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# Secure Service Provisioning in Opportunistic Network

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**Abstract—***Opportunistic network exploit mobility as an opportunity rather than a challenge. Devices are no longer restricted to their own services and resources but can access services and resources made available by other devices as well. This paper presents a preliminary investigation in secure service provisioning and its impact on the performance of opportunistic computing.*

## 1. INTRODUCTION

Opportunistic networking relies on wireless infrastructure. It is an important technique to enable users to communicate in an environment where end-to-end paths are unavailable or unstable. This is achieved by learning patterns over time and forwarding the messages and providing services to the nodes that come in contact. Additionally, the nodes are not restricted to their own services but can access services and resources of surrounding nodes in the environment.

Some key problems in opportunistic computing are finding some efficient metrics to retrieve services to minimise the time a request is sent out and the time the desired service output is received and determining if the node which the user node is attempting to establish a contact with is malicious or not.

In this article we discuss the work done in the field of service provisioning in opportunistic network and the key challenges and on the basis of the lessons learned from several years of research we propose a framework to tackle the same.

## 2. RELATED WORK

The concept of opportunistic networking is not a new idea. Many research projects have already been taken up in the field of opportunistic studies ranging from routing algorithms, service composition to minimum delay service provisioning.

Recently, work has been done in the sphere of opportunistic computing. Opportunistic computing utilises any resource available with the mobile node in a pervasive environment by exploiting opportunistic contacts according to the user service requirements. An end-to-end path between a requesting device and the required service may never exist, while using infrastructure based solutions may prove infeasible. Hence, it is necessary to make services accessible and available anywhere in the environment perhaps, with some delay. In this regard, [3] a middleware architecture for MANET was employed that facilitates application requirements and performs resource management in opportunistic networks and provides fault tolerant service composition in opportunistic networks. An extensive simulation study with synthetic and real traces was performed to investigate the effectiveness of the service composition approach. Also, probability metrics were devised to measure the effectiveness of the service composition approach.

Dedicated work in opportunistic networking has been done in distributed computing in which nodes take services which they are incapable of providing by using services and resources of other nodes. [2] Services requested by seeker nodes can be executed on the provider nodes. The nodes need not be in contact when the input parameters are being uploaded and when output parameters are being uploaded. Various service indexes are maintained by the nodes like available services, ongoing services, completed services and services needed by node. The main task is to find the optimal number of replication of service request which the seeker node should spawn on the provider nodes.

Various metrics have also been proposed to capture the impact of topology of services and resources on opportunistic networks. [1] One of them being ERA (Expected Resource Availability). ERA attempts to gauge the opportunistic computing friendliness of a given network setting – if it is low then opportunistic computing will fail else not. Computing ERA involved evaluating the resource usage at each node in the network. This further involved capturing the resource availability at each node from the user’s perspective. The potential of ERA was then evaluated on the basis of real world traces and it was found that it responds well to increasing service or resource availability as well as to increasing frequency of inter node contact.

However, most of the work has been focused on a theoretical basis with respect to architectures or in designing [4] routing algorithms for message passing and service provisioning whereby two or more nodes combine their services to create a composite application service. Less attention has been devoted to finer aspects of security or threats by malicious spyware nodes seeking unauthorised access to confidential data.

Our proposed framework focuses on such security issues and provides an optimal path for service provisioning.

## 3. PROBLEM STATEMENT

Opportunistic networking is an important technique to enable users to communicate in an environment where contemporaneous end-to-end paths are unavailable or unstable. To support end-to-end messaging in opportunistic networks, a number of probabilistic routing protocols have been proposed. But these routing protocols fail to utilise the current routing computations for future reference which may help in performance boost of the entire network. Hence, we wish devise a dynamic model to structure the opportunistic environment so as to effectively utilise every node’s past experience of routing to model its current routing decisions. At the same time also ensuring its security from malicious spyware nodes seeking unauthorised access to data.

## 4. PROPOSED FRAMEWORK

Our proposed line of work achieves routing of opportunistic networks in a two step validation process which can be carried out as follows:

**4.1** By maintaining a database of past experiences with the surrounding nodes to determine the present decisions to be taken for data dissemination among the current set of neighbouring nodes by employing a self devised metric based on key parameters like delay time, computational time etc.

**4.2** In case of initial loading of the database or when no exchanges in the past has been done with a given provider node we check connectivity of the peer nodes on social networking sites like Facebook and LinkedIn.

Based on the judgement a record is added in the database of the seeker node if the nodes are socially connected and an exchange is initiated or if the node is found malicious.

For the implementation we intend to store a database with each node with the required metric and establish a connection with the server. So when we hit the server the login details of the user facebook account are asked. If the login is successful the friend list database is stored and the next level computations are performed.

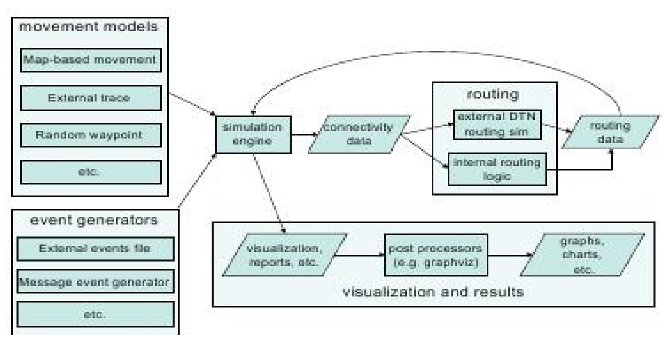
## 5. TOOLS AND TECHNOLOGY

One of the main advantages of using simulations compared to real networks for testing is that a simulation environment is much cheaper to set up, and is also usually faster to set up because the simulator only needs a topology description. It takes considerably less space since only a few simulation machines are needed, and not a complete network with a lot of machines, cables and switches or routers. The results are also easier to compare because of a more controlled environment. Various simulators are being used like OMNET++, ONE, NS2, NS3. NS2/NS3 and ONE are free simulators available for opportunistic network.

Network Simulator is by far the most popular simulation tool for computer networks related evaluations, simulations and analysis. Due to its extensive use, the results obtained using it, have a broader appeal. Additionally, it means that the tool is well supported and documented. NS is a discrete event simulator available in two versions NS2 and NS3. The former has the advantage of being well documented while the latter has the natural advantage of enhanced and improved feature set.

NS uses two languages C++ and OTcl. C++ is fast to run but slower to change, making it suitable for detailed protocol implementation. OTcl runs much slower but can be changed very quickly (and interactively), making it ideal for simulation configuration. The wireless mobility model in NS essentially consists of the "Mobile Node" at the core, with additional supporting features that allows simulations of multihop adhoc networks, wireless LANs etc. The "Mobile Node" object is a split object. The C++ class "Mobile Node" is derived from parent class Node. A "Mobile Node" thus is the basic Node object with added functionalities of a wireless and mobile node like ability to move within a given topology ability to receive and transmit signals to and from a wireless channel etc.

Delay-tolerant Networking (DTN) [9] enables communication in sparse mobile adhoc networks and other challenged environments where traditional networking fails and new routing and application protocols are required. The Opportunistic Networking Environment (ONE) simulator has been specifically designed for evaluating DTN routing and application protocols. It allows users to create scenarios based upon different synthetic movement models and real-world traces and offers a framework for implementing routing and application protocols (already including six well-known routing protocols).




*Source:* A DTN Study: Analysis of Implementations and Tools

**Fig. 1: Data Flow for the ONE Simulator [9],**

- NS has significantly more global appeal and research base. ONE is a better option in case of simulating DTN's in MANET scenarios.
- In terms of setting up and configuring the tool, ONE was found to be more convenient and user friendly as compared to NS. The evidence to this end lies in the installation procedures for both of them.
- NS requires a Linux like environment to run. It can not be used in Windows. However, ONE requires java JDK only and it can be run on Unix, Windows and Mac.
- ONE has better visualization capability with a Graphical User Interface where nodes can be seen traversing different paths on a Map. However it does not provide such facilities like monitoring and tracking individual packets. NS has a "Network Animator" commonly known as NAM. Although, it provides good packet tracking facilities in static nodes not in case of mobile nodes.
- A new protocol implementation in NS or ONE cannot be compared directly since they are based on different languages. But Java is generally found to be more workable than C++. However, it can be argued that it is easy to implement a new protocol in ONE as compared to NS because of less configuration over heads. These over heads stem from the fact that NS has to support a variety of protocols.
- NS has a "Real Time Emulation" feature by virtue of which nodes in a NS simulation can be interfaced with real time applications and data. Such a feature is not present in ONE.
- ONE tool has the ability to load Map data and run simulations using that. It is a feature not present in NS.
- Adding a new protocol in NS requires comparatively more work. This is owing to the broader nature of the tool. ONE protocol has some what similar nature in terms of adding new protocol. Both the tools allow the user to build upon certain basic functionality provided with the tool for adding new protocols. Since, ONE is focused towards MANET's in DTN environment.

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