

Provision

Provision

Role

Role
There is an *expectation* that contract fulfillment satisfies some *business goal*. Contract fulfillment has some expected (economic) value.

Rights, obligations, permissions, consequences, duties, violations, powers (authority).

Contracts may be included by reference.
Contract Document

For a Organization Product / Service

Contract Document Model
Modified after (Milosevic et al.)

Organization Contract Document Specification

Digital Signature Section

Enforcement Policy

CFR 21 Part 11

Rule Specification

Preamble

Approval Section

Provision

Linguistic Clause

- an article or clause (as in a contract that introduces a stipulation)
- a separate section of a discourse or writing, spec. article, document
- conditional stipulation
- Stipulation: a condition, requirement or item specified in a legal instrument

- a group of words containing a subject and a predicate, and functioning as a member of a complex or compound sentence

Organization Contract Document Specification

Organization Person Signature

Contract Document Instance
Contracts: Types

- **Tech Services**
  - Object / Comp.
    - Virtual Services
      - Organization
        - Types defined by law
          - Contracts between subsystems inside system boundaries
          - External
            - Contracts between systems outside system boundaries
          - Automated
            - IT system interactions
          - Non-Automated
            - Primarily People - People Interactions

- **Governed by Contract law**
  - Legal
  - Non-legal

- **Examples**
  - Bus – Bus
  - Bus – Gov
  - Gov - Gov
  - Bus – NonProfit
  - Bus-Consumer
  - Gov - People
Contracts: Registry / Repository

Provisions classified by interaction type (e.g.)
- Enterprise – Enterprise
- Work Organization – Work Organization (internal to enterprise)
- Business - Technology
- Technology - Technology

Provisions classified by topics
E.g.
- Service / Product
- Process
- Quality
- Performance
- Security / Privacy
- Roles
- Value
- Etc.

Including **current value** of service under contract

XML Documents

Contract Registry / Repository

Contract

Content

Signature Block

Log Files

Status Information
An **economic relationship** (a type of relationship) **governed** by law as embodied by the contract (legal agreement)
- this relationship is concerned with (inter-)**actions** with respect to some product / service
- relationship attributes include strength, flexibility, durability, etc.
- each party in the agreement **hypotheses** (at time $T_0$) that **execution** of the agreement will be of some **value** $V_0$. The actual value may differ
- execution (fulfillment) has two parts: creation of product / service, delivery

A legal **relationship** (a type of relationship) **governed** by law as embodied by the contract (legal agreement)
- Rights, Duties, Powers, Obligations, Permissions, Violations, Legal Consequence
- this relationship constrains strategies, responses to changing environmental conditions
Negotiation

Language (s): L*

Internal Models: M* (e.g. interpretations)

Internal Storage

Historical Knowledge, Information, Data

Facts Beliefs

Reasoning

Percepts

Sensors

Receive Data

Context Data

In

Data

Take Actions

e.g. Send Data

Behavior

Temporary Internal Storage

Effectors

Interaction

Knowledge, Information, Data

Out

Data

Negotiation

Context

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Negotiation

Rights, obligations, permissions, consequences, duties, violations, powers (authority)

Contract

Contract has a role
- contract is passive, role is assigned
(role may be different among the parties)
The contract has value

Contract Negotiation
Requires Deontic / Modal Logic
Requires Semantic interoperability

Data
{Language: syntax, vocabulary}

Conduit / Channel / Media

“Instance” of an emergent Contract Negotiation System
Produces a service to all parties involved in negotiations
The parties are part of a group

There are 2..N members/parties in a negotiation group

Agents may be aware of enterprise history, goals, strategies, current state including existing contracts
⇒ contract negotiated must be consistent with all of above

Negotiation Styles
Competitive, Cooperation, Collaboration,
Compromising, Accommodating, Avoiding
Each negotiation style results in some level of utility on both the individual basis
and at the systematic level (ecosystem levels)
There is an efficiency associated with each style to reach a given level of utility
**Contract Fulfillment**

The contract governs the interaction. Especially true with legal contracts.

"Instance" of an emergent / "programmed" Contract Fulfillment System

- Produces a service to all parties involved in the interaction
- The parties are part of a group

**The (business) services have value**

- Services are managed
- Services are governed. If a contract is in place, including rights, obligations, permissions, consequences, duties, violations, and powers (authority), then the **contract governs the interaction**
Assign / MEASURE value to resources and services
Requires Cost, Benefits, Risk, Value, etc. models
This 'maps' value to services and resources.
Contracts are associated with expected values.
Services are managed to that actual is equal to or greater than expected.
Model Driven, Service Oriented Contract Systems
Model Driven Service Oriented Vendor and Standards

Other Standards Bodies
- OASIS, W3C (Web Services)

OMG Enterprise

MDA sense 2 meta-models for example

MDA Tool Vendor Enterprises

COTS Products and associated services

Enterprise

Enterprise services

Enterprise

Contract Systems

Contract Systems

WS, SOA Standards Output as service

MDA Standards Output as Service

MDA Tool Vendor Enterprises

Collaboration

MDA sense 1

Other Standards Tool Vendors Enterprises (WS, SOA)

Collaboration

MDA sense 2

Enterprise

Contract Systems

Enterprise services

MDA sense 3

Model Driven – SOA Enterprise Architecture and Engineering
System Lifecycle (e.g. Contract Systems)

A Process Instance
A part of an Upper-Level Transformation System

Build Environment

Business Change / Drivers / Problems

Goals

Analysis

Analysis and Design

Requirements

----- Design -----

Architecture and Engineering

Implementation

Testing

Factory Floor

Deployment

Execution Environment

Solutions with Services

Maintenance

Retirement

Goals for Inter-system agreements

Analysis Current State of the Enterprise

Includes for Contract System

Design for Contract System

Includes requirements for Integration Interoperability Collaboration

Including Integration, Interoperability Collaboration

Construct Contract System

Test Contract System

Integrate Contract System

There is a (sub) system associated with each step.
Each (sub) system has their own set of processes – operating concurrently.
These systems are loosely coupled, highly coherent.
Each (sub) system has a role.

Each (sub) system provides services to other systems with multiple feed-forward and feedback loops and control points.
All (sub) systems are operational systems – including those in the Build Environment
All (sub) systems are model-driven, service-oriented

The Enterprise System is continuously evolving through, in part, continually evolving contract systems and contracts
MDA Standards

Business Process Modeling Notation
Business Process Definition Metamodel
Semantics Business Vocabulary and Rules
Ontology Definition Metamodel
EDOC
MOF
UML Infrastructure
UML Superstructure
OCL
Query View Transformation
CWM
Business Motivation Model
Organizational Structure
SysML
- Basically all standards
WS Standards

BPEL4WS (Business Process Execution Language for Web Services) 1.1 [IBM, BEA, Microsoft: Specification] à
WSBPEL (Web Services Business Process Execution Language [OASIS: BEA, Hewlett-Packard, IBM, IONA,
Microsoft, NEC, Oracle, SAP, SeeBeyond, Sun, Tibco, webMethods]
Common Base Event [IBM: Specification]
DNS Endpoint Discovery (DNS-EPD) [IETF: Committee Draft]
JSR 172 – J2ME Web Services [JCP: Specification]
JSR109 – (Web Services for J2EE) 0.3 [JCP: Public Draft]
SOAP (Simple Object Access Protocol) 1.2 [W3C: Specification]
UDDI (Universal Description, Discovery and Integration) 3.0 [OASIS: Specification]
WS-Addressing [IBM, BEA, Microsoft: Specification]
WS-Atomic Transactions [IBM, BEA, Microsoft: Specification]
WS-Attachments [IETF, IBM and Microsoft: Specification]
WS-BaseNotification [IBM, Sonic Software, TIBCO Software, Akamai Technologies, SAP AG, Computer
WS-BusinessActivity [IBM, BEA, Microsoft: Specification]
WS-Coordination [IBM, BEA, Microsoft: Specification]
WS-Experience Language (WSXL) 2.0 [IBM: Specification]
WS-Federation Language [IBM, BEA, Microsoft, RSA, Verisign: Specification]
WS-Federation: Active Requestor Profile [IBM, BEA, Microsoft, RSA, Verisign: Specification]
WS-Federation: Passive Requestor Profile [IBM, BEA, Microsoft, RSA, Verisign: Specification]
WS-I Attachments Profile 1.0 [WS-I: Working Draft]
WS-I Basic Profile 1.0 [WS-I: Specification]
WS-I Basic Profile 1.1 [WS-I: Working Draft]
WS-I Simple SOAP Binding Profile 1.0 [WS-I: Working Draft]
WS-Inspection 1.0 [IBM, Microsoft: Specification]
WS-Manageability 1.0 [IBM, Talking Blocks, Computer Associates: Specification]
Standards – cont.

WS-PolicyAssertions [IBM, BEA, Microsoft, SAP AG: Specification]
WS-Provisioning [IBM: Specification]
WS-ReliableMessaging [IBM, BEA, Microsoft, TIBCO: Specification]
WS-Security 1.0 [OASIS: Open Standard]
WS-Security Addendum [IBM, Microsoft, Verisign: Supplemental Information]
WS-Security Kerberos Binding [IBM, Microsoft: Specification]
WS-SecurityPolicy [IBM, Microsoft, RSA, Verisign: Specification]
WS-Transactions [IBM, BEA, Microsoft: Specification]
WSDL (Web Services Description Language) 1.1 [W3C (IBM and Microsoft: note]
WSDL (Web Services Description Language) 1.2 [W3C (IBM and Microsoft: working draft]
WSRP (Web Services for Remote Portals) 1.0 [OASIS: Open Standard]
Vendors and Products (may be incomplete)

Web Services Suites

- Actional Corporation (Actional SOA Command and Control)
- Magic Software Enterprises (iBOLT Integration Suite)
- Novell (Novell exteNd Enterprise / Professional Suite)
- ReadiMinds Systems and Services Pte Ltd. (ReadiMinds WebServices Applications Suite – WSS)
- Sonic Software Corporation (Sonic ESB)
- Systinet Corporation (Systinet Product Suite)

Web Services Desktop Integration

- NetEdge Software, Inc. (Web Services Enabler)
- RatchetSoft, LLC (Ratcht – X)

Web Services Development Tools

- Above All Software, Inc. (Above All Studio)
- Altova GmbH (xmlSpy)
- Ascential Software Corporation (Enterprise Integration Suite)
- Attachmate Corporation (myEXTRA! Smart Connectors)
- BEA Systems, Inc. (BEA WebLogic Workshop)
- ClientSoft, Inc. (ServiceBuilder)
- Commerce One Operations, Inc. (Conductor Composite Manager)
- Compuware Corporation (UNIFACE)
- FusionWare Corporation (FusionWare Integration Server)
- GT Software, Inc. (Ivory Web Services)
- IBM (Eclipse, Websphere)
- InterSystems Corporation (Ensemble)
- IONA Technologies (Artix)
- iWay Software (iWay Web Services)
- Panter Corporation (Shared Data Services Suite)
- Rogue Wave Software, Inc. (Lightweight Enterprise Integration Framework – LEIF)
- Seagull Software Systems, Inc. (Trnasidion and LegaSuite)
- SeeBeyond, Technology Corporation (The SeeBeyond Integrated Composite Application Network – ICAN – Suite)
- Strikelron, Inc.
- Swingtide, Inc.
- TIBCO Software, Inc. (TIBCO Business Works)
- Verity, Inc. (Ultraseek)
- Vultus, Inc. (Webface Solution Suite)
- WDI (Redbern)
- WebCollage, Inc. (WebCollage Syndicator)
- webMethods Inc. (webMethods Glue)
## Vendors and Products (may be incomplete – cont.)

### Web Services Orchestration

- ActiveBPEL (ActiveBPEL)
- Active Endpoints, Inc. (ActiveWebFlow)
- Collaza, Inc. (Collaxa BPEL Server – acquired by Oracle Corporation)
- Commerce One Operations, Inc. (Conductor Composite Manager)
- Corticon Technologies, Inc. (Corticon Decision Management Platform)
- Dralasoft, Inc. (Dralasoft Workflow)
- IBM Corporation (WebSphere Business Integration Modeler)
- Metastorm, Inc. (e-Work)
- Novell, Inc. (Novell exteNd Enterprise Suite)
- OpenStorm Software, Inc. (Service Orchestrator)
- Oracle Corporation (Oracle BPEL Process Manager – formally the Collaxa BPEL Server)
- Readiminds Systems and Services Pte Ltd. (Readiminds WebServices Applications Suite – WSS)
- SeeBeyond, Technology Corporation (eInsightBusiness Process Manager)
- Sonic Software Corporation (Sonic orchestration Server)
- WebV2, Inc. (WebV2 ProcessCoupler)

### Web Services Security

- BEA Systems, Inc. (BEA Weblogic Enterprise Security)
- Commerce One Operations, Inc. (Conductor Composite Manager)
- DataPower Technology, Inc. (XML Security Gateway)
- Digital Evolution, Inc. (DE Management Server)
- Forum Systems, Inc. (XML Sentient)
- Layer 7 Technologies, Inc. (SecureSpan)
- Netegrity, Inc. (TransactionMinder)
- Reactivity (Reactivity XML Firewall)
- RSA Security, Inc. (RSA BSAFE Secure – WS)
- Sarvega, Inc. (XML Guardian Security Products)
- Teros, Inc. (Teros Web Services Security Gateway)
- Vordel Limited (VordelSecure and Vordel SOAPbox)
- Actional Corporation (XML Message Server) – formerly Westbridge XML Message Server

### Web Services Testing

- iTKO Corporation (LISA)
- Parasoft Corporation (SOAPtest)
- Mindreef, Inc. (SOAPscope)
- Segue Software, Inc. (SilkPerformer Component Test Edition)

### XML Data Routers, Message Routers, and Adapters

- Appligent, Inc. (APConductor)
- BEA Systems, Inc. (BEA Weblogic Integration)
- Commerce One Operations, Inc. (Conductor Composite Manager)
- Kanemea, Inc. (Web Messaging Platform)
- NEON Systems, Inc. (Shadow z/Services)
- Novell, Inc. (Novell exteNd Enterprise Suite)
- Sarvega, Inc. (XML Context Router)
- SeeBeyond, Technology Corporation (eWay Intelligent Adaptors)
- Actgional Corporation (XML Message Server) – formerly the Westbridge Message Server

### XML Accelerators

- DataPower Technology, Inc. (XML Accelerator)
- Sarvega, Inc. (XML Speedway Accelerator)
- Tarari, Inc. (RAX Content Processor and XML Content Processor)
Mathet Consulting, Inc.

Integrated, Interoperable and Collaborative Systems

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