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An Optimizing Technique to Reduce Risk Factor in Mobile Service Composition

K.Sai Krishna[1], Dr.B.Lalitha [2],
CSE Dept, JNTUACEA ,Anantapur, AP India, Student [1], Assistant Professor [2],
Email ID: kakarlasaikrishna11@gmail.com [1] , lalitha_balla@yahoo.co.in[2]

Abstract: As people of all walks of life started using mobile devices, they became important that the mobility of users is respected and applications need to make this as a note. Mobile applications help users to utilize services and also provide services to others while not limiting users to a particular location. Wireless communication technologies can be exploited to combine services running in mobile devices within limited range. However, there are some problems with mobile computing such as mobility and change of topology of network and so on. In this context there is high risk involved in the functioning of tasks rendered through service composition. Therefore, it is essential to have a dependable service composition strategy for reducing risk. However, it is very challenging task to be accomplished. The existing system from Deng *et al*. has a risk model and service composition is made on top of the risk model for reducing risk execution of the tasks. Under the mobility model, they performed service composition which demonstrates risk reduction. Chosen mobile services are composed to form a combined service which has more utility than individual services. However, it needs improved optimization. In the proposed work, the service composition and risk models are further improved by defining more refined and optimized service composition and risk technique. It helps users to avail the composed service with high utility besides its ability to be in line with the mobility model which is highly desired by users of mobile devices.

Keywords — Mobile Services;Ns2 simulator, Risk Reduction; Service Discovery; Service Composition; Shareable mobile devices.

1. INTRODUCTION

Service Oriented Computing (SOC) became very important phenomenon in the wake of distributed computing technology and dynamic environments that we come across. Discovering required services and composing them in the way that works best are the two most important aspects of SOC. There are unprecedented advances in mobile communication technologies and the ability of mobile devices. Service compositions have important role as any single service may not accomplish complete task required [1]. It became an important research topic of late as more researchers contributed towards it [16], [17].

There are two important reasons for SOC with respect to mobile services. The first reason is that smart mobile devices are equipped with extended capabilities and functionalities. The second one is that the mobile application developers are targeting services, devices that provide standard interfaces to Participate in SOC. Thus mobile devices are being to participate in the scheme of things of SOC by acting as a service requester, service provider or broker [15]. The service provided traditionally run in computers that do not have portability. However, with mobile devices, the service discovery and composition are very challenging due to the mobility of nodes. There is risk of failure of Quality of Service. To overcome these problems Deng et al. [17] proposed a method to reduce risk factor and improve Quality of service in the functioning of composed services. Anyway, there is further need for optimization. Contributions of this paper are as follows.

- We proposed a methodology to have risk-aware service composition to provide high quality of service.
- We proposed an algorithm named Service Composition Optimization (SCO) that analyzes risk of different compositions and suggests the one which has minimal risk in deteriorating QoS.
- We made NS2 simulations to demonstrate proof of the concept. The simulations show the utility of the proposed algorithm and evaluate its performance.

The paper further described as Section 2 provides the related work. Section 3 goes with proposed methodology. Section 4 mentions experimental setup. Section 5 details the experimental results and Section 6 concludes with the paper along with future work.

2. RELATED WORK

This section reviews literature on the mobile service discovery and service composition related works. Comparison of web services and their compositions is made [1] for good service interaction level. Analysis of group modeling which is for grouping mobile devices [2]. Service patterns requests are analyzed in [3] for mining multiple services. In [4] Map Reduce programming paradigm is used to deal with large scale data related to few methods that is known a distributed and incremental inference. The devices that participate in the Internet of Things (IoT) are the main focus of the study [5]. A good survey of IoT technology is found [9]. With Wireless Sensor Network (WSN) a hybrid Analogy approach is explored [6] for optimization of coverage. The advancement of mobile services that are context-aware and can be used effectively is explored in [7]. Compliance checking for service workflows is studied

[10]. The services used by devices and finding requested services are focused in [11]. Mobile services and social-robots are studied in [13] for detection and tracking of humans in multi-person environments. The process of risk control while acquiring business processes related to services is studied [14]. From the literature it is understood that the problem of discovering services and composing them is an optimization problem and further investigated in this paper. We proposed an algorithm to this effect which will try to improve the process of discovering services and composing them.

3. METHODOLOGY

The purpose of the project is to discover nearby mobile services and compose related services that can be used by composing them to form an application. However, risk is associated with it when such services are composed for many reasons like mobility. The aim of this project is to optimize service composition towards reducing the risk on the execution of the tasks. The proposed methodology is the combination of service discovery and service composition. Service discovery and composition of services with mobility consideration is made in [8]. In the first phase, nearby devices are detected and services are discovered while in the second phase, the discovered services are composed optimally in order to reduce risk on the execution of the tasks.
In the first phase, network service discovery (NSD) is used to detect mobile devices and other wireless gadgets like printers. This discovery is a DNS based approach that allows an application running in mobile to make a request for required services by mentioning the name, device and kind of service. In the same fashion, while making use of mobile services, computation offloading is by mentioning the name approach explored in Mobile Cloud Computing (MCC) [12]. This Technique is supported by all mobile devices including Android. The ability to discover devices and services can pave way to having many peer-to-peer applications. The following algorithm is used to ensure risk reduction in service composition.

3.1 *Proposed Optimization Algorithm*

An algorithm by name Service Composition Optimization (SCO) is proposed and implemented. The algorithm considers devices and their services as input and produce risk-free composition of services.

Algorithm: Service Composition Optimization (SCO)

Inputs: Devices and services

Output: Risk-free composition of services

```
Initialize devices vector D
Initialize services vector S
Initialize device-service map M
Initialize service composition vector SC
Initialize service composition map SCM
```

Device and Service Discovery

```
For each device d in D
  For each service s in S
 Add d and s to M
 End For
End For
```

Service Composition

```
SC = Make Compositions()
For each sc in SC
 Analyze risk r
 Add sc and map to SCM
End For
```

Find Best Composition

```
For each scm in SCM
 risk=risk of scm
 IF(risk<lowrisk) THEN
 lowrisk= risk
   END IF
 lowrisk_scm=scm
End For
Return lowrisk_scm
```

The proposed work involves in three important phases. In the first phase various mobile devices and their services are discovered. In the second phase, service compositions are made based on the risk analysis. While the reliable service composition method is proposed in [16].Then the best fit service composition is chosen for final application composition that seamlessly provides services intended.

4. EXPERIMENTAL SETUP

Experiments are made with NS2 simulations. The simulation study is found suitable for the creation of mobile nodes and services associated with them prior to performing service discovery and service composition. The environment used in terms of different parameters is presented in Table 1. As shown below in Table 1, it is evident that the different parameters are used for simulation. The number of mobile nodes used is 30 and the network interface type is Phy/WirelessPhy. The simulation is made in NS2 running in Ubuntu operation system.

Parameter	Description
channel type	Channel/WirelessChannel
radio-propagation model	Propagation/TwoRayGround
network interface type	Phy/WirelessPhy
MAC type	Mac/802_11
interface queue type	Queue/DropTail/PriQueue
link layer type	LL
antenna model	Antenna/OmniAntenn
max packet in ifq	50
number of mobile nodes	30
routing protocol	AODV
X dimension of topography	1000
Y dimension of topography	1000

Table 1: Environment used in NS2 for experiments

5. EXPERIMENTAL RESULTS

Experimental results are observed in terms of execution time taken for service discovery and composition.

Simulation Time (s)	Delay (ms)	
	Existing	Proposed
0	0	0
5	0.024751462811428555	0.014751462811428555
10	0.022122883002455986	0.012122883002455986
15	0.021365920993651442	0.011365920993651442
20	0.021191158946650503	0.011191158946650503
25	0.021191158946650503	0.011191158946650503
30	0.021191158946650503	0.011191158946650503
35	0.021191158946650503	0.011191158946650503
40	0.021191158946650503	0.011191158946650503
45	0.021191158946650503	0.011191158946650503
50	0.021191158946650503	0.011191158946650503

Table2: Simulation time versus delay performance

As shown in Table 2, the delay time of the proposed system and existing system are presented against different simulation times.

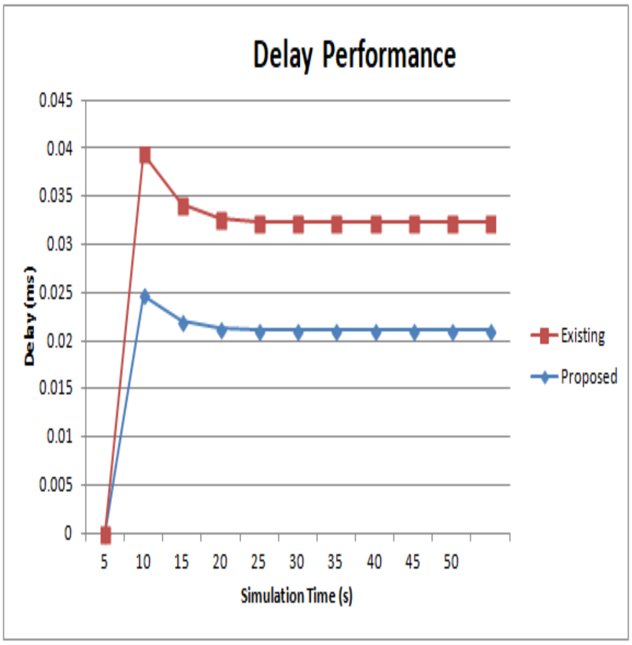

Figure 1: Delay performance

As presented in Figure 1, it is evident that the simulation time with 5 seconds interval from 5 seconds to 50 seconds is shown in horizontal axis. Delay time is shown in vertical axis in milliseconds. The experimental results show that the algorithm in the proposed work has caused less delay time when compared with that of existing system.

Simulation Time(s)	PDR	
	Existing	Proposed
0	0	0
5	20	22
10	45	48
15	70	78
20	89	89
25	89	89
30	89	89
35	89	89
40	89	89
45	89	89
50	89	89

Table3: Simulation time versus PDR performance

As shown in Table 3, the PDR of the proposed system and existing system are presented against different simulation times.

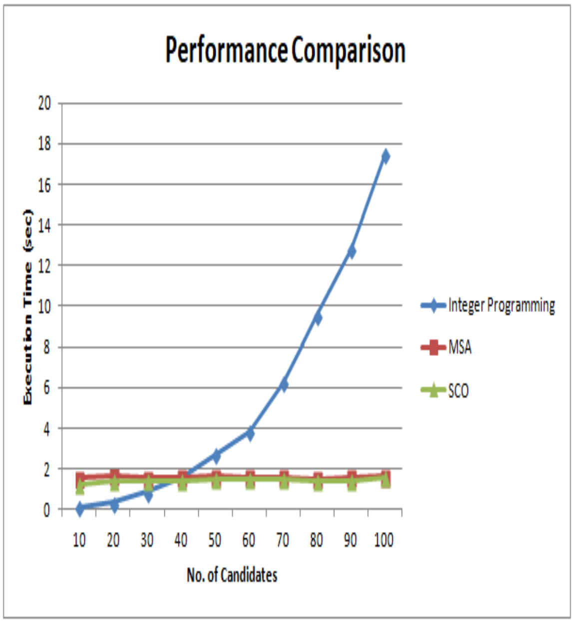

Figure 2: PDR performance

As can be seen in Figure 2, it is evident that the simulation time with 5 seconds interval to 50 seconds is shown in horizontal axis while the vertical axis shows PDR (%). The observations showed that the proposed algorithm has cause better PDR when compared with that of existing system.

Simulation Time (s)	Throughput	
	Existing	Proposed
0	0.0	0.0
5	34048.0	40048.0
10	42560.0	47560.0
15	38304.0	43304.0
20	0.0	0.0
25	0.0	0.0
30	0.0	0.0
35	0.0	0.0
40	0.0	0.0
45	0.0	0.0
50	0.0	0.0

Table4: Simulation time versus throughput performance

As shown in Table 4, the throughput of the proposed work and existing work are presented against different simulation times.

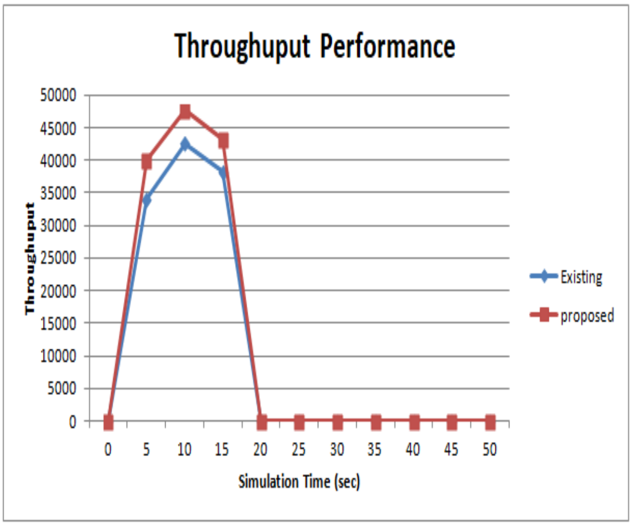

Figure 3: Throughput performance

As presented in Figure 3, it is evident that the simulation time with 5 seconds interval from 5 seconds to 50 seconds is shown in X axis while the Y axis shows throughput. The results revealed that the proposed work has better throughput when compared with that of existing work.

No. of Nodes	Time Taken (milliseconds)		
	Device Discovery	Service Discovery	Network Formation
2	11623	13820	13794
3	970	2320	3768
4	130	554	2354

Table 5: Performance of the proposed work

The proposed system is evaluated with different number of nodes. The observations are made in terms of execution time taken for different operations like device discovery, service discovery, and network formation. The survey is presented in Table 5.

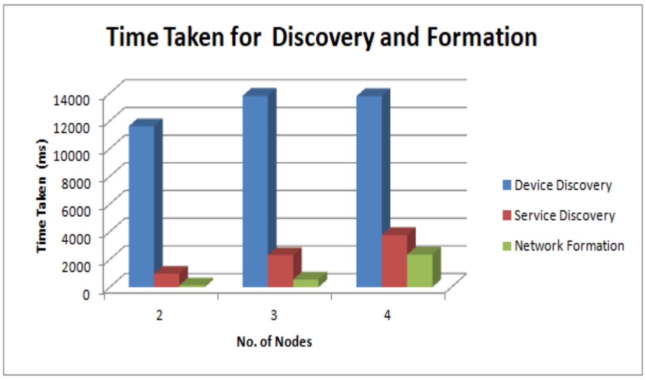

Figure 4: Performance of the proposed work

As presented in Figure 4, it is noticeable that the number of nodes used for observations in the simulation study is presented in horizontal axis. The nodes 2, 3 and 4 are particularly studied to understand the execution dynamics of device discovery, service discovery and network formation. The results revealed that device discovery took more time than service discovery. In the same fashion, the network formation time is less than the other two activities.

	Execution Time (sec)		
No. of Candidates	Integer Programming	MSA	SCO (Proposed)
10	0.114	1.5321	1.2324
20	0.325	1.6314	1.4312
30	0.852	1.5357	1.3912
40	1.586	1.5848	1.4264
50	2.729	1.6235	1.5123
60	3.823	1.5764	1.4865
70	6.239	1.5521	1.4685
80	9.582	1.5034	1.4124
90	12.836	1.5583	1.4356
100	17.443	1.6139	1.5521

Table 6: Evaluation of the proposed algorithm

As shown in Table 6, the proposed SCO is evaluated by comparing with two algorithms like MSA [17] and Integer Programming [17]. The performance comparison is shown below.

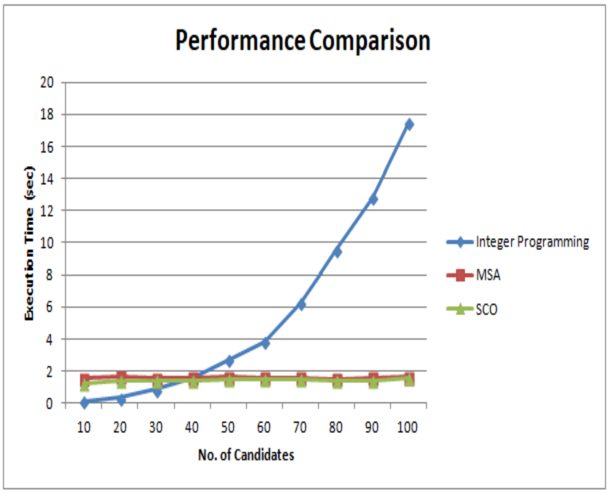

Figure 5: Performance Comparison

Number of candidates such as 10 to 100 is shown in X axis while the Y axis shows execution time in seconds. The proposed work known as SCO is related with algorithms like integer programming and MSA. The results provided tells that the proposed algorithm performance is efficient than the other two algorithms. In the similar fashion, the MSA shows better performance than integer programming.

6. CONCLUSION AND FUTUREWORK

In this paper we studied the need for service oriented computing and provided a methodology. Service orientation became prevalent in the contemporary era as there has been innovations in technological advancements and the need for services to provide rich user experience. Mobile communication technologies and mobile devices have undergone tremendous improvements and that is the rationale behind the need for mobile services that can be discovered and composed. With respect to mobile devices service composition is challenging as the nodes exhibit mobility. More of this fact, there was need for addressing risk of deterioration of QoS once service composition is made. To overcome this problem, we proposed an algorithm called Service Composition Optimization (SCO) which performs risk analysis and makes well informed decisions on finalizing mobile service composition that incurs less risk and minimize the QoS issues. In future we intend to improve the composition algorithm to include some other criteria other than QoS to have better optimization.

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