

Using Facets of Security within a Knowledge-based Framework to Broker and Manage Semantic Web Services

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Research Goals

- Provide a framework & methodology to create Virtual Organizations (VO) via Semantic Web Services
- Support end-to-end requirements & life-cycle tasks to create VO on the fly
- Address layers that correspond to Specification, Design and Implementation
- Focus here is on Intelligent Middle-ware Services for Secure Knowledge Management

Where is the VO Knowledge?

- Humans as part of the VO
- Intellectual Property wrapped in Semantic Web Services
- Policies that govern the VO
 - Service-level agreements
 - QoS agreements
- Security Policies and Protocols
- Access Control, Authentication Services for VO
- Virtual Security for GRID Services

Problem Space

- Automate Web Services
 - Apply Semantic Web Technologies (Semantic Web Services)
 - Deal w/ Plethora of Standards and Protocols
- Issues of a Virtual Organization
 - Rapid configuration needed due to temporal nature of requirements;
 - Enterprise Issues of Resource Management, Quality of Service and Negotiation, and
 - Security issues run through every facet of the VO

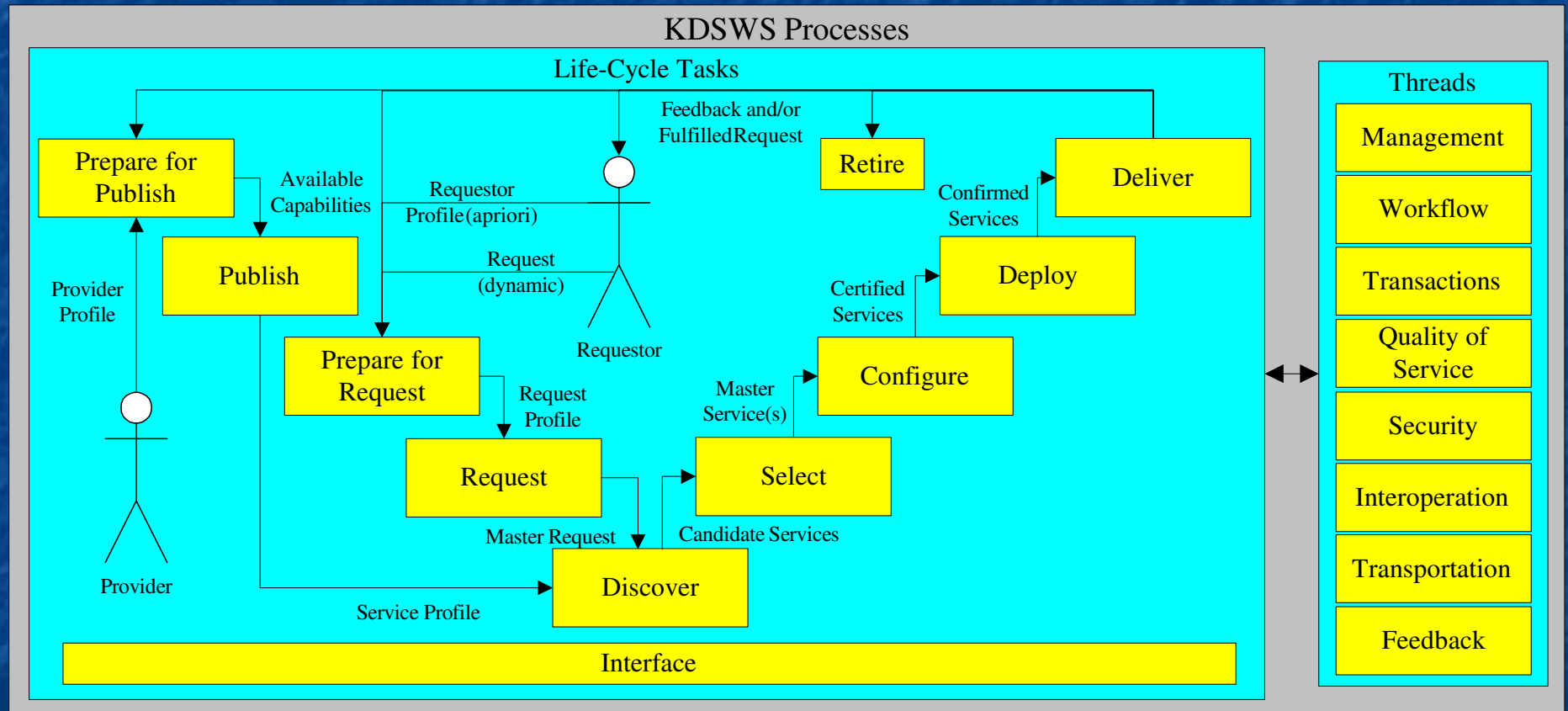
Solution Space

- Knowledge-based Dynamic Semantic Web Services (KDSWS) Framework
 - Meta-Model for Semantic Web Services
 - Meta-Process (Methodology)
 - Specification Languages based on KDM/KDL
- Specifies:
 - End-to-end tasks of the life-cycle for context,
 - Threads to deal with Management, Workflow, Transaction Control, Interoperation, Security, Transportation and Feedback
 - Enterprise and Local Perspectives
 - Functional Architecture Components

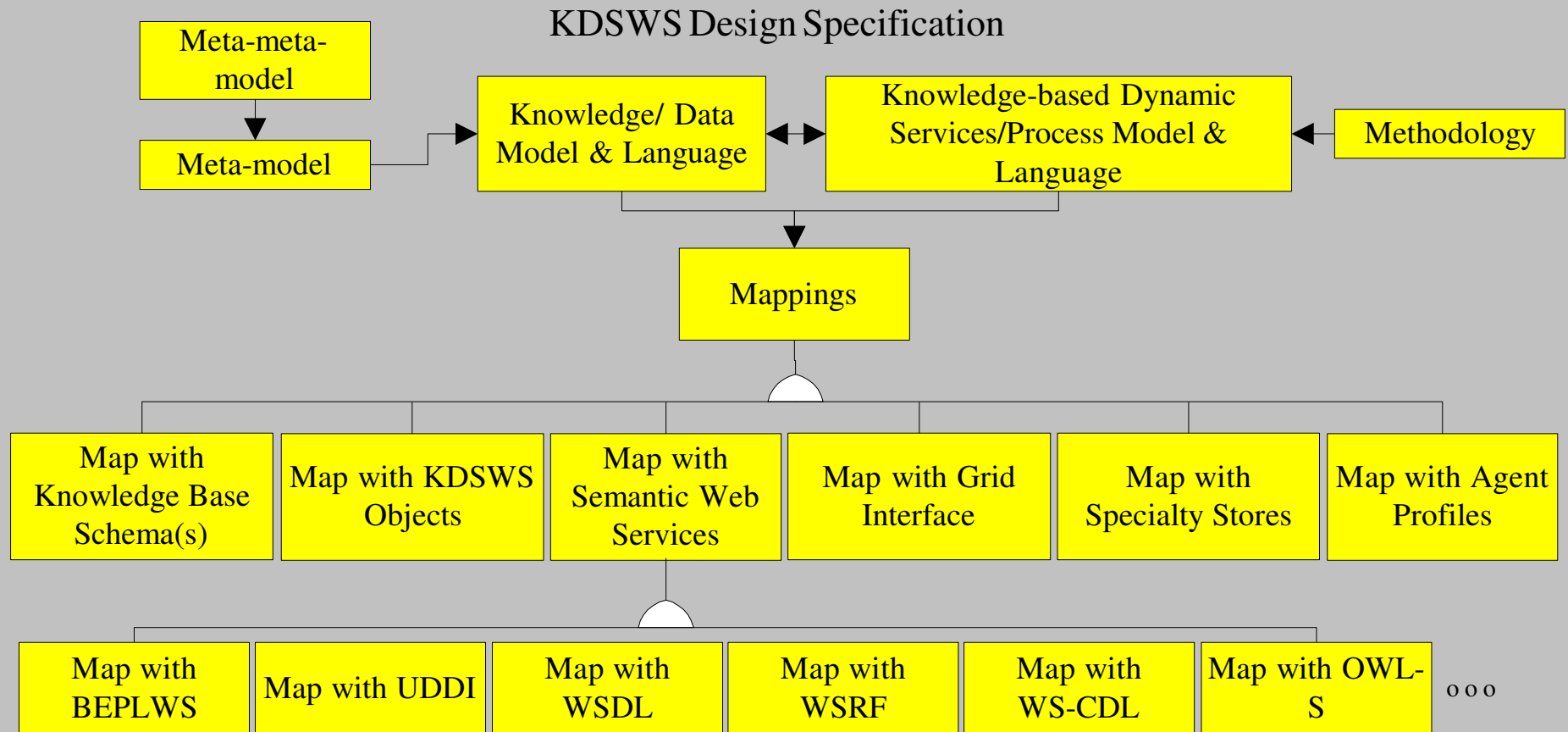
Brokering and Management

- Brokering, or matchmaking, involves [Paolucci, 2004]:
 - Services advertising themselves to a broker
 - Broker handling queries about the available services
 - Mediating the results for the requestor
- Management Levels [Nayak, 2001]:
 - Strategic
 - Asset
 - Value-Chain

KDSWS Framework-Processes

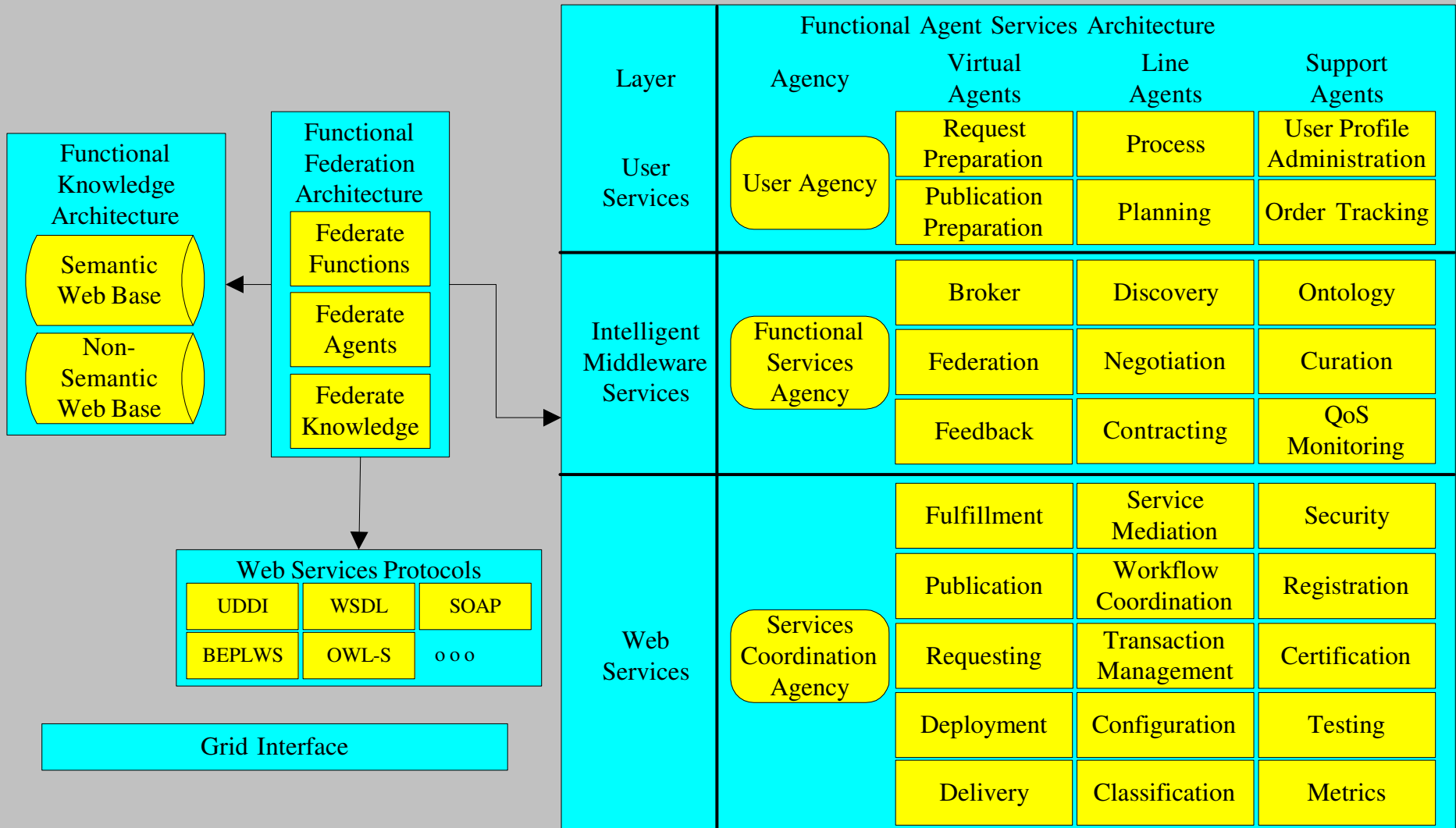


KDSWS Framework Design Specification



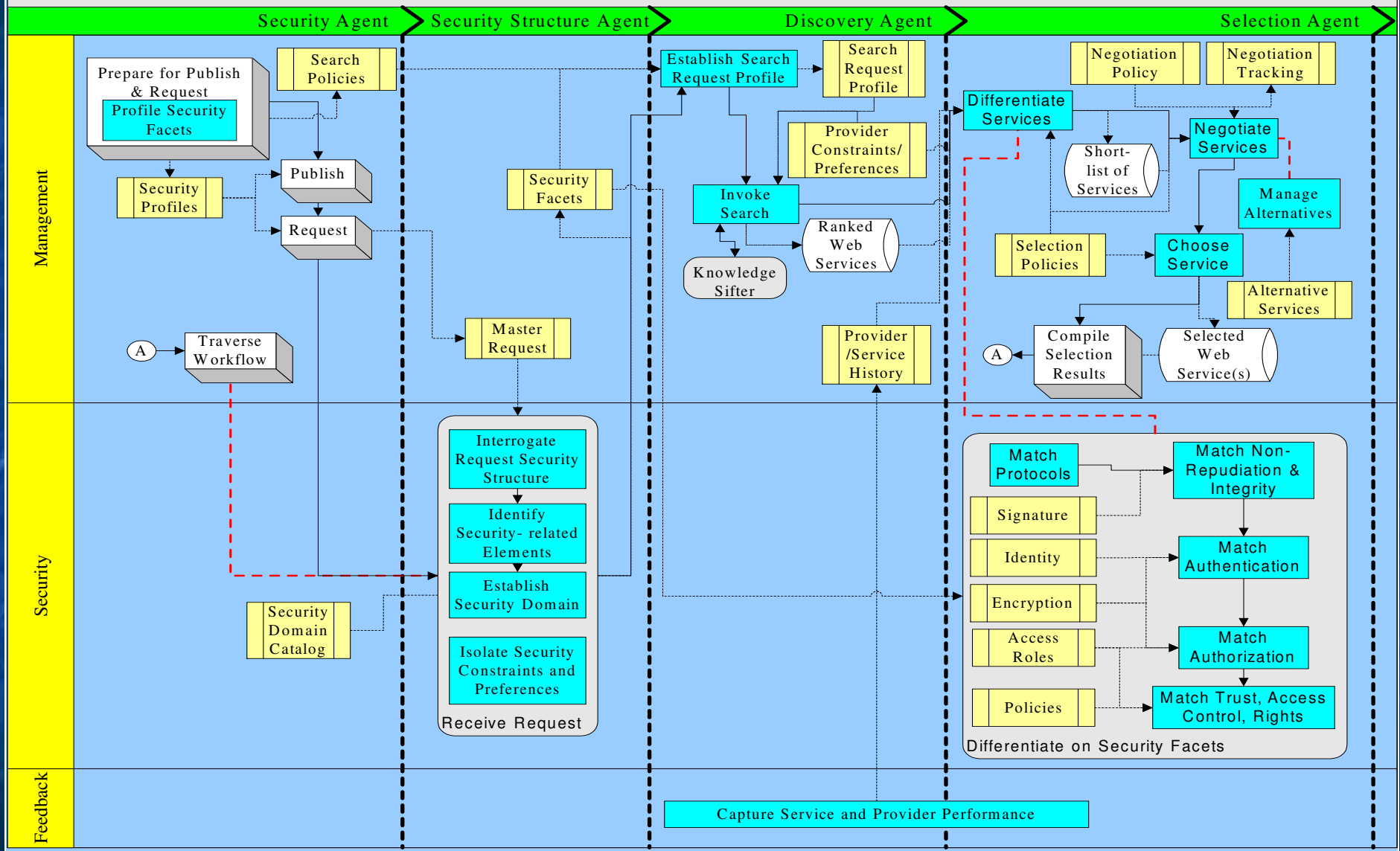
KDSWS Functional Architecture

KDSWS Functional Architecture

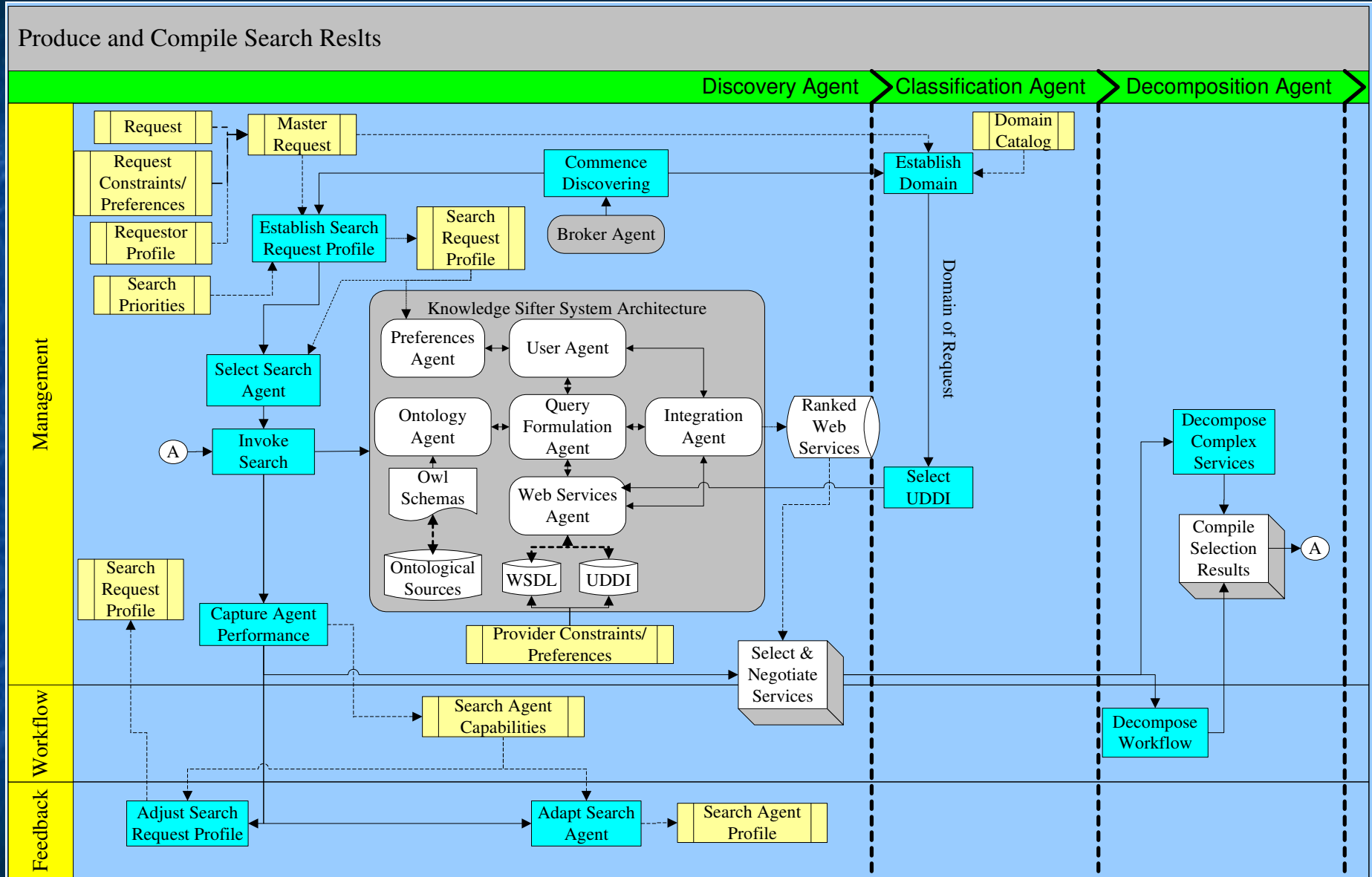


KDSWS Brokering Methodology Flow

Broker on Security Facets



KDSWS Brokering Methodology Flow



KDL Specification Example

kdsdBlanketsSecurityConstraint

```

:DESCRIPTION Provider-side security constraints
:SUPERTYPES  kdsdSecurity
              kdsdConstraint
              kdsdProvider
:SUBTYPES    kdsdPrivacy
:ATTRIBUTES  kdsdDescription      :TYPE Object
              kdsdAccessLevel     :TYPE Integer
              kdsdAuthorityLevel   :TYPE Integer
              kdsdEncryptMethod    :TYPE String :CONSTRAINT In ("x508?", "Kerberos")
              kdsdSignatureSwitch  :TYPE Boolean
              kdsdVisibility       :TYPE String :CONSTRAINT In ("Public", "Partner", "Internal")
              kdsdIdentity         :TYPE Object
              kdsdAuthorityLevel   :TYPE Integer
:CONSTRAINTS :CONSTRAINT-ID      C-02-1
              :CONSTRAINT-CATEGORIES Supply, Security
              Allow only partners to access
:PREFERENCES :PREFERENCE-ID      P-02-1
              :PREFERENCE-CATEGORIES Supply, Security
              Prefer medium security for assurance of fund transfer
:HEURISTICS  :HEURISTIC-ID       H-02-1
              :HEURISTIC-CATEGORIES Supply, Security
              Don't let security impede acquisition
:METHODS     :METHOD-ID          M-02-1
              Check for partner and access level
    
```

Knowledge-based Dynamic Services/Process Language Specification Example

kdspSearchForProviders

```

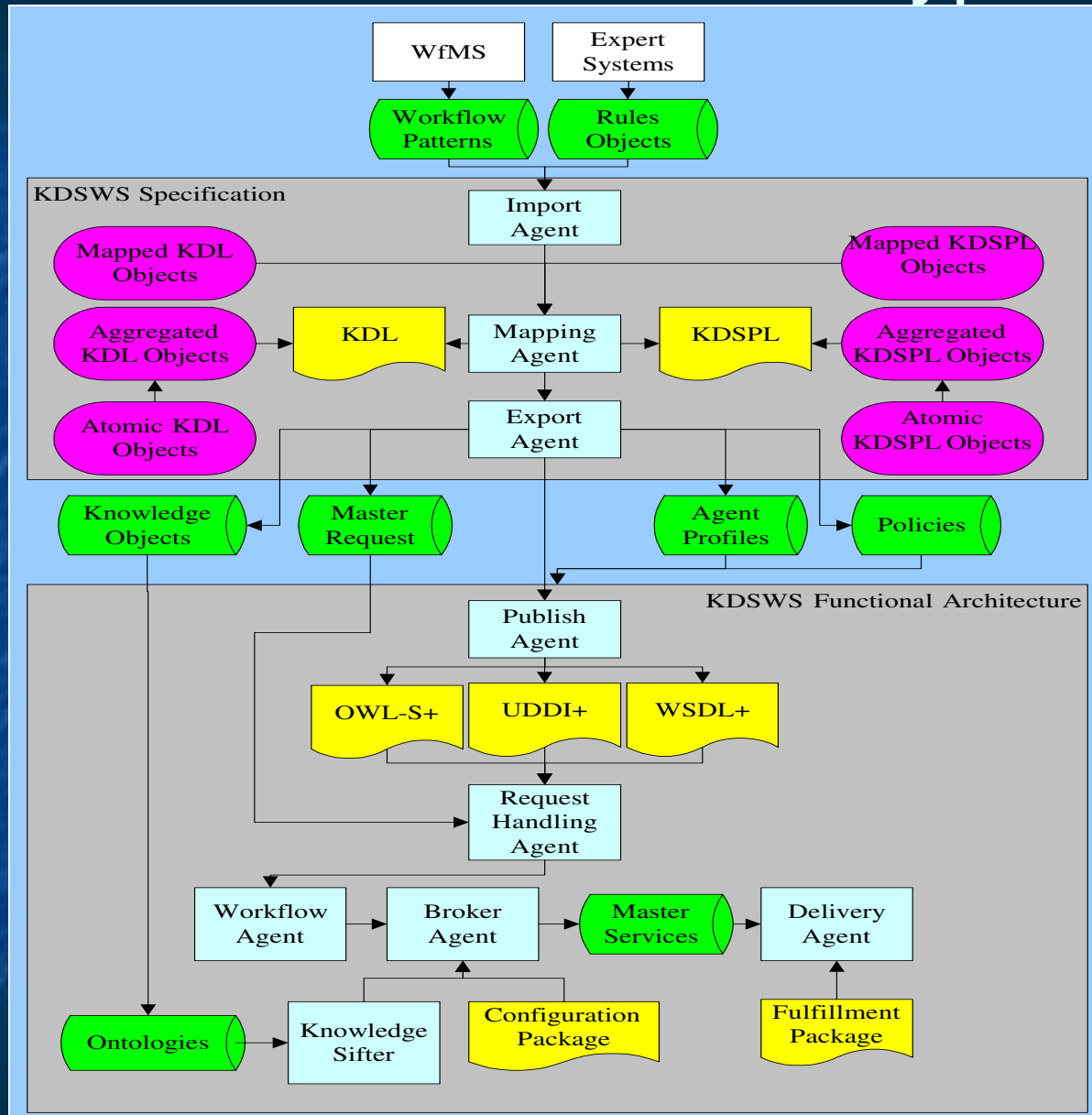
:DESCRIPTION Core Broker activities
:GOALS ProviderSearchGoal (Find services from providers that meet the goals of the request)
:TASK kdspDiscover
:THREAD kdspManagement
:OWNER kdsdSearchAgent
:STEWARD kdsdKnowledgeSifter
:PREDECESSORS kdspClassifyRequest
:SUCCESSORS kdspCompileSearchResults
:STEPS
  :STEPNAME kdspSearchUDDI
  :SEQUENCE-NUMBER 1
  :STEP-DESCRIPTION Search the UDDI registry for acceptable providers and services
  :DELEGATE kdsdKnowledgeSifter
    :DELEGATE-TYPE AGENT
    :DELEGATE-ROLE LINE
  :OPERATION searchUDDI
    :METHOD-NAME kdsdKnowledgeSifter.Search
  :STEP-SUCCESSORS
    :STEP-SUCCESSOR-MODE Decision
    :STEP-SUCCESSOR-BRANCH kdspAdjustSearchParameters :STEP-CONTROL-CONDITION Insufficient Results
    :STEP-SUCCESSOR-MODE Sequential
    :STEP-SUCCESSOR-BRANCH kdspRankResults :STEP-CONTROL-CONDITION Sufficient Results
:CONSTRAINTS
  :CONSTRAINT-ID C-13-1
  :CONSTRAINT-CATEGORIES Search
  kdsdSearchReturnLimit (Return only the top 25)
  :CONSTRAINT-ID C-13-2
  :CONSTRAINT-CATEGORIES Security
  Select only partners that support PKI
:HEURISTICS
  :HEURISTIC-ID H-13-1
  :HEURISTIC-CATEGORIES Search
  Partners who are in bankruptcy are a bad risk; therefore, do not use services from providers who are in bankruptcy"

```

KDSWS Contributions

- Three-tiered framework for specification, design and implementation of Virtual Organizations using Semantic Web Services.
- Languages for enhanced specification of Semantic Web Service requirements for the VO.
- Security issues are addressed in specification, design and implementation phases of VO life-cycle.
- Agency-based functional architecture allows for agent specialization of functional capabilities including security.
- Workflow management of VO “transactions” with end-to-end security.

Future Work - Prototype



Conclusions

- Web Services and Semantic Web Services are still in their infancy so new tools and techniques are needed for Secure Knowledge Management within the Virtual Organization.
- The KDSWS Framework is one approach to meeting the above goal.
 - Meta-models capture the data organization,
 - Methodology helps to integrate the plethora of standards
 - Languages embody the meta-model & methodology to allow for “security semantics” specification
 - Integrated specification, design and implementation environment.

Questions and Answers

