ABSTRACT

Mobile Ad hoc Networks (MANETs) are wireless networks having transient mobile nodes with no pre-installed infrastructure. They are of utmost interest for the future networks owing to their flexibility, effortless deployment and related low cost. Most of the research problems of mobile ad hoc networks are stems from mobile computing. The constraints like resource-poor elements and their limitations, gives rise to many research problems. Among them, the research issue, service provisioning for application development by the concept of reusing is of high importance.

Services are hardware or software entities that can be shared or reused by many other software entities. One of the main uses of mobile ad hoc networks is accessing the services that are provided by other nodes wherever possible. This reuse of services is predominantly used in fixed networks. The process used to realise the reusing of services is termed as service provisioning. The service provisioning is used to describe the process starting from service selection, service binding, service maintenance and termination.

Because of their dynamic nature, service provisioning in mobile ad hoc networks should have different components compared to that of fixed networks. This thesis focuses on finding the essential new components, or modifications to be done in the existing components to enable service provisioning in mobile ad hoc networks.

In fixed networks reusing of services is done by Service Oriented Architecture. Service Oriented Architecture (SOA) is an architectural paradigm and discipline that may be used to build infrastructures enabling the interaction of those with needs and those with capabilities via services. In SOA the service providers will advertise their capabilities, which are stored in the central entity namely service broker. The service capability information includes both functional and non-functional properties. Whenever a client needs a service, the requester’s requirements will be compared with the service capabilities. If they found a matching service provider they can access the service.
Thus, the service provisioning framework for mobile ad hoc networks has to provide a means to advertise the services and store them. The requesters may access the stored information to know the availability of the service providers. In fixed networks the service oriented architecture uses central entity to store the service capabilities. Whereas having the central entity in mobile ad hoc network is not feasible due the nature of mobility of nodes. If the central entity which has the information moves other nodes may not be able to access those information stored in the central entity and in turn the services. The concept peer-to-peer caching is the suggested method used in this thesis in which every node must have a copy of the services available in the network. A set protocol has been designed and implemented to publish and check for availability.

Maintaining the local view of the service availability is useful compared to having the knowledge of all the available services in the entire network. So, only the services that are available within a few hops are cached. Same services many be provided by more than one service providers. Services are grouped based on their type and they are sorted based on the providers’ metric. A set of protocol are designed and implemented to maintain and update the services available based on the current situation.

In the case of fixed network any service which satisfies the requirement may be selected without considering the service providers’ condition. But for mobile ad hoc networks selecting a best provider should also take into consideration of battery power of and the moving speed of the provider into consideration. So that aborting the services in between due to provider’s mobility or power exhaustion of the provider may be avoided. In this proposed work service providers are allowed to send their context information along with the advertisement. The requester may use this information to calculate the provider’s metrics while selecting the service provider. The proposed work shows that the service selected with metrics 21% increase in the success rate compared to one without metrics. Similarly the proposed work shows that the system with metrics average discovery time is 26% faster than the one without metrics.

During service selection the services’ non functional properties are also has to be considered. Non functional properties of a service define the characteristics of the services other than the functional ones, such as bandwidth usage of the service, cost of the service etc. The
requester’s preference on the non functional properties may be different from time to time based on the current situation. Similarly the need of one requester may be different from the other.

From the literature surveyed there is no existing work which incorporated the use of user preferences on the non functional properties for selection. So there should be a way to access user’s preference on the non functional properties of the services. In this thesis the requester and service provider may specify the details related to the non functional properties. The requesters are permitted to specify their preference on these properties in terms of weight between 1 and 10. The properties are categorised into ‘mandatory’ (which needs an exact match of the non functional property of the service) and ‘secondary’ (for which approximate match may be needed for selection) properties depending upon their importance for the selection.

The current situation or otherwise called context of the client and the providers needs to be known for making decisions such as service selection. In order to facilitate context manipulation the providers and clients has to be provided with mechanisms to input/access their context information. Some of the users’ preference may be specified in the form of static meta data whereas some others has to be accessed dynamically. Some work in the literature uses user context but they use only static context. The context of the provider such as moving speed, the context of the client such as memory availability has to be accessed dynamically.

This thesis proposes methods to access the context values. Cross layer mechanism is used to find the dynamic context values. Cross layer design refers to protocol design done allowing layers to exchange state information in order to obtain performance gains. Protocols use the state information flowing throughout the stack to adapt their behaviour accordingly. Some of this information can be accessed and processed to find the execution context. Monitors, a set of classes which are used to find the internal status of the nodes like battery power, speed and remaining memory have been designed. The application can give threshold values upon which the monitoring should be done and it will raise events to the required objects when the threshold is reached.

In the traditional service provisioning, since the service providers will not be on the move, the binding between client and the service provider may not be changed till the completion of the service. But in the case of mobile ad hoc networks the binding between the
client and the service provider may not be assured till the completion due to the nature of mobility. Though the service providers’ metrics are considered for selection, (this thesis selects the provider which moves slowly compared to the others). Mobility of nodes mandates a new component which will handle the need of binding to a new service provider when the service provider to which the client already connected to, cannot be accessed now. So, service maintenance phase has to be there in order to handle the dynamic situation. In this phase new provider with the matching capabilities are searched either in the local pool of advertisements (reselection) or search through the network by issuing query through the network (rediscovery). When to do reselection or rediscovery has to be specified to the framework before the provisioning starts. These rebinding choice and conditions on which rebinding has to be done are specified in the form of polices in this work.

The proposed framework CASP (Context Aware Service Provisioning) has been implemented using Java. The modules designed are based on the requirements identified. Their functionalities of the service provisioning modules have been tested and compared with other protocols such as adder and konark using NS2 simulator.

The proposed framework has peer-peer directory storage for the service advertisements received from other providers. The service providers are enabled to provide both functional and non functional properties. The requesters are provided with an interface to specify their requirements with their order of preference. The context of the user is accessed and the service provider’s offer is matched for service selection. The flexibility in specifying the service offers with capabilities and preference specification makes the framework possible to identify the best servers. The recall ratio of CASP is above 70% whereas, Konark achieves 55% and adder achieves 20%.

The dynamic service availability is taken care by rebinding to new service providers based on the choice. These choices are specified in the form of policies. The framework has been evaluated by simulation and compared with other protocols. It shows in the heavily loaded environment 25% improvement in throughput over SLP-PING. It has been identified that the rebinding is the essential mechanism for service provisioning in mobile ad hoc networks. Thus,
the identified and implemented components in this proposed work are essential for service provision in mobile ad hoc networks by using context awareness and they perform well compared to other works.