A policy-based evaluation framework for Quality and Security in Service Oriented Architectures

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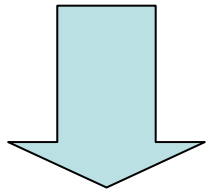
Current Web Service Scenarios:

• Customers ask for Web Services providing with specified Quality levels;

• Providers are interested to publish *both* functional and quality characteristics of the Web Services they provide;

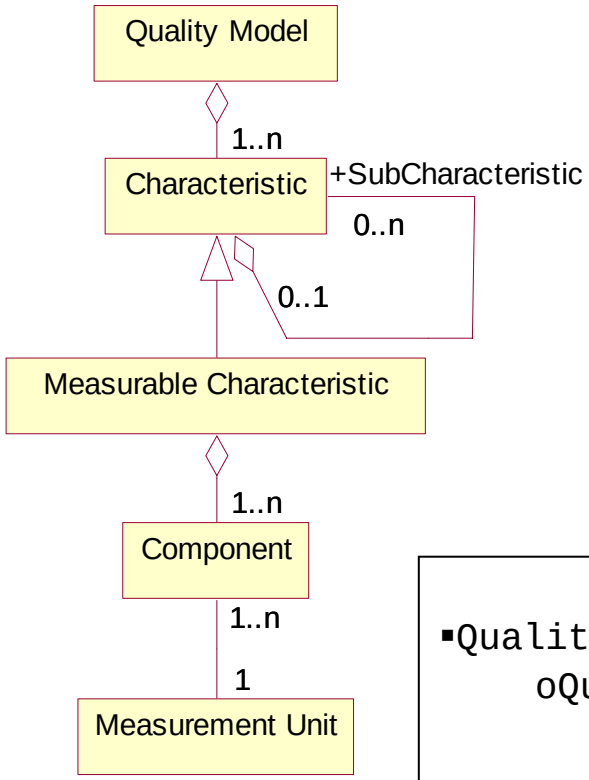
• Service Level Agreements (SLAs) are contracts between a Customer and a Provider; they specify the characteristics in terms of performance and security of the provided services; they are usually expressed by means of free text documents, i.e. in natural language;

•All these factors represent a wide limit in the formal definition and automatic evaluation of SLA.



→ Models are needed to formally express the Quality of Web Services (software quality, QoS, security and so on) requested by Customers and offered by Providers

Our Proposal: define a Quality Meta-Model



• Quality Characteristic: any quality requirements, such as Performance, Security, Cost, Maintainability

•Characteristics may be arranged in a hierarchy (Measurable Characteristics are the leaves)

• Measurable Characteristic: a Quality Characteristic that can directly be measured

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▪Quality Characteristic: Efficiency
    oQuality Characteristic:  Time Behaviour
        ▪Quality Characteristic: Response Time
            •Measurable Quality Characteristic: Average
            Response Time
                oComponent:  Average Response Time Value
                ▪  Measurement Unit: Seconds
                oComponent: Samples Number
                ▪  Measurement Unit: Natural Number
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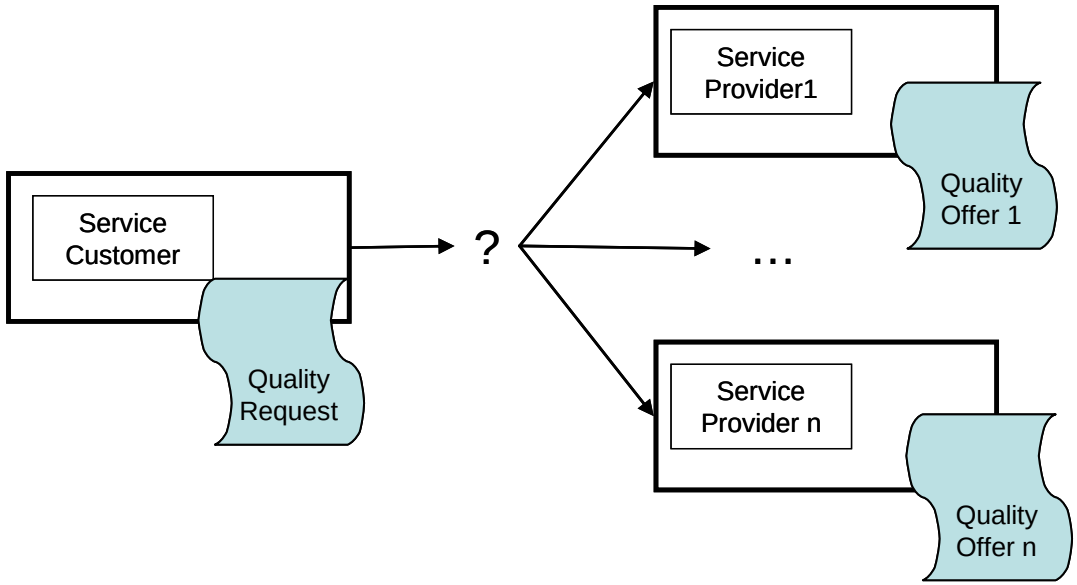
Open problem: How a Customer can choose the Web Service that better fits his quality requirements?



- We propose to formally express Quality as an istance of the meta-model;
- We adopt a decision framework for Quality evaluation;
- The framework is based on AHP (Analytic Hierarchy Process) proposed by Saaty.

T.L. Saaty. How to make a decision: the analytic hierarchy process, European Journal of Operational Research, 1990. Vol. 48, n.1, Elsevier, pp. 9-26.

The Analytical Hierarchy Process

1. **The decision framework design activity:**
    1. **Weight Assignment step**: the relative importance of the characteristics is rated;
    2. **Clustering step:** for each measurable characteristic, the sets of values that will be considered equivalent for the aims of the evaluation are defined;
    3. **Rating Step:** each set is associated to a rating value;

2. **The decision making activity:** to compare the quality of an offered service (formalised in a Quality Offer Model) against requestor needs (formalised in a Quality Request Model)

Step 1: Weight Assignment

Intensity of Importance and its interpretation	
Intensity of Importance	**Interpretation**
1	Equal Importance
3	Moderate Importance
5	Strong Importance
7	Very strong Importance
9	Extreme Importance

1. Build the Comparison matrix

	Average Response Time	Standard Deviation Response Time	Maximum of Response Time
Average Response Time	1	3	7
Standard Deviation Response Time	1/3	1	5
Maximum Response Time	1/7	1/5	1

2. Normalize The matrix

	Average Response Time	Standard Deviation Response Time	Maximum Response Time	Weights
Average Response Time	21/31	15/21	7/13	0.64
Standard Deviation Response Time	7/31	5/21	5/13	0.28
Maximum Response Time	3/31	1/21	1/13	0.07

Characteristic Weights are assigned by comparing their relative importance:

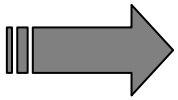
$$w(i) = \sum_{k=1}^{n} \frac{m'(i,k)}{n} \quad \forall \mathrm{i}$$

Step 2: Clustering

Let's consider the Average Response Time characteristic

R = Offered_value / Requested_value

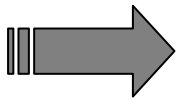
Possible Solutions are clustered in three levels:



R < 0.5 (very fast response);
0.5≤ *R* <1 (sufficiently fast response);
1≤ *R* <2 (quite slow response).

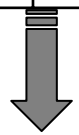
Step 3: Rating

Intensity of Goodness and its interpretation	
Intensity of Goodness	**Interpretation**
1	Equivalent
3	Moderately better
5	Strongly better
7	Very strongly better
9	Extremely better



Ratings are assigned to clusters by comparing their relative Goodness

	R<0.5	0.5≤R<1	1≤R<2	Rating
R < 0.5	1	3	5	0.63
0.5≤R<1	1/3	1	3	0.26
1≤ R<2	1/5	1/3	1	0.11



Satisfaction Function S(R)

$$S(\mathrm{R}) = \begin{cases} 0.63 & if \quad \mathrm{R} < 0.5 \\ 0.26 & if \quad 0.5 \le \mathrm{R} < 1 \\ 0.11 & if \quad 1 \le \mathrm{R} < 2 \end{cases}$$

The Decision Making Activity

The Quality of different Web Services is compared by evaluating:

1. a Satisfaction Function for each Measurable Characteristic.
2. a Satisfaction Function for each non-Measurable Characteristic

$$S_c(request, offer) = \sum_{sc \in C(c)} w_{sc} S_{sc}(request, offer)$$

3. the Overall Satisfaction Function:

$$S(request, offer) = \sum_{c \in Characteristic} w_c S_c(request, offer)$$

The Web Service with the greater Satisfaction Function value is chosen