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Combinatorial Auction Service Selection in Service Based Systems Using Trust Based Quality Awareness

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ABSTRACT

The service-oriented paradigm offers support for engineering service-based systems (SBSs) based on service composition where existing services are composed to create new services. The selection of services with the aim to fulfil the quality constraints becomes critical and challenging to the success of SBSs, especially when the quality constraints are stringent. However, none of the existing approaches for quality-aware service composition has sufficiently considered the following two critical issues to increase the success rate of finding a solution: 1) the complementarities between services; and 2) the competition among service providers. This paper proposes a novel approach called combinatorial auction for service selection (CASS) to support effective and efficient service selection for SBSs based on combinatorial auction. In CASS, service providers can bid for combinations of services and apply discounts or premiums to their offers for the multi-dimensional quality of the services. Based on received bids, CASS attempts to find a solution that achieves the SBS owner's optimization goal while fulfilling all quality constraints for the SBS. When a solution cannot be found based on current bids, the auction iterates so that service providers can improve their bids to increase their chances of winning.

Keywords: Combinatorial auction, Quality of service, Service composition, Service selection, Trust.

1. INTRODUCTION

The phenomenon of computing has been evolving as a prime course in the service based real time systems. To search for specific service in thousands of them is a challenging issue in the service based systems. To select best service from composite services is a good approach for system quality. Service based system designers execute multiple business processes and develop new service based systems [1], [2], [3].

Service composition in service based system consists of four stages.

- Planning: Functionalities of services are determined by the service provider.
- Service discovery: Candidate services are developed by the service provider in discovery stage but there is no security development of candidate services. In this phase, security issues are needed to be provided before service selection from the providers.
- Service Selection: To select the candidate services for dynamic system based services, service selection is used. Non linear quality attributes like success rate, availability, response time, throughput, cost, reliability, security and ranking performance are considered and good quality service selection are provided.
- Service delivery: The selected services are executed based on the trust manner and trust aware quality services are provided.

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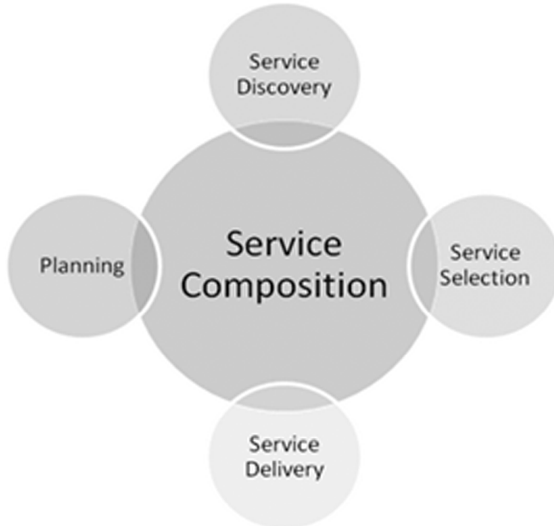

Figure 1: Service Composition Stages

Trust based service providers should negotiate service level agreements (SLAs) with multiple candidate service providers and then select the best service from Multiple Services. [4] [5] [12] [6]. Consider the multiple services by a single service provider, shorter response time is proposed from the cloud based service based system to transmit the services using global environment. We propose middleware service selection through M2M communications between the mobile devices carried by the service providers. This M2M provides efficient service classification from multiple services [15] [18]. The middleware connects the Mobile Adhoc network and cloud network automatically over the multiple services for service discovery in the cloud server. Middleware framework can be considered as one of the most trust based services from reliable providers by optimizing the route (on hop distance and route expiry time (RET) for accessing service). These trust issues are accessed by hop count to access the services. In [7] [16] [17] there are no trust issues included in the M2M opinion. Here we have to include the trust security during the execution path from service providers. In addition, reduced cost of service monitoring is maintained in the service based system during the SLA negotiation so that they can provide better QOS at lower cost. The Probabilistic timing model is proposed for quality aware service selection [8] [13], to take into account the randomness of the timing properties of the composite services of the SBS. This approach is used to maintain the cost through trust based monitoring in quality aware systems.

We propose a framework for quality based trust aware service based system [QBTASBS] for development of adaptive service based system that achieve all QOS requirements through dynamically and different type service configurations are developed based on context aware cloud computing environment [9]. It makes better quality aware decision making and provides better optimization in service based systems. To advance CASS procedure (Combinatorial Auction for Service Selection), we introduce the new novel approach Trust Based Quality Aware CASS procedure (TBQCASS), a type of auction scheme using different type of bidders for multiple items [10]. Here more non-linear quality parameters such as success rate, availability, response time, throughput, cost, reliability, security and ranking performance are considered [11] [14]. The proposed improved CASS procedure is extensible, dynamically adaptable and reconfigurable at runtime without affecting the execution of Multiple Services. The context awareness ranking strategies are included in this platform and replace the previous one to provide better utilization.

2. PROPOSED FRAMEWORK

Based on the ever growing internet popularity and the utilization of cloud based services for various e-commerce activities, the development of the reliable and trust worthy frameworks has become very essential in service based systems (SBS). Establishment of certification process and authentication procedures form the integral part of the SBS mechanisms. The proposed trust based quality aware combinatorial auction service selection (TBQCASS) has both certified process and ranking scheme to have better reliability in the cloud based service based systems.

The service requester initiates the service request which reaches the service oriented engine. The Engine analyses the request and process further for quality selection. The service QoS metrics are measured and compared with the standard values through the Service Level QoS coordinator. The main function of the coordinator is to queue up the list of requests to be analyzed for threshold metrics and process them for further service provision through the data cloud.

The Cloud based service based system (SBS) is the heterogeneous framework supporting multiple services with multi attribute functionalities. The query request processed through the service level QoS coordinator is sent to the list of corresponding service provider through cloud access. The service requests are queued up based on the service requirements and preceded to the relevant service providers from S1, S2…up to Sn, where n is the number of service provider. Next phase in the framework is the Service Level QoS optimizer. Trust based ranking and certified processes are incorporated in the optimizer to have better reliability, high success rate and less cost. The services thus optimized are processed through the monitoring agent called as Service monitoring and then delivered to the client in the remote end

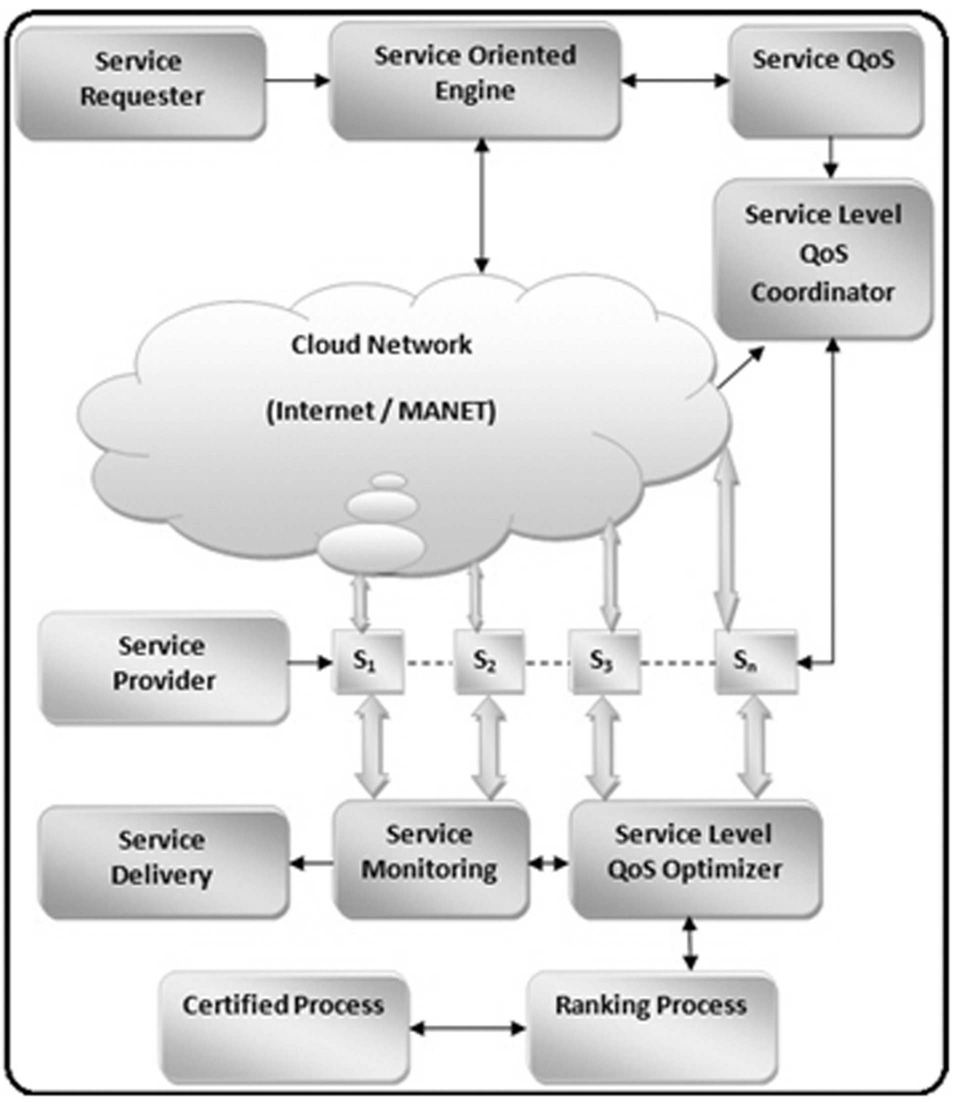

Figure 2: Framework of Proposed System TBQCASS

through distributed processing via. Service Provider. The complete framework of the proposed system is available in fgure 2 and the Flowchart for the service flow from request to delivery is presented in figure 3.

2.1. Key Features of TBQCASS

1. It allows a multiple combinations of bids for services in a uniformed manner. It utilizes the QOS capacities for multiple cloud based services.
2. It allows SBS developers to negotiate with multiple candidate service providers for each non linear QOS services of the SBS.
3. It provides the trust based execution path for service discovery and provides less cost for selections of multiple services.
4. Novel Approach for selection of dynamic multi dimensional cloud based MANET service of task QOS (trust based QOS) – It is developed to help SBS developer coordinate the auction processes and exploit the competition among service providers. It guarantees for the bidders improvement.
5. Trust based winner determination problems are developed by TBQCASS for all QOS requirements and it optimizes the services in global level.
6. Overall this procedure provides 90% better accuracy than normal CASS procedure.

2.2. Salient Advantages of TBQCASS

1. Improved Trust based Quality aware CASS monitoring is considered and the procedure is developed
2. More non linear quality parameters are considered. (success rate, availability, response time, throughput, cost, reliability, security, and ranking performance).
3. More number of bidders is added to create composite services.
4. Non-linear programming problem is overcome by means of adding attributes and negotiable SLAS.
5. Activity based utility functions are developed.
6. Higher accuracy rate is achieved
7. To create orchestration engine such as apache ODE, which adopt to a different way of composting services.
8. Quality aware decision making is proposed for context aware system based on cloud computing environment.
9. Different types of service configurations are developed to achieve better QOS requirements.
10. Service composition configuration is developed in SBS. (lower response time, lower network latency, lower energy consumptions and higher success rate are achieved)
11. No malicious opinion being shared with the selection of composite services. So security and trust issues are considered during the execution path from service providers (M2M).

3. IMPLEMENTATION

The new CASS procedure determines higher trusted structure of loops with many entry points and many exit points through selection. It contains many conditional branches b1, b2, b3, b4 upto bn, where Pb0, Pb1, Pb2, Pb3 upto Pbn are probabilistic models selected for execution respectively.

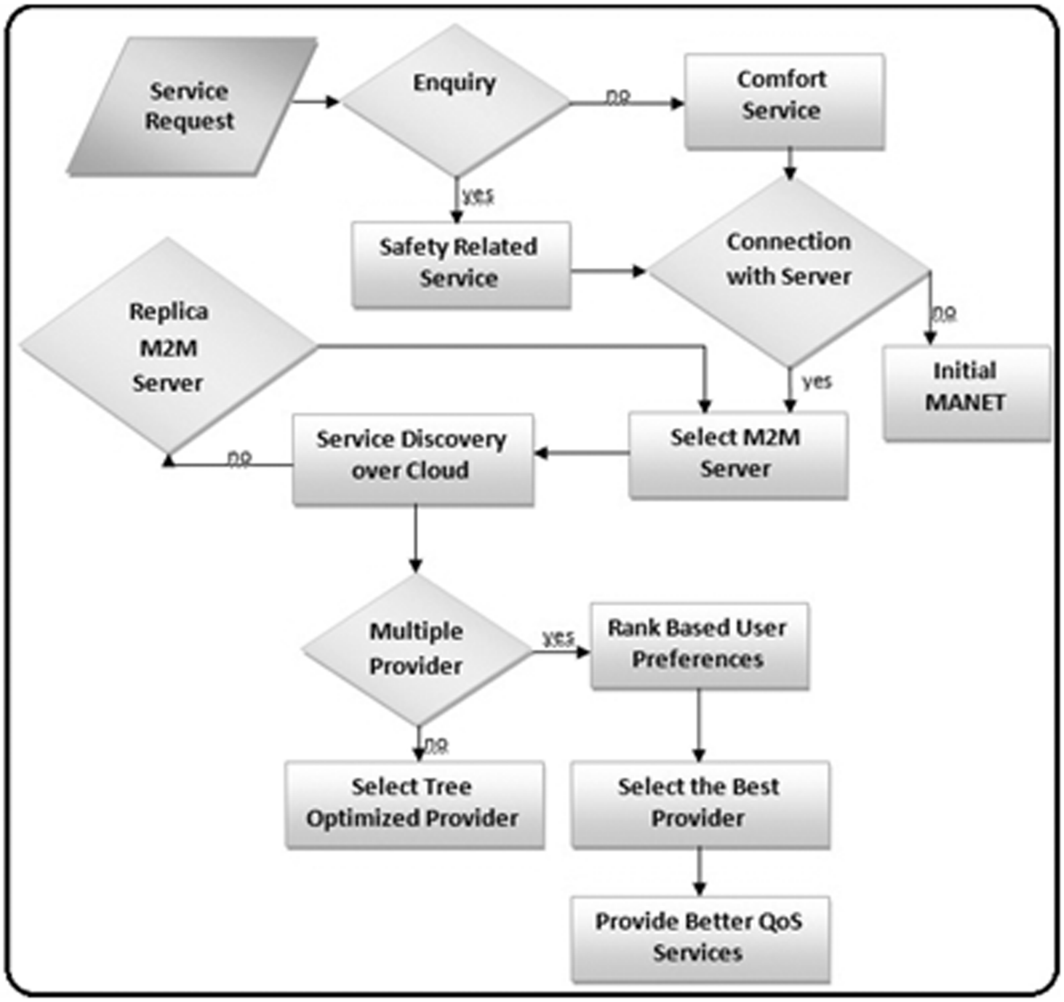

Figure 3: Flowchart of Proposed System TBQCASS

The flowchart is the proposed context aware trust based Quality aware CASS model which explains a middleware operating on a user's network device and initiates its operations upon getting a service request from the provider. The service requested is clarified using users cloud context that represents the cloud network system i.e., the urgent system is detected from users' velocity which increase the priority level of faster execution of the system. The velocity data is implemented using cloud based M2M connectivity and integrated with network devices. The service is classified to be the trust based model and comfort service model. When the dedicated servers are reducing the speed of their system operations, the middleware framework initiates another network connection for discovering new service. The provider gets service using selection methods and incorporates the service related contexts and the user service expectations for the service requestor.

3.1. Discovery Model

The trust related service requests are implemented using trust routes in the middleware framework and locally cached up by lookup table and route tables. Cross layer service discovery method discovered by TREQ and TREP (Trust based Request and Reply) are included in the middleware framework. Routing techniques implemented are AODV (Adhoc On Demand Vector) routing and Trust based routing. In this mechanism, the hop counts between the user and service providers are returned. The providers' addresses are A1, A2……AK and it is piggybacked with request and reply. The energy E1, E2….EK, mobility data and trust data are stored in the trust based lookup table. The trust based information is used to find the Link

Expiry Time (LET) of links and it indicates the duration of time a user may remain connected with trust based user before they become disconnected due to low mobility and energy. Route Expiry Time (RET) provides with an estimation of the maximum time duration a route would remain active between multiple providers. All the data are stored in the lookup table.

3.2. Safety Related Services

3.2.1. Service Discovery

A1, A2……AK are provider's address and C1, C2……CK, for K = 1, 2, …. K are providers. Each providers' trust capacity T1, T2……TK is requested with TREQ which is in optimization and further subjected to the constraints.

Rhop = min [Ai, k]

RRET = max [RET i, k]

s.t T_k ≤ [T]_(max,) E_k ≥ E_min

Energy E1, E2 …. EK, K = 1, 2, ……, k

RETi, k = min [LETe]

Where RET = Route Expiry Time

LET = Link Expiry Time

Two users i, j location (x1, y1) & (x2, y2)

Velocity – V1 & V2

Phase angle - θ_1 and θ_2

Links = 1, 2………………. L

$$LET\ i,\ j = \frac{-\left(pq+rs\right)_{T_k} + \sqrt{\left(p^2+r^2\right)R^2 - \left(pr-qs\right)^2_{T_k}}}{\left(p^2+r^2\right)_{T_k}}$$

where Tk is the trust information.

3.3. Trust based QOS Generation

To filter the untrusted bids and add the QOS, the complexity of solving winning determination process can be reduced due to the increase of number of bids and users.

Nonlinear trust based $QOS\ (TQ(S_m)\}\ t\ q_{i,p}(S_m) + t\ q_{i,w}(S_a) \neq t\ q_{k,p}(S_m) + t\ q_{k,p}(S_p)$

Where $t\ q_{i,p}(S_m)$, $t\ q_{i,w}(S_a)$, $t\ q_{k,p}(S_m)$ and $t\ q_{k,p}(S_p)$ represent the trust based Pth QOS parameters for the services Sm and Sa specified in TQi (S_m), TQi S_n, TQk S_m and TQk S_n.

The trusted QOS proposed by bidders can be nonlinear and trusted. The bids j of trusted property is as follows,

Given trusted bids, $\{TS_m\}$, $\{Q_i\ TS_m\}$

$(\{TS_n\}, \{Q_i T(S_a)\}), (\{TS_m, TS_n\}, \{Q_k(TS_m), Q_k(TS_n)\})$, which involve two abstract trusted services TSm and TSn $(T\,S_m \neq S_n)$ non linear trusted bids allow,

$q_{i,p}\,(TS_m) + q_{j,p}\,(TS_n) \neq q_{k,p}\,(TS_m) + q_{k,p}\,(TS_n)$ Where $q_{i,p}\,(TS_m)\ q_{j,p}\,(TS_n)\ q_{k,p}\,(TS_m)$ and $+\,q_{k,p}\,(TS_n)$ represent the pth trusted QOS parameter of TSm and TSn specified in $Q_i\,(TS_m)\ Q_j\,(TS_n)\ Q_k\,(TS_m)$ and $Q_k\,(TS_n)$.

Cost = $q_{\text{cost}}\left(TS\right)=\sum_{t_j\in S} q_{price}\left(TS_p\right)$

Response Time = $q_{rt}\left(TS\right)=\sum_{t_j\in S} T_p\left(es_e\right)\times T_{qrt}\left(es_e\right)$

Throughput = $q_{tp}\left(S\right)=\sum_{t_j\in S} T_p\left(tes_e\right)\times q_{tp}\left(es_e\right)$

4. EXPERIMENTAL ANALYSIS AND RESULTS

For analyzing the Trust based Quality aware CASS schemes, we have set up an experimental setup using Java with JDK 1.6 Toolkit. With the defined quality constraints for service based systems and systematic parameters viz. reliability, stability and throughput, the performance of the trust based CASS system is compared with the normal CASS system and the results are tabulated.

4.1. Evaluating Effectiveness and Efficiency

The effectiveness of the trust based CASS system can be measured by analyzing the optimization approach. The type of services provided and the number of service providers are taken for consideration while computing the optimization. For static optimization, the bidders bid for individual services, where as for CASS, the bidders bid for composite services. In Trust based CASS, the selection criteria is based on for composite services with multiple trust attributes.

In the simulation analysis for evaluating effectiveness, the proposed trust based optimization is compared with CASS and static optimization based on the three parameters, viz. number of quality constraints, number of abstract services and number of bidders. The simulation setup is tabulated in Table1. The success rate of each mechanism is measured and presented in figure 4, figure 5 and figure 6. Success rate is defined as the percentage of circumstances where a solution is arrived that satisfies both the system constraints like quality of services, number of services and number of bidders and also the optimization goal in the service based system.

Significantly from the figure4, the performance success rate of trust based CASS optimization is better than normal CASS optimization and static optimization. In the scaling up of quality constraint parameter, the performance of static optimization is dipped where as trust based CASS and normal CASS maintains the scalability.

As shown in figure5, considering the varying number of abstract services, the success rate for trust based CASS is maintained in near about 70% even for maximum of 100 services. The success rate of CASS is varied from high range of 60 % to the minimum of 30%. When number of abstract services is increased, the static optimization procedures could not uphold the success rate and eventually failed.

In figure 6, the number of bidders is varied. With intense population bidding for the service, trust based CASS scheme is found to be the better solution. In the web based cloud platform, with more users hitting the services, trust based CASS has high success rate of around 85% when compared to normal CASS and static optimization schemes.

Table 1
Simulation Setup - Tabulation

Attribute	*Simulation Setup 1*	*Simulation Setup 2*
Number of Quality Constraints	From 1 to 10 in steps of 1	2
Number of Abstract Services	10	From 10 to 100 in steps of 10
Number of Bidders	100	100

Figure 7 and figure 8 represent the performance evaluation to find the efficiency of the proposed trust based CASS scheme for varying number of multi-attribute multiple services. In the simulation analysis, the proposed scheme is compared with normal CASS and static optimization schemes. Cost is defined as the percentage of service usage involved in the efficient system performance. figure 7 illustrates, the overall cost involved in minimum in range of 20% for maximum number of services involved while using trust based CASS against the higher cost utilization for CASS and static optimization schemes.

Reliability is defined as the quality of service yielding the similar results for multiple iterations. figure8 shows the reliability percentage for multiple service attributes in the service based systems. The simulation analysis reveal that trust based CASS has better reliability in order of close to 90% in service based system when compared to less reliable schemes, viz. CASS and static optimization.

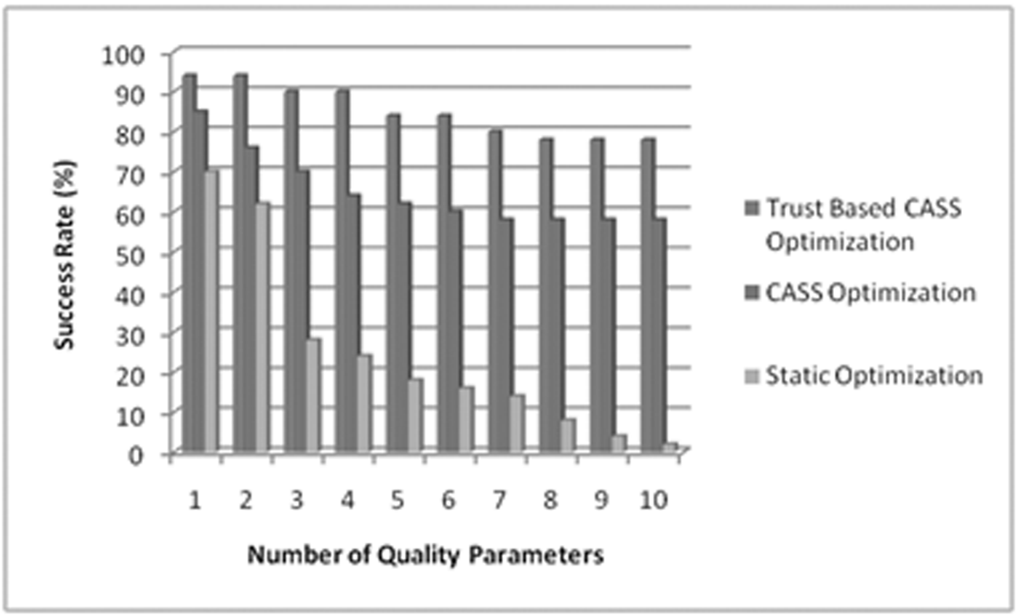

Figure 4: Success Rate for varying Quality constraints

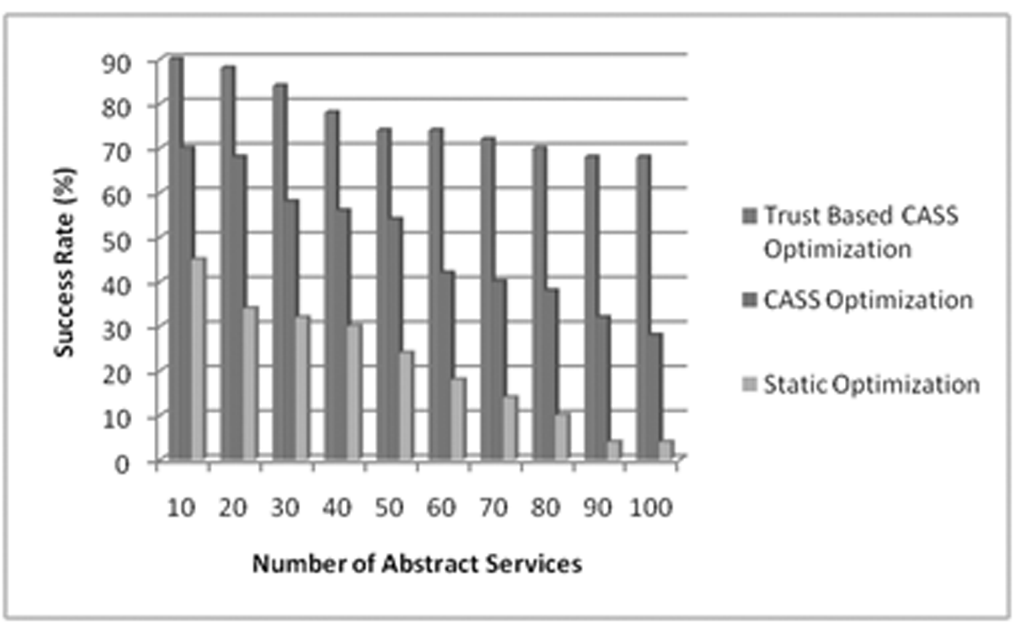

Figure 5: Success Rate for varying Number of Abstract Services

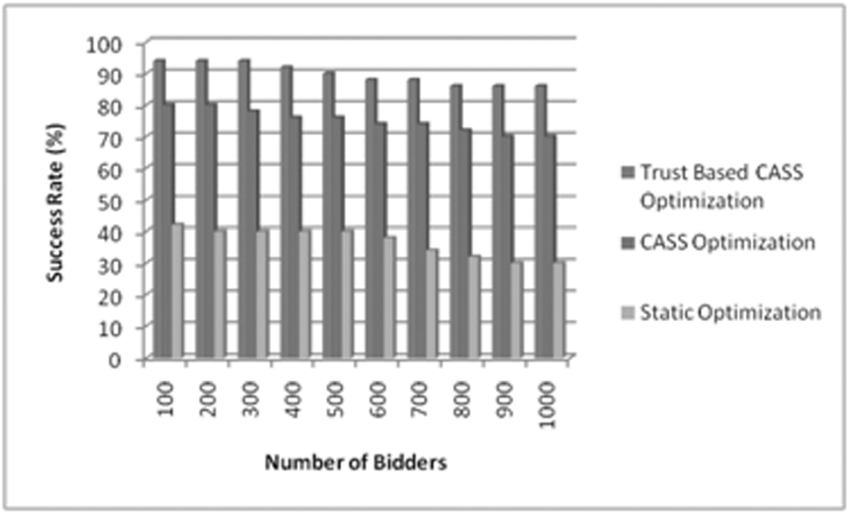

Figure 6: Success Rate for varying Number of Bidders

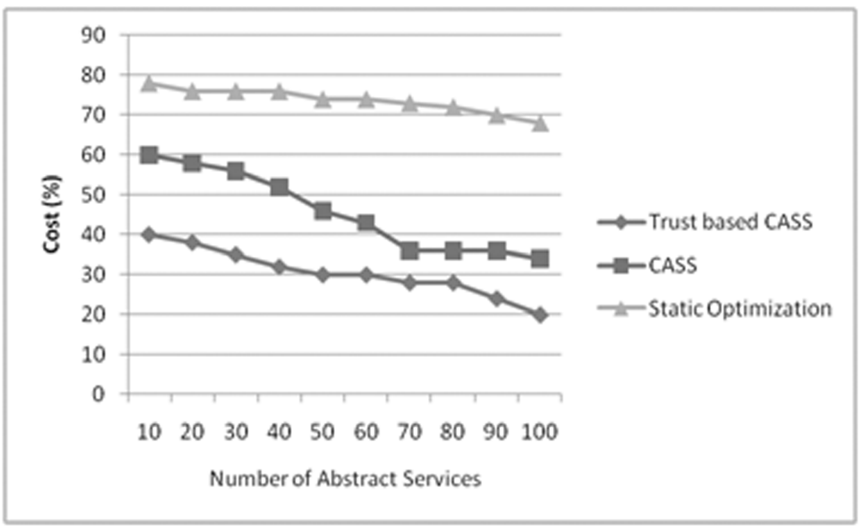

Figure 7: Cost Percentage Comparison

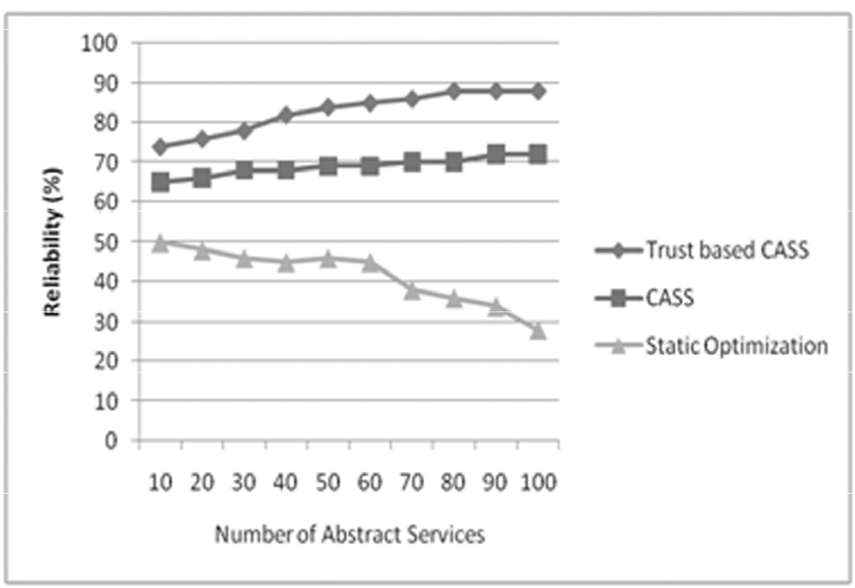

Figure 8: Reliability Comparison

5. CONCLUSION

In the service oriented environment, quality aware mechanisms are of challenging nature. The innovative approach to support effective service based scheme using trust based awareness is presented in this paper. The ability of the service based system, to handle non-linear quality constraints and services parameters are analyzed using the trust based quality aware selection schemes. Different bidders are chosen for various combination of winner determination process and middleware service selection schemes for achieving better accuracy than normal CASS procedure. Redundant context sources are selected in the trust aware mechanism to achieve low cost for service selection. Trust based iterative awareness is effective for the improvement of the selection of bidders when satisfactory solution is not arrived in the first iteration. Using Trust Based Quality aware Combinatorial Auction Service Selection (TBQCASS), the exploitation of competition is established among the service providers which provide high success rate and system throughput efficiency. As a future direction, the trust based quality awareness mechanism can be incorporated in the heterogeneous cloud based architecture and the combinatorial auction schemes can be analyzed.

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