

A Service Level Agreement Language for Dynamic Electronic Services

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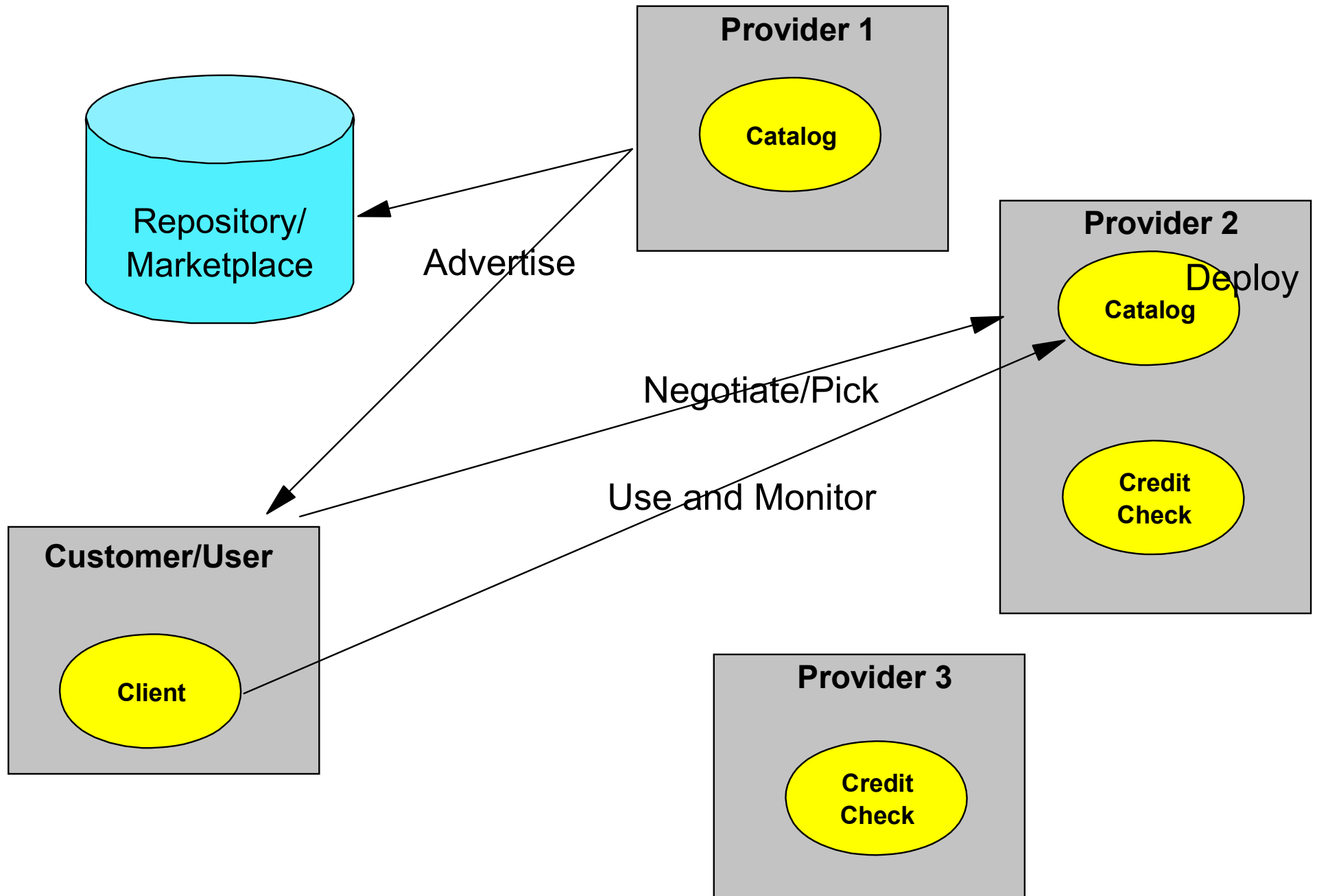
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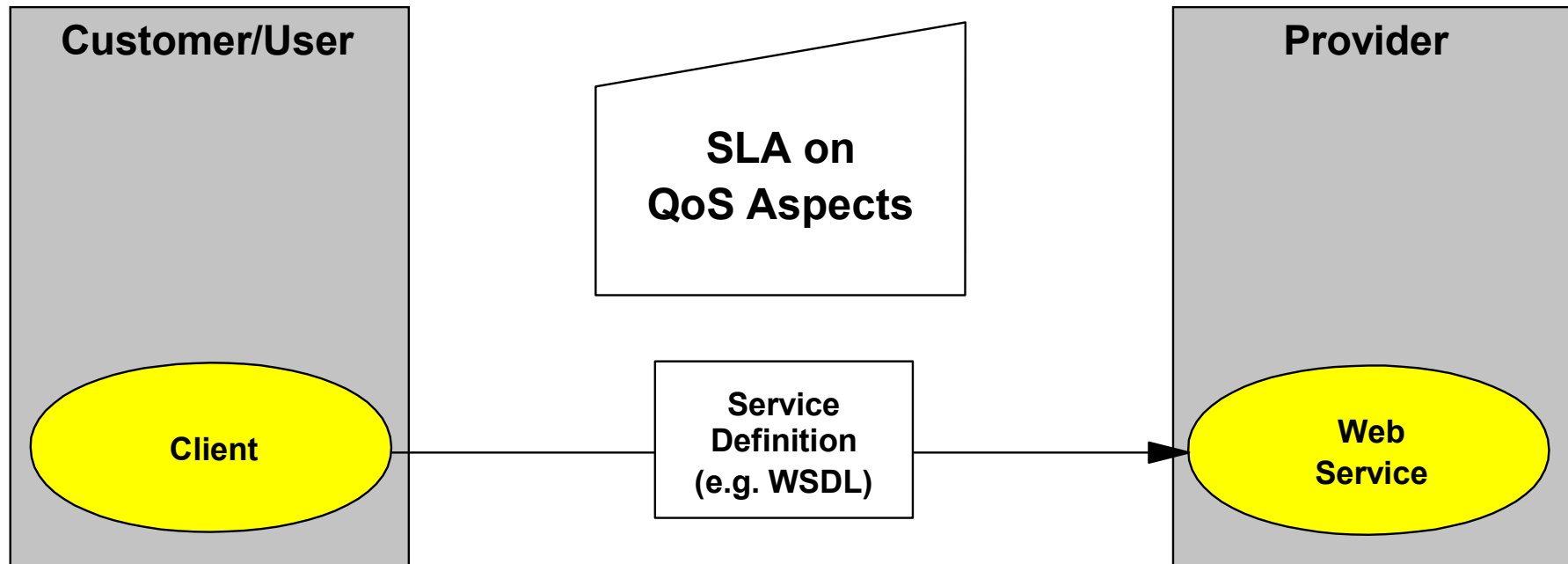
Outline

- Formal SLAs for Dynamic Electronic Services
 - SLAs in a Web Services Environment
 - Requirements
- SLA Language Elements
 - SLA Parameters
 - Obligations
 - Distributed Measurement and Third Parties
- Extensibility
- Summary and Conclusion

SLAs in a Web Services Environment

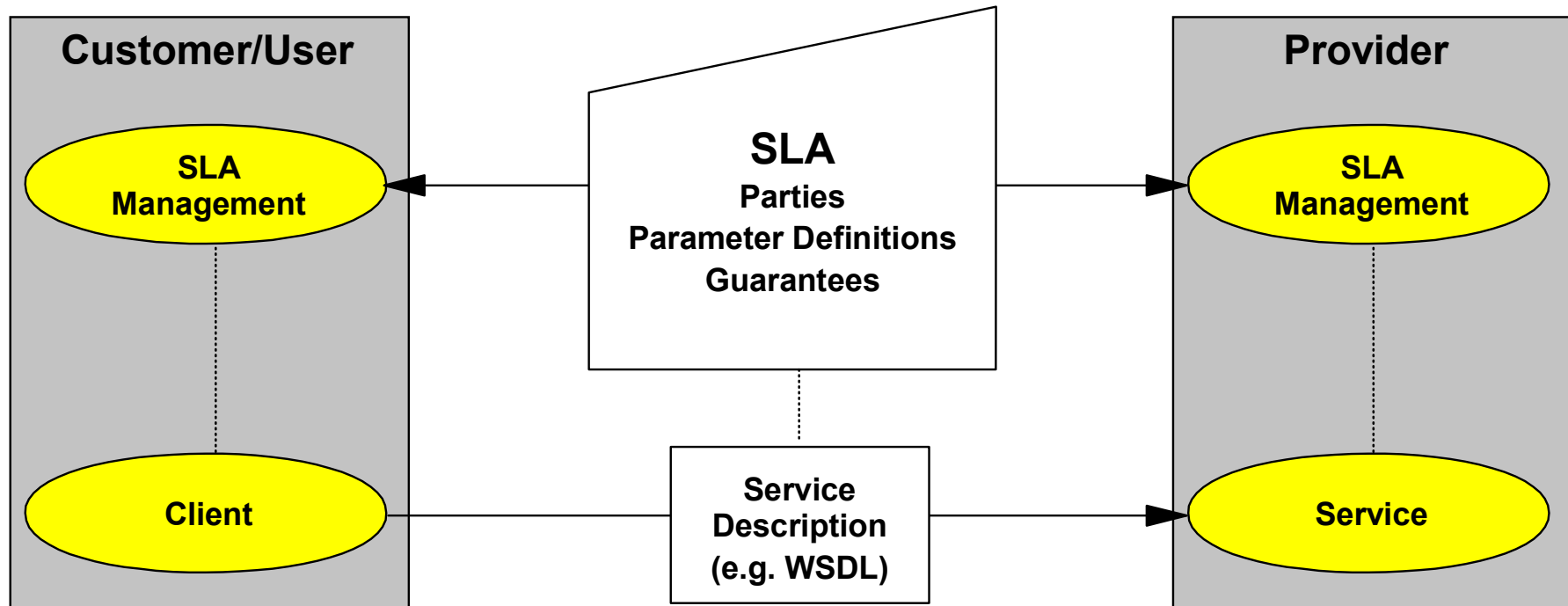


SLAs in a Web Services Environment (c'd)



- B2B services require quality guarantees
- Today:
 - Natural language SLAs
 - Fuzzy QoS parameter definitions, e.g. "open trouble ticket starts downtime".
 - Expensive to deploy
- We want:
 - Formal representation
 - Automated, cheap deployment process
 - Flexibility to deliver/receive service in a range of different SLAs (e.g. Ticker Service)
 - Standard language (for advertising and deployment) processed by B2B middleware

SLAs in a Web Services Environment (c'd)



- SLA is an agreement between parties
- SLA is associated with a service specification:
 - *WSDL*, *WSFL* specification,
 - other types
- SLA covers:
 - **What** to measure, **How** to measure it, **Who** does what, **Guarantees**

Requirements on SLA Language

- **Formal specification** of SLA aspects relevant for automatic provisioning and monitoring
- **Association** with individual Web services, composite Web services/processes, other services
- **Unambiguous specification** of parameters and metrics
- Formal specification of **service level objectives** (SLO)
- Usable in **whole life-cycle** (publishing, negotiating, provisioning, monitoring)
- Define **third party involvement** in monitoring an SLA
- Usable **independently** of provider or customer technical infrastructure

SLA Language Concepts

Defining SLA Parameters and Metrics

SLA Parameter: Property of a service that is subject of SLOs

Issue:

- Association of SLA parameters with a particular service element, e.g., service, operation, process

Approach

- SLA Parameters associated with Service Objects
 - Describe link to service description
 - Link information subtyped to SOAP Operations, WSFL processes, etc.

```
<Operation name="GetQuote" xsi:type="WSDLSOAPOperationDescriptionType">  
  
  <!-- SLA Parameter Definition skipped -->  
  
  <WSDLFile>DemoService.wsdl</WSDLFile>  
  <SOAPBindingName>SOAPNotificationBinding</SOAPBindingName>  
  <SOAPOperationName>getQuote</SOAPOperationName>  
</Operation>
```

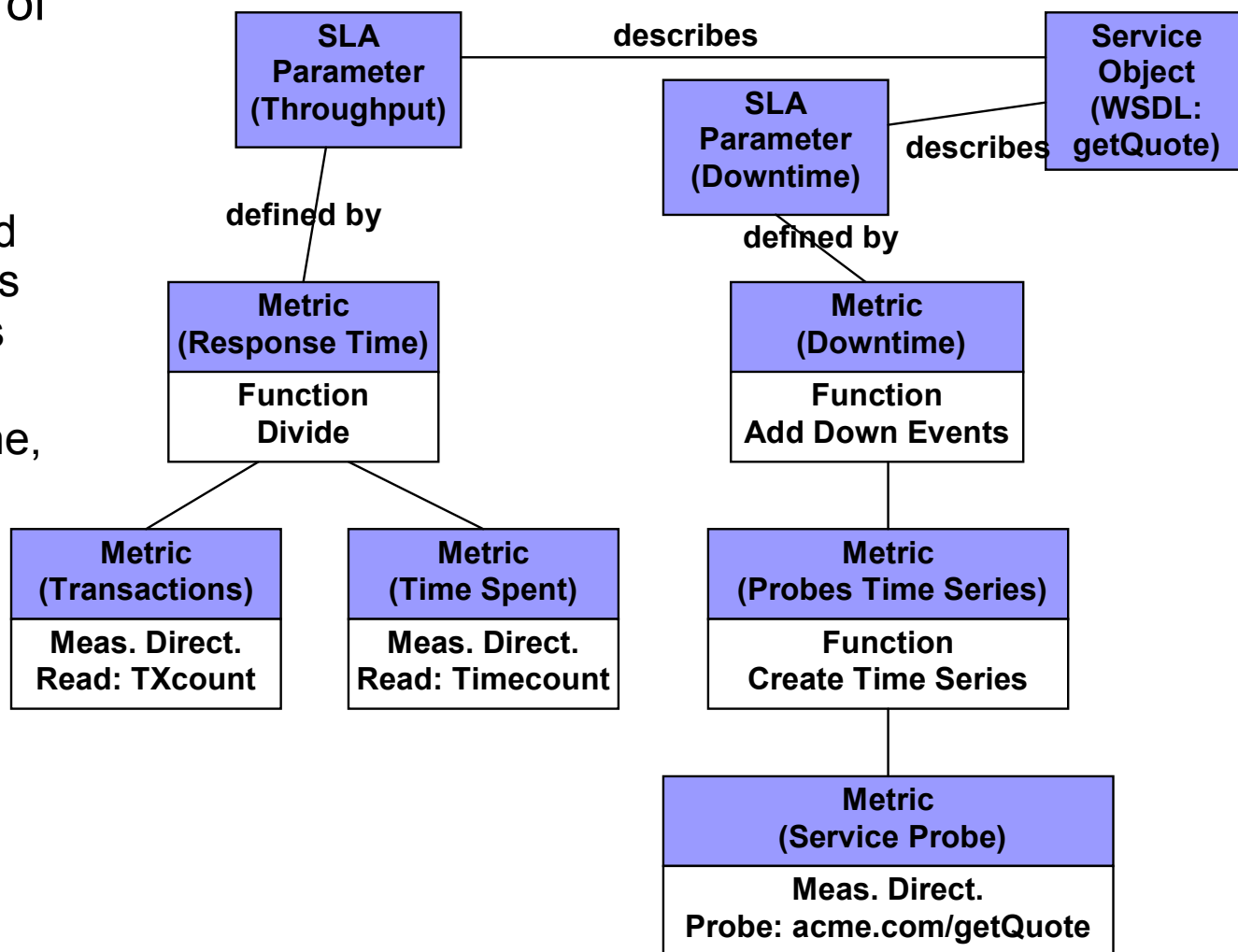
Defining SLA Parameters and Metrics

Issue:

- Common understanding of what SLA parameters mean
 - Example:
 - ▶ Availability is measured by help desk log entries when customer reports outage
 - ▶ Availability of a machine, service, particular operation?

Approach:

- Define how metrics are measured
- How metrics are derived from other metrics



Metric Definition

Raw Metric Specifies:

- Access to Instrumentation
- Party that measures the metric (ACMEProvider)
- Measurement Directives, typed depending on instrumentation of particular system

```
<Metric name="SumTransactions"
  type="long"
  unit="transactions">
  <Source>ACMEProvider</Source>
  <MeasurementDirective
    xsi:type="InvocationCount"
    resultType="long"/>
    <Address>http://service.acme.com/getQuoteCount
  </Address>
  </MeasurementDirective>
</Metric>
```

Composite Metric Specifies:

- Computation of a composite metric
- Party that computes the metric (ACMEProvider)
- Function specifies the computation from other metrics

```
<Metric name="AverageResponseTimeMetric"
  type="double" unit="">
  <Source>ACMEProvider</Source>
  <Function xsi:type="Divide" resultType="double">
    <Operand>
      <Metric>SumResponseTime</Metric>
    </Operand>
    <Operand>
      <Metric>NumberTransactions</Metric>
    </Operand>
  </Function>
</Metric>
```

Defining Obligations - SLOs

Service Level Objectives Elements:

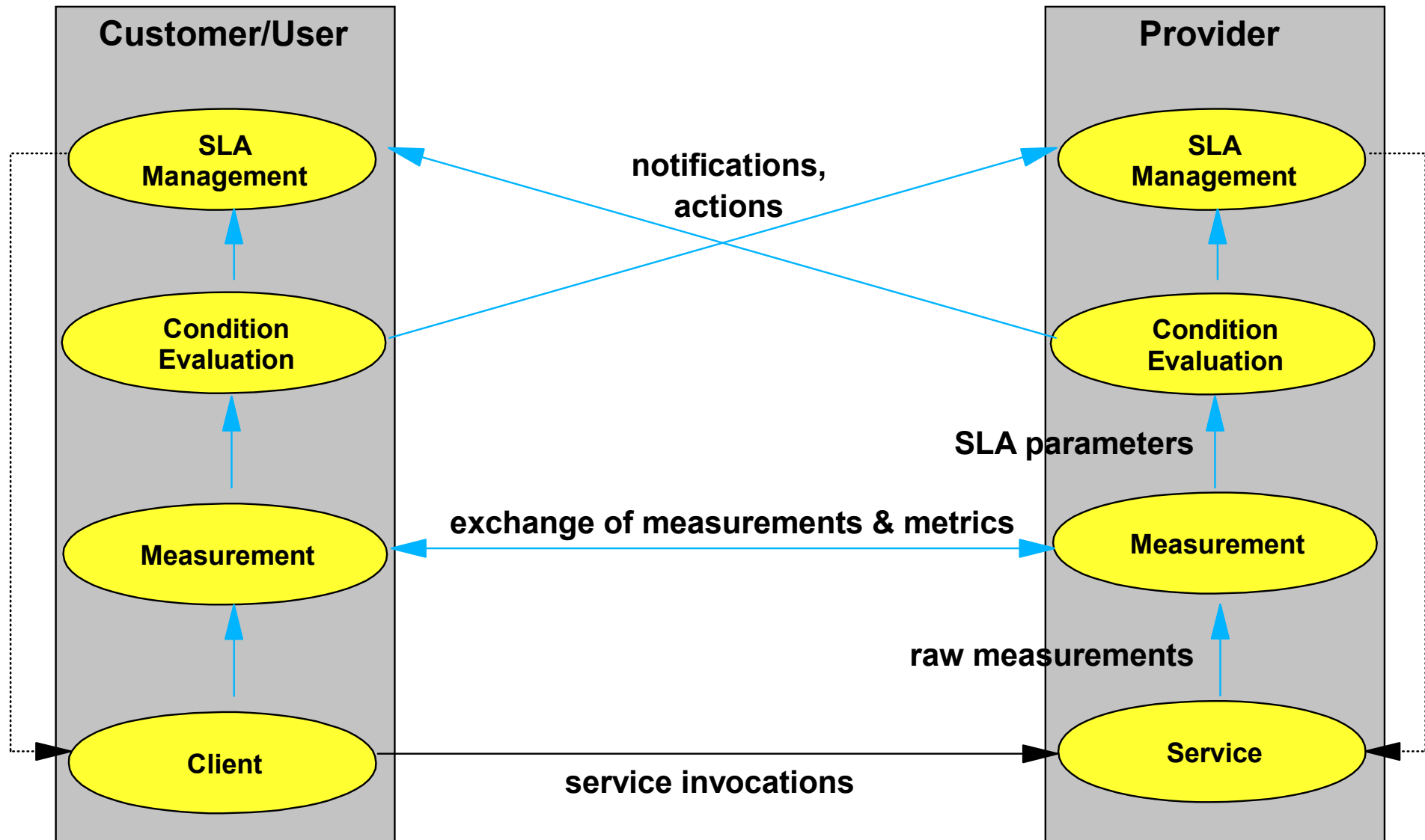
- Obligated Party
- Validity
- Expression over SLA Parameters
- Evaluation Event or Schedule

Example:

(TransactionRate < 10000) ->
(AverResponseTime < 0.5)

```
<ServiceLevelObjective name="g1">
  <Obligated>ACMEProvider</Obligated>
  <Validity>
    <Start>2001-11-30T14:00:00.000-05:00</Start>
    <End>2001-12-31T14:00:00.000-05:00</End>
  </Validity>
  <Expression>
    <Implies>
      <Expression>
        <Predicate xsi:type="Less">
          <SLAParameter>TransactionRate</SLAParameter>
          <Value>10000</Value>
        </Predicate>
      </Expression>
      <Expression>
        <Predicate xsi:type="Less">
          <SLAParameter>AverageResponseTime</SLAParameter>
          <Value>0.5</Value>
        </Predicate>
      </Expression>
    </Implies>
  </Expression>
  <EvaluationEvent>NewValue</EvaluationEvent>
</ServiceLevelObjective>
```

Defining SLO Monitoring Interaction - Model



Interactions related to monitoring are in blue.

Party Definitions - Including Interfaces

Parties offer Interfaces:

- Set of WSDL definitions for simple interactions
- Parties define their implementation part of the WSDL interface

Contact information:

- Not used in SLA, use other standard for identification and information

```
<ServiceProvider
  name="ACMEProvider">
  <Contact>
    <Street>PO BOX 218</Street>
    <City>Yorktown, NY 10598, USA</City>
  </Contact>
  <Action name="notification"
    partyName="ACMEProvider"
    xsi:type="WSDLSOAPActionDescriptionType">
    <WSDLFile>notification.wsdl</WSDLFile>
    <SOAPBindingName>soapnotification</SOAPBindingName>
    <SOAPOperationName>notification</SOAPOperationName>
  </Action>
</ServiceProvider>
```

SLA Monitoring Interaction - Action Guarantee

Action Guarantees:

- Invoke action of another party if precondition holds

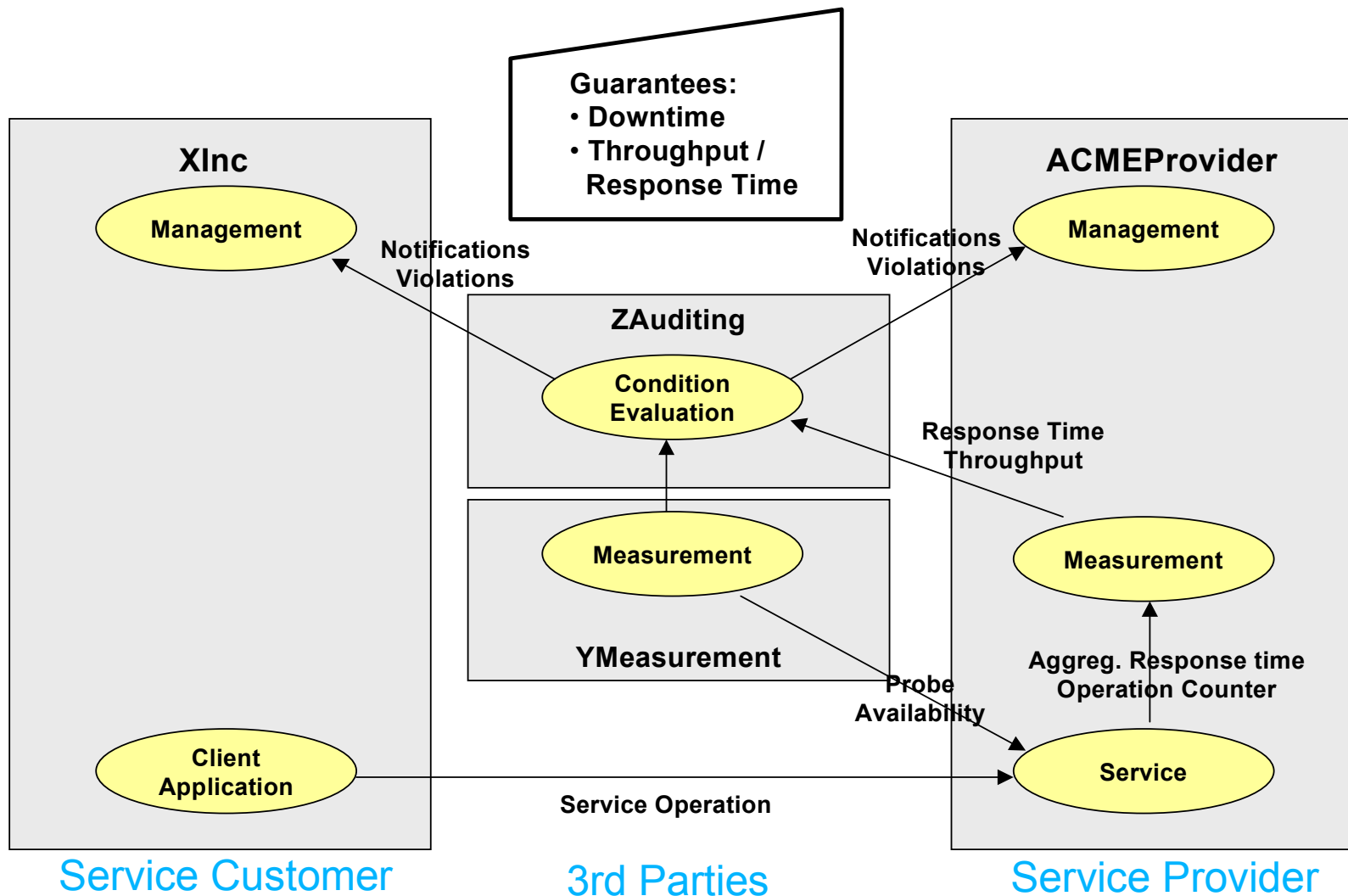
Elements:

- Obligated
- Precondition Expression over SLA Parameters
- Evaluation Event or Schedule
- Action, i.e. marshalling of an invocation.
- Execution Modality

Expression can refer to SLOs via Violation predicate.

```
<ActionGuarantee name="g2">
  <Obligated>ZAuditing</Obligated>
  <Expression>
    <Predicate xsi:type="Violation">
      <ServiceLevelObjective>g1</ServiceLevelObjective>
    </Predicate>
  </Expression>
  <EvaluationEvent>NewValue</EvaluationEvent>
  <QualifiedAction>
    <Party>XInc</Party>
    <Action actionName="notification" xsi:type="Notification">
      <NotificationType>Violation</NotificationType>
      <CausingGuarantee>g2</CausingGuarantee>
      <SLAParameter>ResponseTimeThroughPutRatio
        TransactionRate</SLAParameter>
    </Action>
  </QualifiedAction>
  <ExecutionModality>Always</ExecutionModality>
</ActionGuarantee>
```

Third Parties in Monitoring a Web Service



Third parties support monitoring for measurement and condition evaluation.

Sponsoring of third parties

Many configurations possible, depending on situation.

Sponsored Party Specification

Regular Party Specification:

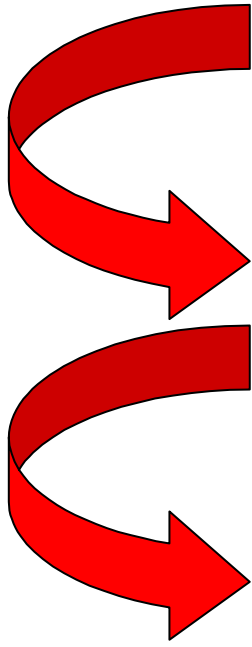
- Interfaces

In Addition:

- Role
- Sponsors

```
<SupportingParty
  name="ZAuditing"
  role="ConditionEvaluationService">
  <Contact>
    <Street>Hursley Park</Street>
    <City>Winchester, England, SO21 2JN</City>
  </Contact>
  <Action xsi:type="WSDLSOAPOperationDescriptionType"
    name="parameterUpdate"
    partyName="ZAuditing">
    <WSDLFile>ParameterUpdate.wsdl</WSDLFile>
    <SOAPBindingName>SOAPNotificationBinding
    </SOAPBindingName>
    <SOAPOperationName>parameterUpdate</SOAPOperationName>
  </Action>
  <Sponsor>ACMEProvider</Sponsor>
  <Sponsor>XInc</Sponsor>
</SupportingParty>
```

SLA Structure Overview - Recap



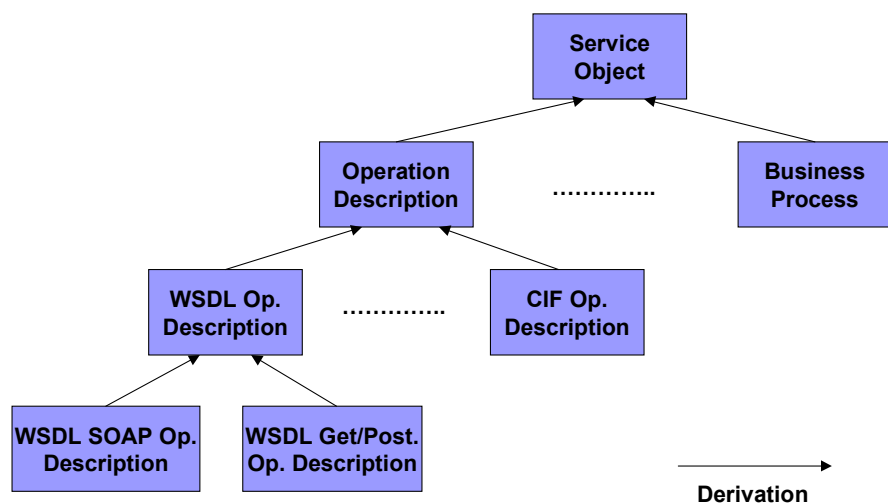
Definition of Parties:	<ul style="list-style-type: none">• Service Provider• Service Customer• Supporting Parties in Sponsored Roles
Agreement on the Common View of the Service:	<ul style="list-style-type: none">• Service Objects<ul style="list-style-type: none">• Service• Operations• Business Process• SLA Parameters• Metrics• Measurement Directives• Functions
Definition of Obligations:	Guarantees defined over SLA Parameters

- ▶ SLA documents are composed of **small number of simple concepts**
- ▶ **Flexible, expressive** definition of SLA Parameters, SLOs, and interaction

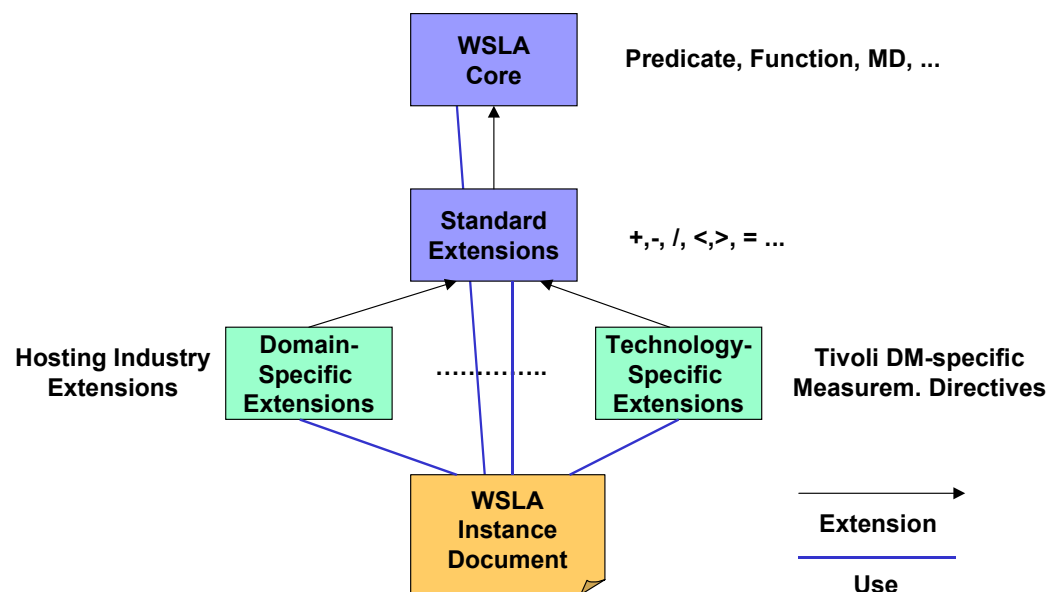
Extensibility

Issue

- Wide scope of application
- Variety of
 - Measurement Directive types (different types of instrumentation and measurements)
 - Service objects to relate to different, e.g., non-Web services
 - Actions for specific interactions
 - Functions, predicates



Concept extensions along XML Schema subtyping



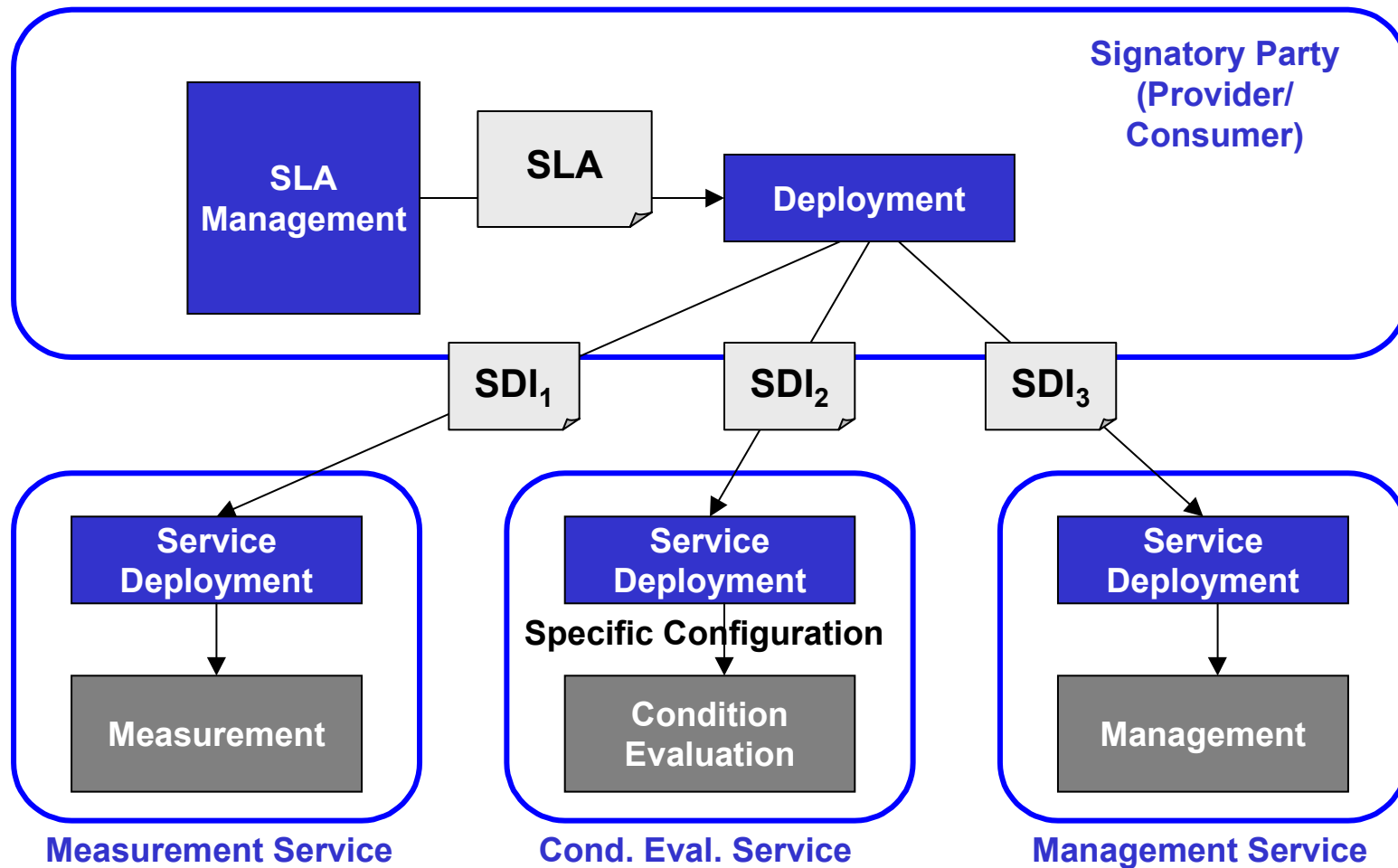
Organization of Extensions

Summary and Outlook

- Formal Language for SLAs
 - Association Web services, etc.
 - Unambiguous specification of parameters and metrics
 - Service Level Objectives and Action Guarantees
- Interaction model for SLA Monitoring
- Third party involvement
- Usable in whole life-cycle (publishing, negotiating, provisioning, monitoring)
- Define third party involvement in monitoring an SLA
- Tooling Support:
 - Compliance Monitor
 - Authoring Toolkit

Thank you

Deployment Involving 3rd Parties



Cross-organizationally standard deployment information is needed: **SDI-Format - relevant SLA parts**

SLA Language Flexibility

SLA

Flexibility

Flexible Guarantees

```
<Guarantee>
  <Obligated>ACMEProvider</Obligated>
  <Expression> .....
</Guarantee>
```

Flexible Metric Description

```
Average response time =
  avg(time series(probes))
....
```

Name-Value Pairs

```
MaxResponseTime="2"
Availibility="95"
```

Natural Language only

```
<Clause number="21">
  Downtime, measured as
  ....
</Clause>
```

► Trade-Off:

- Flexibility of expressiveness must be matched by
- Flexibility of service-providing system

Relationship to Standards

- Web Services Endpoint Language
- Open Grid Standard Architecture

Relationship to WSEL

WSEL

- Description of a Web service end point, including "QoS"
- Unilateral
- How does WSLA fit the QoS aspect of WSEL?

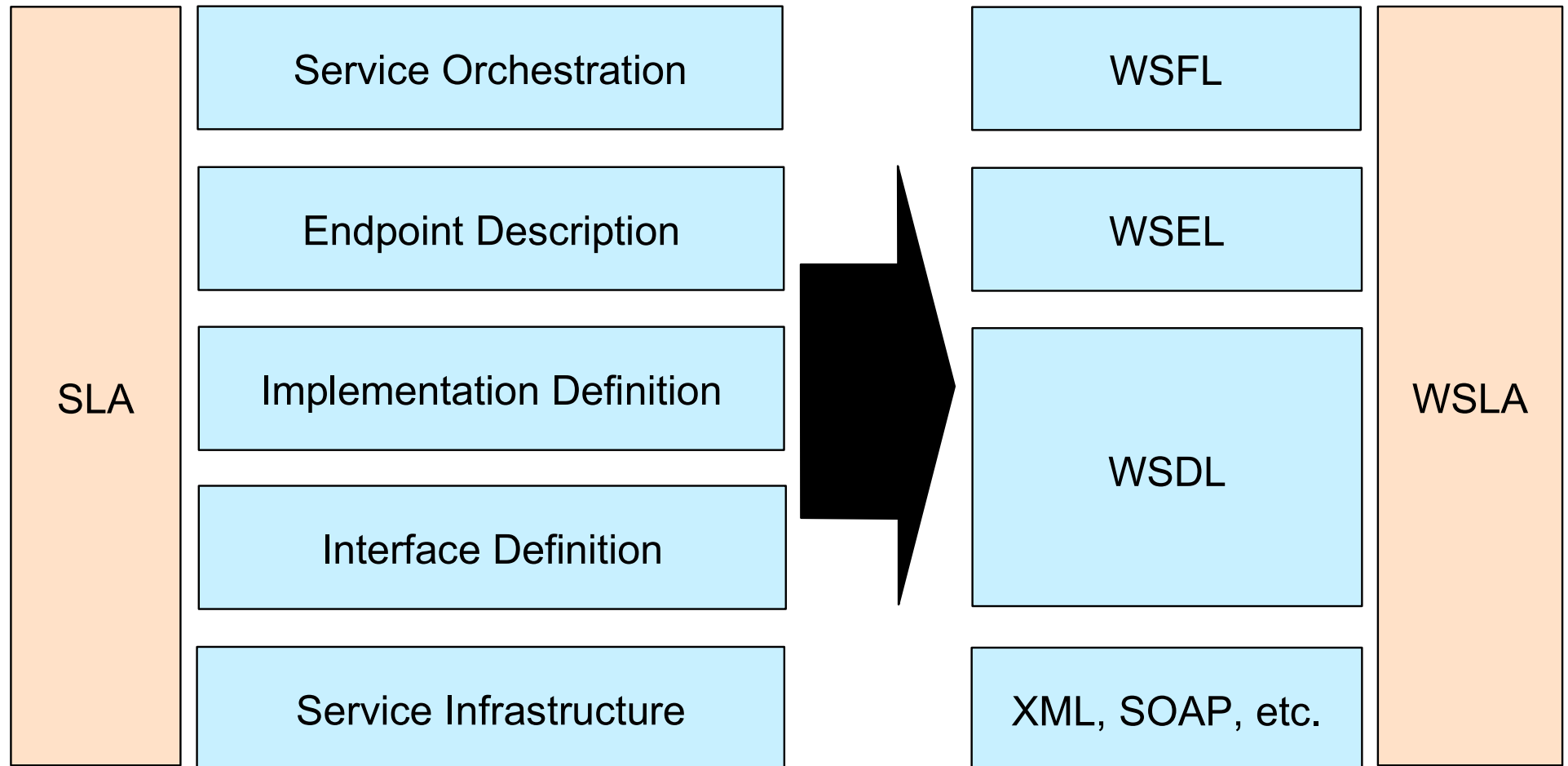
Pointer to WSLA template in WSEL

- WSLA template is WSLA with:
 - Open fields to be filled (e.g. service customer, 3rd parties, guarantees)
 - Completion rules (how the fields must be filled in)
 - Requires complex binding protocol, including simple negotiation

Simple WSLA Service Quality Description

- Part of WSEL, using the "binding" mechanism
- Features:
 - Flexible metric definitions, SLOs, advertising and provisioning
- Not possible:
 - Third party involvement, action guarantees, notifications

Positioning in the Web Service Stack



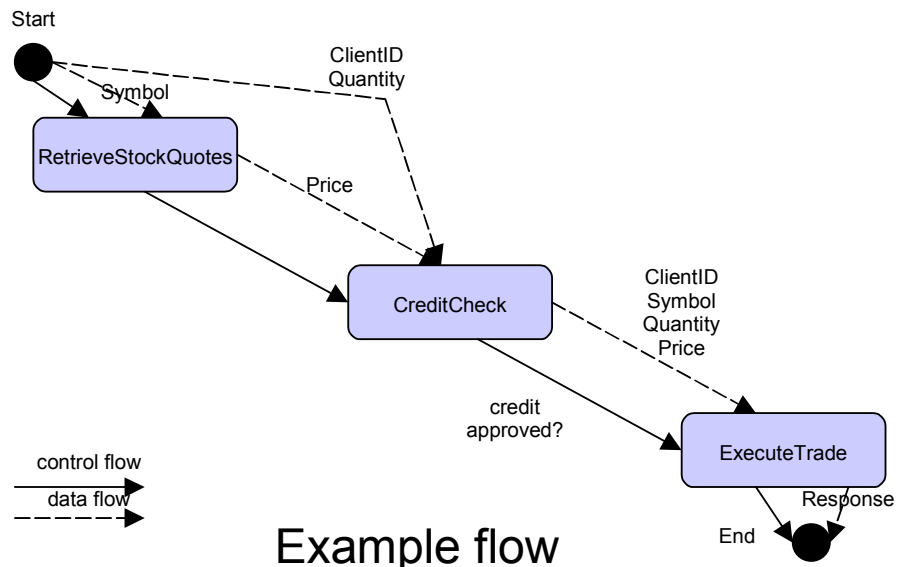
WSLA for Composite Web Services (WSFL)

WSLA can be used to define SLAs on composite Web services

Run times, completion events, and current states are the most interesting measured values

- Simple measurement directives
- Can be used to describe aggregate parameters such as times used completing multiple steps

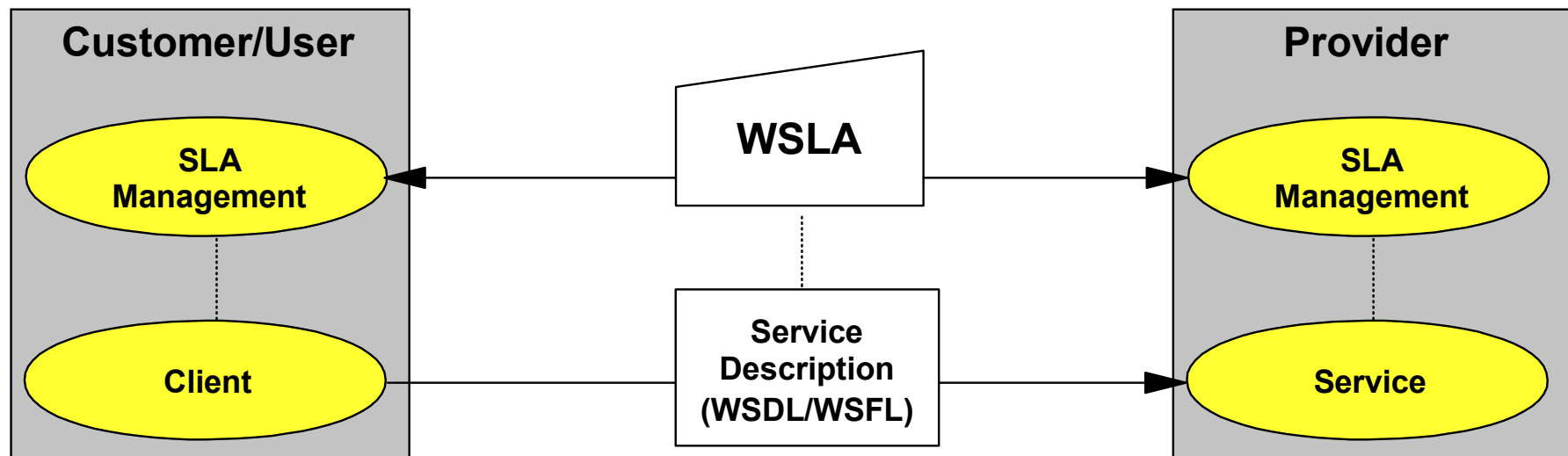
Depends on state model of WSFL



```
<Metric name="ElapsedProcessRunTime"
  type="integer"
  unit="milliseconds">
  <Source>ProcessProvider</Source>
  <MeasurementDirective
    xsi:type="ElapsedProcessCompletionTime"
    resultType="integer">
    <ProcessTypeID>StockPurchaseFlow</ProcessTypeID>
  </MeasurementDirective>
</Metric>
```

Example measurement directive

Role of an SLA in Web Services



Service Level Agreement (SLA) language is used for:

- ▶ **Specification:** unambiguous, measurable and hence, enforceable

SLA document is input for:

- ▶ **SLA monitoring:**
 - Customer guarantees: performance, availability & other business process level objectives
 - Possible monitoring by client or third-party
 - Violation notification & generation of predictive alerts
- ▶ **Automatic provisioning:** allocated resources (e.g., new servers, server settings)
- ▶ **Runtime scheduling:** prioritization of requests & admission control based on service level objectives