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WS Agreement specified Service Selection for Grid Service Providers

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Agenda

(1) Grid Services – Enabler for a Sustainable Business Model?

(2) WS Agreement for Grid Service Selection

(3) Implementation in CATNETS

(4) Discussion and Outlook

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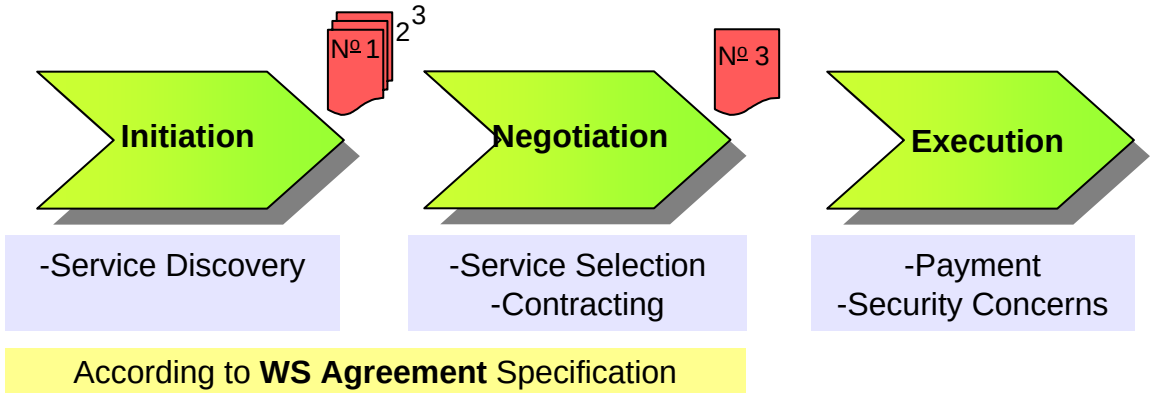
Grid Services for enabling Business Processes

- Enabling business processes by combining distributed Grid Services and Processes (e.g. by applying GT4 components)

  → For a sustainable, economic usage a mapping of the transactional phases is necessarily required.



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Transactional Costs in Grid Service Selection

- Availability of external resources specified by WS Agreement, which can be added on if needed (on-demand), involves
  - a flexible, scaling enterprise infrastructure and
  - transparency of costs (pay per use).
- Increases agility to reply to market dynamicity
- Easy integration and aggregation of business processes permits rapid reorganisations.

But:

- A GS provider has to minimize transaction costs
  - Externalisation of costs (initiation, negotiation and execution phases)
  - Risk & Insurance costs for insufficient availability

  to give clients an equivalent or even better economic performance in comparison to an in-house solution.

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Cost Reduction Potentials for GS Users

Cost Dispensation in the Transactional Phases

technical

economic

Initiation

Negotiation

Execution

Standards

- ✓ ***Service Discovery*** reduces initiation costs (UDDI, WSDL).
- ✓ **Negotiation** via XML/SOAP permits a standardized message exchange.
- ✓ ***(Business-) Processes*** can be modelled with BPEL4WS and allow a dynamic execution.

+

Semantics

- × ***Discovery and Selection of Services*** *fulfilling WS Agreement specifications*
- × ***Availability must be guaranteed when beeing exposed to***
  - interferences and failures,
  - supply and capacity fluctuations

  to maintain the business capability.
- × ***Security, Trust, Reputation***

Efficient Usage

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Business Case for Resource Brokers

(1) User assigns a Resource Broker (e.g. GT4 Scheduler/ Agent Dispatcher) to contract Grid Services by forwarding a WS Agreement specification to the broker.

(2) The GS Broker receives this specification and tries to fulfill requirements by negotiating on an electronic marketplace for Grid Services and Resources.

(3) The accomplishment of requirements decides the market price and the broker‘s profit.

→ The CATNETS Project investigates several business models and architectures for Grid Service and Resource provision.

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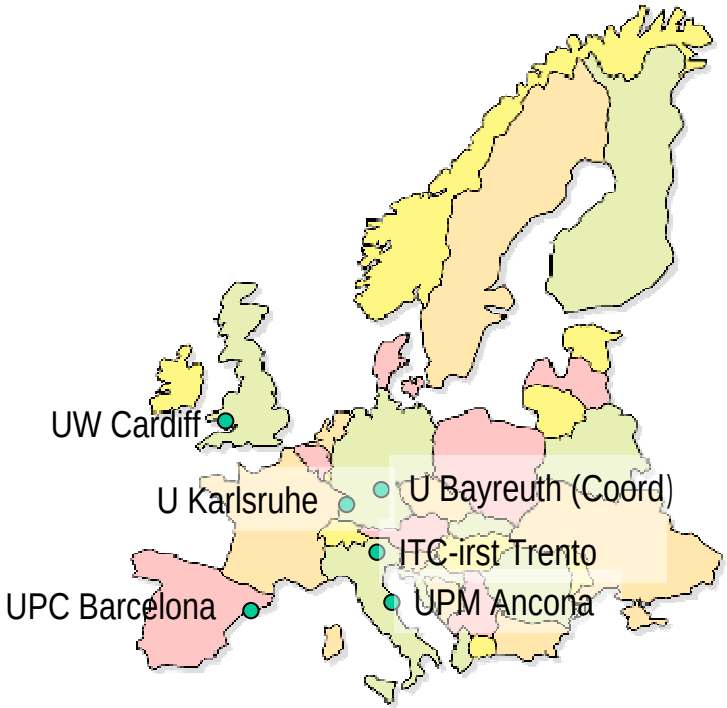
CATNETS in one slide

- Evaluation of an economic self-organization approach to the control of application layer networks
- Research Method
  - Simulation and evaluation of different resource allocation approaches
  - Implementation of a proof-of-concept prototype in a realistic application setting
- Funded by EU's „Future and Emerging Technologies“ programme
  - Budget 1.4 Mio EUR
  - 36 months, 09/2004-08/2007
  - 6 partner institutions



Information Society Technologies

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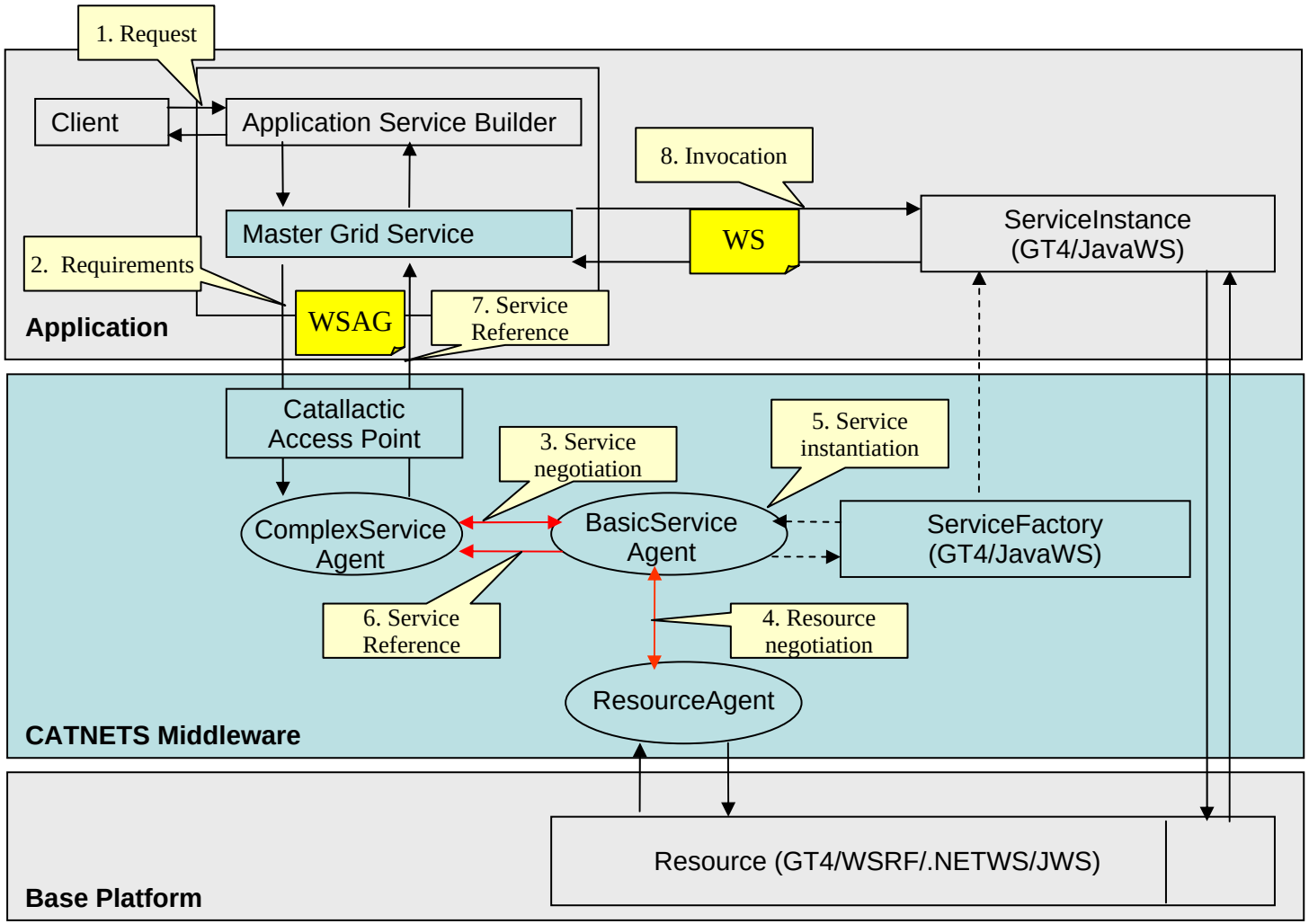
Integrating WS-Agreement with Prototype Application



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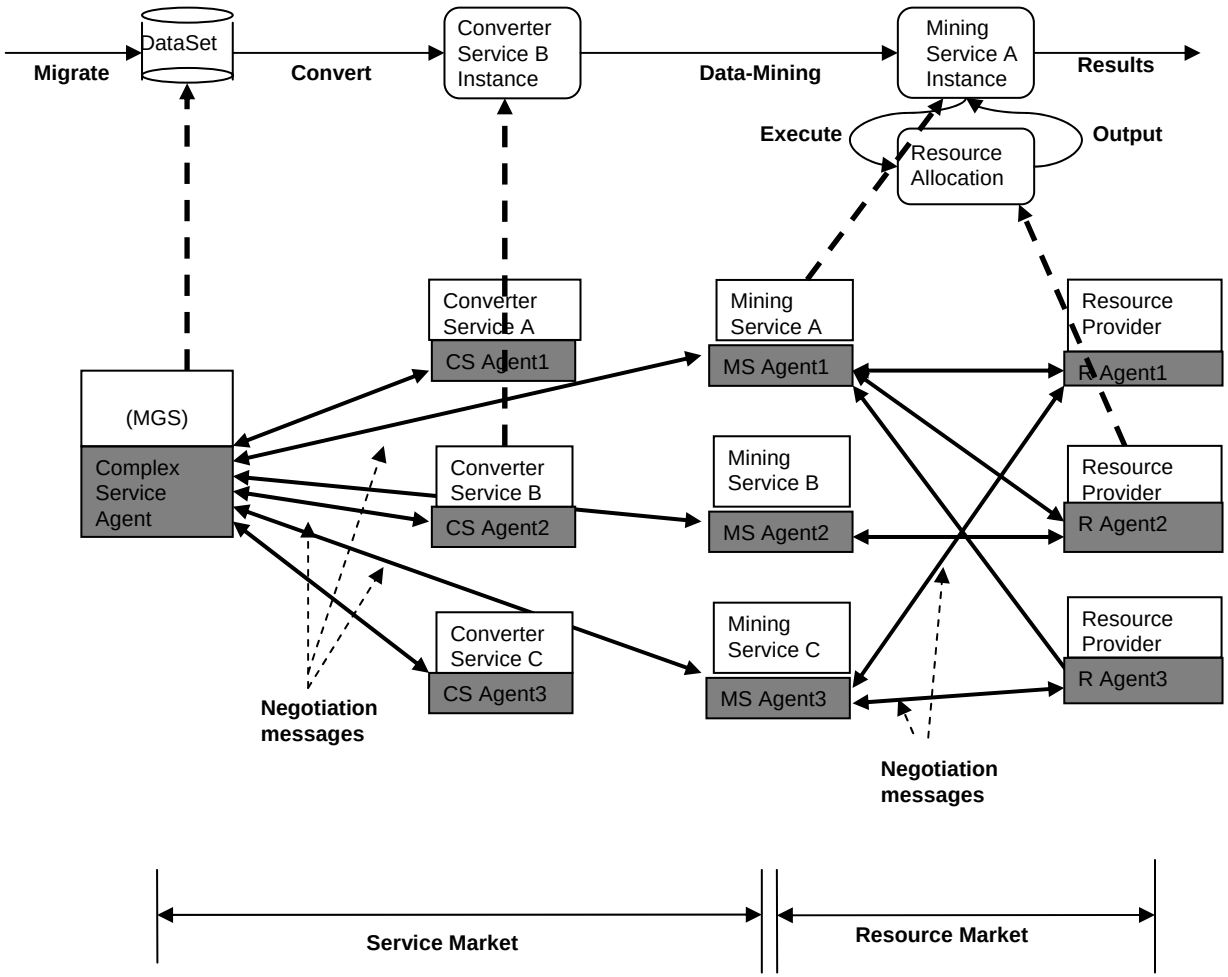
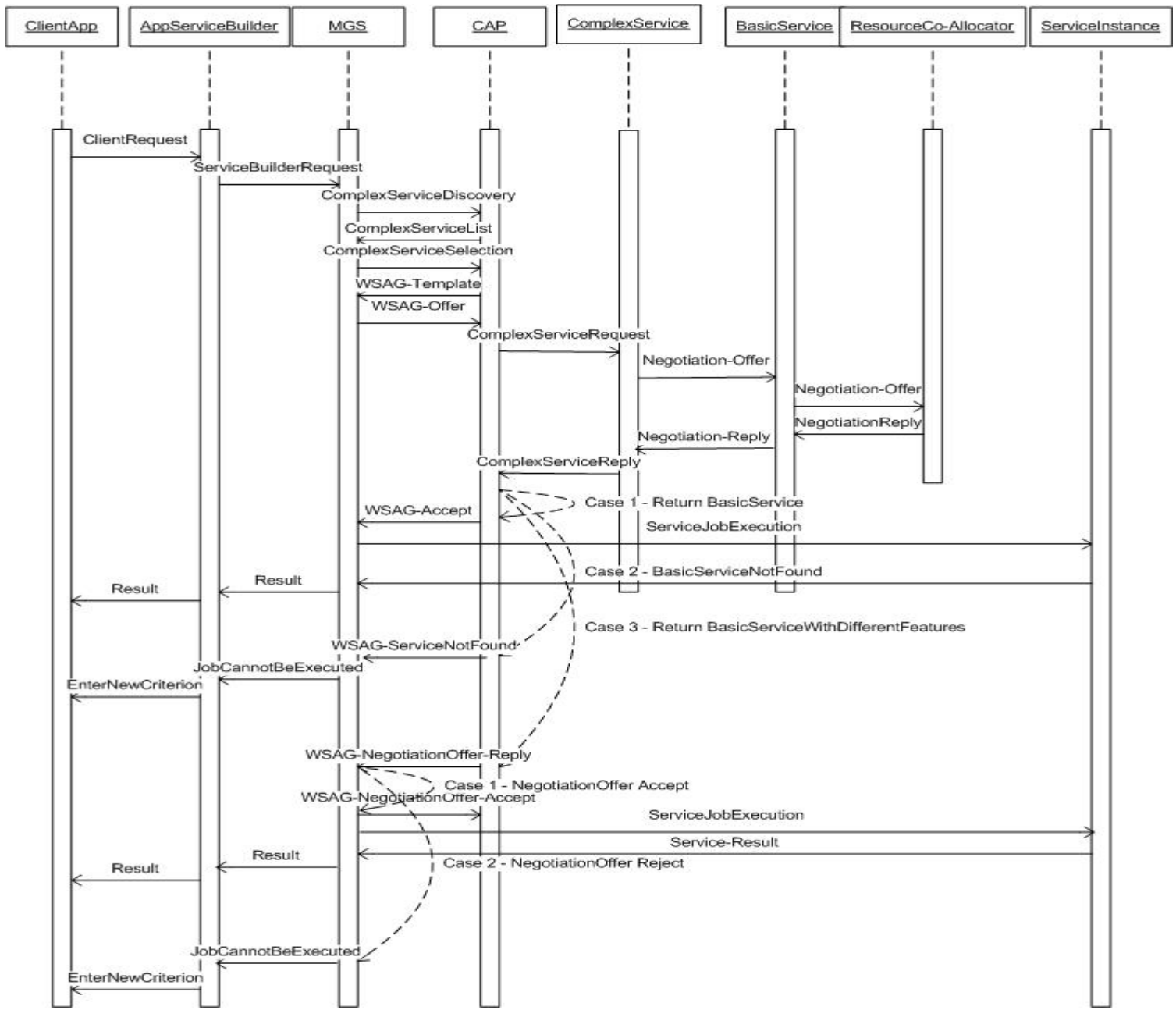
Data Mining Services



UML Sequence Diagram



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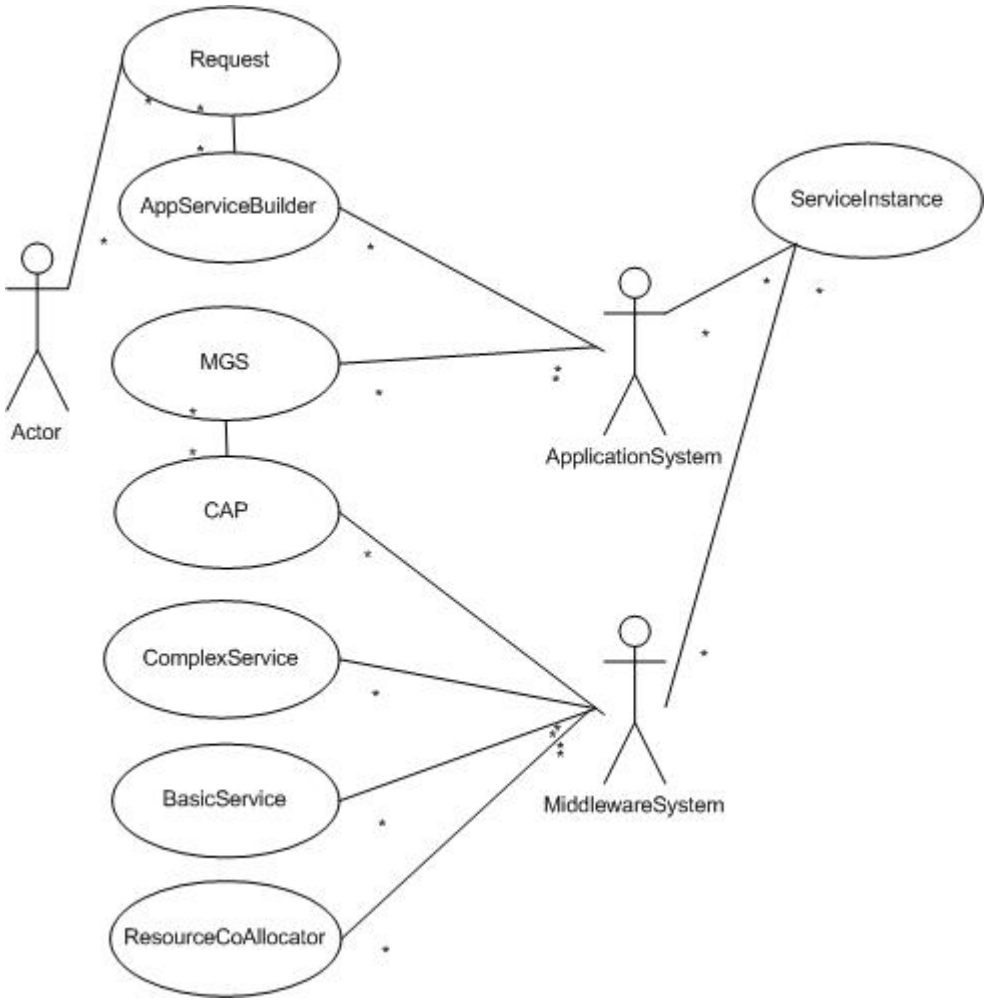
UML Use Case Diagram



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WS-Agreement in Catallaxy

- The Agreement Template (AT) specifies the service description elements that are allowed by the factory which advertises it.
- The Agreement Offer (AO) complies with the Agreement Template. Initially, the most important element is the amount MGS is willing to pay for fulfilling the application tasks via the service(s) and resource(s) bought from the Catallactic markets.
- Future development
  - the latency, CPU and Memory bundle will be considered too. MGS will make use of a policy document to decide which BasicServiceInstance(s) to choose from.
    - To be defined: Policy document
      - E.g. of a policy: execution time/price

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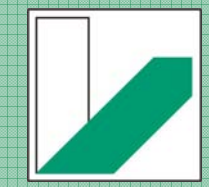

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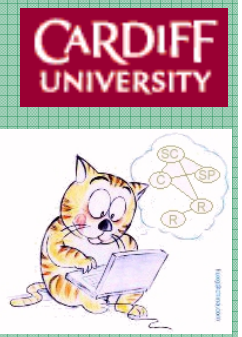

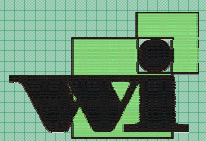

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WS-Agreement Template Lite – Data Mining Service

```
<?xml version="1.0" encoding="UTF-8"?>
<wsag:AgreementTemplate AgreementID="DataMiningTemplate-v001"
    xmlns:wsag="http://schemas.ggf.org/graap/2005/09/ws-agreement">
    <wsag:Name>DataMiningComplexService</wsag:Name>
    <wsag:Context>
        <wsag:AgreementInitiator>
            <! -- can be a URI or a security identity of the initiator -->
            NameOfTheInitiator
        </wsag:AgreementInitiator>
        <wsag:ExpirationTime>DateTime</wsag:ExpirationTime>
        <wsag:TemplateID>DataMiningTemplate-001</wsag:TemplateID>

        <wsag:TemplateName>DataMiningComplexService</wsag:Template
    Name>
    </wsag:Context>
    <wsag:Terms>
        <BasicServiceName>DataMiningBasicService
        </BasicServiceName>
        <NumberOfBasicServiceNodes>
        </NumberOfBasicServiceNodes>
        <BasicServiceConstraints>
            <BasicServiceType>
            </BasicServiceType>
        </BasicServiceConstraints>
        <Price>
        </Price>
    </wsag:Terms>
</wsag:AgreementTemplate>
```

WS-Agreement Offer Lite – Data Mining Service

```
<?xml version="1.0" encoding="UTF-8"?>
<wsag:AgreementOffer AgreementID="DataMiningOffer-v001"
    xmlns:wsag="http://schemas.ggf.org/graap/2005/09/ws-agreement">
    <wsag:Name>DataMiningComplexService</wsag:Name>
    <wsag:Context>
        <wsag:AgreementInitiator>
            <! -- can be a URI or a security identity of the initiator -->
            NameOfTheInitiator
        </wsag:AgreementInitiator>
        <wsag:ExpirationTime>DateTime</wsag:ExpirationTime>
        <wsag:TemplateID>DataMiningTemplate-001</wsag:TemplateID>
        <wsag:TemplateName>DataMiningComplexService</wsag:TemplateName>
    </wsag:Context>
    <wsag:Terms>
        <BasicServiceName>DataMiningBasicService
        </BasicServiceName>
        <NumberOfBasicServiceNodes>1
        </NumberOfBasicServiceNodes>
        <BasicServiceConstraints>
            <BasicServiceType>J48
            </BasicServiceType>
        </BasicServiceConstraints>
        <Price>100
        </Price>
    </wsag:Terms>
</wsag:AgreementOffer>
```


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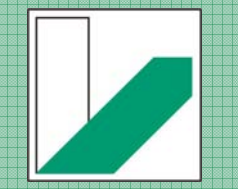
WS-Agreement Template – Data Mining Service (1)

```
<wsag:AgreementTemplate AgreementID="DataMiningTemplate-v001"
        xmlns:wsag="http://schemas.ggf.org/graap/2005/09/ws-agreement"
        xmlns:wsa="http://schemas.xmlsoap.org/ws/2004/03/addressing"
        xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance">

    <wsag:Name>Data Mining Service</wsag:Name>

    <wsag:Context>
        <wsag:AgreementInitiator>
            <! -- can be a URI of the initiator or a security identity of the initiator -->
            NameOfTheInitiator
        </wsag:AgreementInitiator>
        <wsag:ExpirationTime>DateTime</wsag:ExpirationTime>
        <wsag:TemplateID>001</wsag:TemplateID>
        <wsag:TemplateName>DataMiningComplexService</wsag:TemplateName>
    </wsag:Context>

    <wsag:Terms>
        <wsag:All>
            <wsag:ServiceDescriptionTerm wsag:Name="BasicServiceName"
wsag:ServiceName="DataMiningBasicService">
                <BasicServiceName>"BasicServiceInstance"</BasicServiceName>
            </wsag:ServiceDescriptionTerm>

            <wsag:ServiceDescriptionTerm wsag:Name="NumberOfBasicServiceNodes"
wsag:ServiceName="DataMiningBasicService">
                <NumberOfBasicServiceNodes>5</NumberOfBasicServiceNodes>
            </wsag:ServiceDescriptionTerm>

            <wsag:ServiceDescriptionTerm wsag:Name="Price"
wsag:ServiceName="DataMiningBasicService">
                <Price>
                </Price>
            </wsag:ServiceDescriptionTerm>
```



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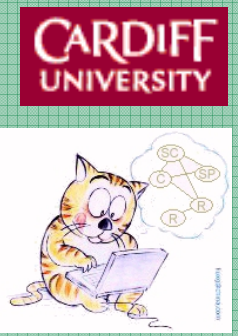
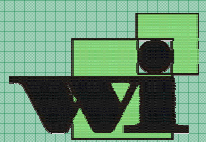


WS-Agreement Template – Data Mining Service (2)

```
<wsag:ServiceDescriptionTerm wsag:Name="BasicServiceConstraints"
wsag:ServiceName="DataMiningBasicService">
        <BasicServiceConstraints>
            <BasicServiceType>
            </BasicServiceType>
            <CPUArchitecture>
            </CPUArchitecture>
            <Memory>
            </Memory>
            <Latency>
                <min/>
                <max/>
            <Latency>
        <BasicServiceConstraints>
        </wsag:ServiceDescriptionTerm>

<wsag:GuaranteeTerm wsag:Name="StartTime"><wsag:ServiceScope>
    <wsag:ServiceName> DataMiningBasicService
        </wsag:ServiceName>
            </wsag:ServiceScope>
            <wsag:ServiceLevelObjective>startTime
IS_NOW</wsag:ServiceLevelObjective>
            <wsag:BusinessValueList>
                <wsag:Importance>
                </wsag:Importance>
            </wsag:BusinessValueList>
        </wsag:GuaranteeTerm>
```



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WS-Agreement Template – Data Mining Service (3)

```
<wsag:GuaranteeTerm wsag:Name="EndTime"><wsag:ServiceScope>
        <wsag:ServiceName> DataMiningBasicService
        </wsag:ServiceName>
    </wsag:ServiceScope>
    <wsag:ServiceLevelObjective>endTime IS_BEFORE-UnitTime</wsag:ServiceLevelObjective>
    <wsag:BusinessValueList>
    <wsag:Importance>
    </wsag:Importance>
                                        </wsag:BusinessValueList>
                    </wsag:GuaranteeTerm>
        </wsag:All>
    </wsag:Terms>

    <wsag:CreationConstraints>
        <wsag:Item wsag:Name="BasicServiceName">

        <wsag:Location>/wsag:Template/wsag:Terms/wsag:All/wsag:ServiceDescriptionTerm/basicS
erviceName</wsag:Location>
        <!-- for each domain-specific service description <basicServiceName>, constrain the value of
that element (i.e. reduce list of possible BasicServiceName)     -->
        </wsag:Item>


        <wsag:Item wsag:Name="NumberOfBasicServiceNodes">
        <wsag:Location>/wsag:Template/wsag:Terms/wsag:All/wsag:ServiceDescriptionTerm/number
OfBasicServiceNodes</wsag:Location>
                    <! --<numberOfBasicServiceNodes> is allowed, but must be within the range
                    <xs:minInclusive xs:value="1"/>
                    <xs:maxInclusive xs:value="5"/>
        </wsag:Item>
        <wsag:Item wsag:Name=“Price">
<wsag:Location>/wsag:Template/wsag:Terms/wsag:All/wsag:ServiceDescriptionTerm/price</wsag:Lo
cation>
                    <! -- <price> is allowed; no constrain on its value (amount of money pay for
dedicated the period of service)   -->
        </wsag:Item>
```


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WS-Agreement Template – Data Mining Service (4)

```
<wsag:Item wsag:Name="BasicServiceConstraints">
<wsag:Location>/wsag:Template/wsag:Terms/wsag:All/wsag:ServiceDescriptionTerm/basicServiceConstraints</
    wsag:Location>
                        <! --<basicServiceConstraints> is allowed; no constrain on its value -->
</wsag:Item>

<wsag:Item wsag:Name="BasicServiceType">
<wsag:Location>/wsag:Template/wsag:Terms/wsag:All/wsag:ServiceDescriptionTerm/basicServiceType
</wsag:Location>
<! --<basicServiceTypetype> is allowed; no constrain on its value (e.g. the type of data mining service where the
    job is executed)  -->
</wsag:Item>

<wsag:Item
    wsag:Name="Latency"><wsag:Location>/wsag:Template/wsag:Terms/wsag:All/wsag:ServiceDescriptionTer
    m/job:latency</wsag:Location>
                        <! --<latency> is allowed; but must be within a range (milliseconds) -->
                        <xs:minInclusive xs:value="2"/>
                        <xs:maxInclusive xs:value="10"/>
</wsag:Item>

<wsag:Item wsag:Name="CPU">
<wsag:Location>/wsag:Template/wsag:Terms/wsag:All/wsag:ServiceDescriptionTerm/cpu</wsag:Location>
                        <! --<cpu> is allowed; no constraints on its value (minimum cpu speed)          -->
</wsag:Item>

<wsag:Item
wsag:Name="Memory">
<wsag:Location>/wsag:Template/wsag:Terms/wsag:All/wsag:ServiceDescriptionTerm/memory</wsag:Location>
                        <! --<memory> is allowed; no constraints on its value (minimum MB memory)    -->
</wsag:Item>
    </wsag:CreationConstraints>
</wsag:AgreementTemplate>
```


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WS-Agreement Offer – Data Mining Service (1)

```
<wsag:AgreementOffer AgreementID="DataMiningOffer-v001"
        xmlns:wsag="http://schemas.ggf.org/graap/2005/09/ws-agreement"
        xmlns:wsa="http://schemas.xmlsoap.org/ws/2004/03/addressing"
        xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance">
    <wsag:Name>DataMiningComplexServiceOffer</wsag:Name>

<wsag:Context/>

<wsag:Terms>
    <wsag:ServiceDescriptionTerm wsag:Name="BasicServiceName" wsag:ServiceName="
    DataMiningBasicService ">
        <BasicServiceName>BasicServiceInstance</BasicServiceName>
        </wsag:ServiceDescriptionTerm>

    <wsag:ServiceDescriptionTerm wsag:Name="NumberOfBasicServiceNodes"
    wsag:ServiceName=" DataMiningBasicService ">
                    <job:NumberOfBasicServiceNodes>1
                    </job:NumberOfBasicServiceNodes>
                </wsag:ServiceDescriptionTerm>

<wsag:ServiceDescriptionTerm wsag:Name="Price" wsag:ServiceName="
    DataMiningBasicService ">
                    <Price>100</Price>
</wsag:ServiceDescriptionTerm>
```

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WS-Agreement Offer – Data Mining Service (2)

```
<wsag:ServiceDescriptionTerm wsag:Name="BasicServiceConstraints"
    wsag:ServiceName=" DataMiningBasicService ">
                                <BasicServiceType>J48
                                <BasicServiceType>
                                <CPUArchitecture>1GHz
                                </CPUArchitecture>
                                <Memory>1024MB
                                </Memory>
                                <Latency>
                                        <min/>2
                                        <max/>8
                                <Latency>
</wsag:ServiceDescriptionTerm>
<wsag:GuaranteeTerm wsag:Name="StartTime">
<wsag:ServiceScope>
    <wsag:ServiceName> DataMiningBasicService
            </wsag:ServiceName>
    </wsag:ServiceScope>
    <wsag:ServiceLevelObjective>startTime
    IS_NOW</wsag:ServiceLevelObjective>
    <wsag:BusinessValueList>
<wsag:Importance>2 <!-- 0 – low; 1 – medium; 2 – high -->
    </wsag:Importance>
</wsag:BusinessValueList>
</wsag:GuaranteeTerm>
```

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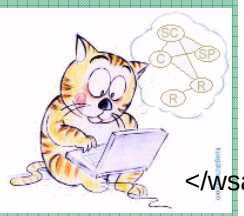
WS-Agreement Offer - DataMiningService (3)

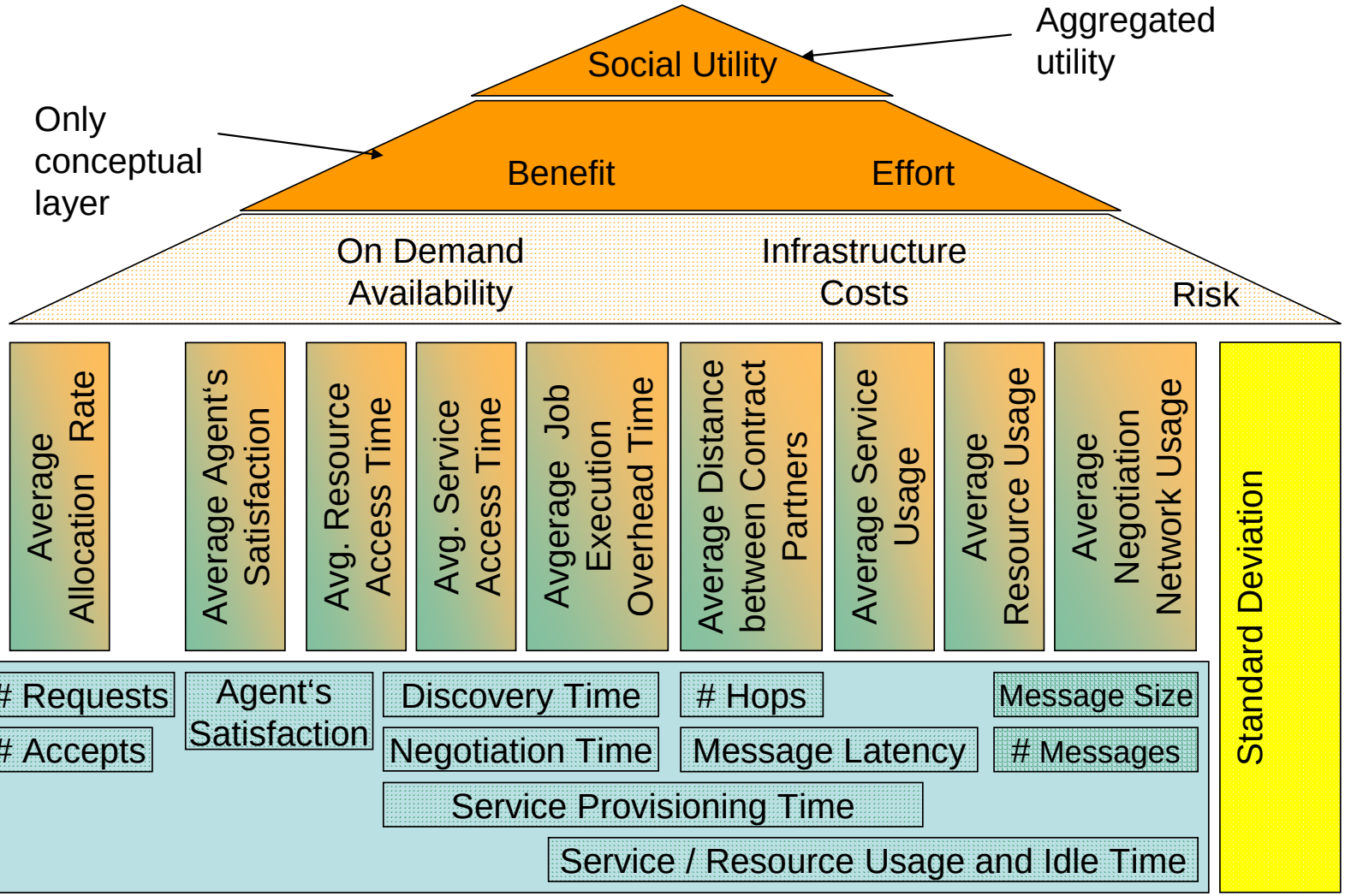
```
<wsag:GuaranteeTerm wsag:Name="EndTime">
        <wsag:ServiceScope>
                <wsag:ServiceName> DataMiningBasicService
</wsag:ServiceName>
        </wsag:ServiceScope>
        <wsag:ServiceLevelObjective>endTime IS_BEFORE-UnitTime</wsag:ServiceLevelObjective>
        <wsag:BusinessValueList>
                <wsag:Importance>2 <!-- 0 – low; 1 – medium; 2 – high -->
                </wsag:Importance>
        </wsag:BusinessValueList>
</wsag:GuaranteeTerm>
```



```
        </wsag:All>
</wsag:Terms>

</wsag:AgreementOffer>
```

Metrics Framework



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Discussion and Outlook

- Currently evaluating metrics with respect to WS Agreement
- Discuss issues of multi-shot interactions
- Relate WSAG to business metrics in more explicit terms

→ Demonstrator is available in Summer (GGF17)

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Reserve Slides

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Grid Service Selection – State-of-the-Art

	Global coordination explicitly achieved by a coordinator	Resource discovery and allocation achieved without coordinator
Economic Matching Mechanism	GridBus, EcoGrid, Nimrod/G [Buyya02]	Catallactic Information-systems
Ordinal Matching Mechanism	Grid Networks with Ressource Brokers, Condor, Globus	File Sharing (Gnutella, KaZaA)

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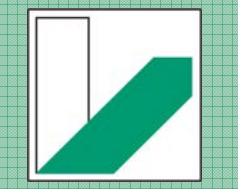

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Service Selection Mechanisms (1)

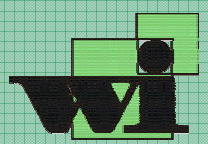
The **service discovery process** delivers a list of homogeneous formed services, whilst in the follwing **service selection** one of these items will be selected.

Centralized service selection with a central *Resource Broker,* that matches supply and demand via a mathematical optimization rule.

Example: Grids (Condor-G, DMR-broker, Nimrod-G Broker, DataGrid OptorSim, etc.)

Decentralized service selection without coordination, based on the local knowledge of the consumers (demand)

Example: File Sharing (Gnutella, FastTrack etc.)



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Service Selection Mechanisms (2)

Service selection bases on principles, that consider the scarcity of goods (e.g. **prices**) or **technical parameters** (metrics).

- Manual selection includes technical parameters, e.g. in common file sharing systems
- Automated selection of services, based on prices
  - Bilateral negotiations with software agents, based on local knowledge
  - Optimizer (Calculation of equillibrium prices)
  - Auctions (Sealed vs. Open-outcry, Ascending vs. Descending, First price vs. Second price)

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Grid Service Selection – State-of-the-Art

	Global coordination explicitly achieved by a coordinator	Resource discovery and allocation achieved without coordinator
Economic Matching Mechanism	GridBus, EcoGrid, Nimrod/G [Buyya02]	Catallactic Information-systems
Ordinal Matching Mechanism	Grid Networks with Ressource Brokers, Condor, Globus	File Sharing (Gnutella, KaZaA)