International Journal of Notural and Engineering Sciences
Uluslararası Doğa ve Mühendislik Bilimleri Dergisi
E-ISSN: 2146-0086, 11 (3): 13-18, 2017, www.nobel.gen.tr

Intelligence Base Routing in Wireless Networks Using Linux Router

Shabir AHMAD[1*], Bilal EHSAN[1], Mohib ULLAH [2]
[1]Department of Computer Science, Government College of Commerce, Multan, Pakistan
[2]Department of Computer Science, NFC-Institute of Engineering and Technology, Multan, Pakistan

*Corresponding Author
E-mail: mian_shabbir@hotmail.com

Received: September 10, 2017
Accepted: November 20, 2017

Abstract

In today modern life the use of wireless networks have attain a great attraction because in wireless environment the nodes or user can move freely without any physical connection the network resources. The throughput is considering a basic element in this environment. Swarm Intelligent solutions are then analyzed in both wired and wireless networks. Keeping such attitude in view we should try to design and develop such kind of naturally inspired protocols that after simulation be easy to implement as early as possible with low cost factors. Also during the designing and simulation process we should not use such kind of software which is not available for the implementation in real world networks. In our research experiments are conducted in the Linux router real network, in these experiments parameters or values were given same corresponding to virtual machine values. The big advantage of the Linux router is that anyone can change its personal computer to Linux router or gateway after doing some basic configurations. This will helps to make its wireless network for optimization of data traffic. The results or output that we received from the experiments was really beneficent because when we increase the number of repetition then its performance was also increased. This is the best feature of an intelligence based routing protocol that learns from the external working structure and enhance the throughput accordingly.

Keywords: Wireless Networks, Artificial Intelligence, Linux Router, Intelligent Routing, Throughput.

INTRODUCTION

In the present wireless networks the basic concept about technology are the same as these were effectively used in previous decades. The necessary elements of the network are same as sender and receiver. Similarly in the wireless communication the base station is playing the important role, each of which services a specific area of a (mobile) user terminal access. If users move out of range of the network, all services will be lost. The ad hoc technology helps remove this limitation and scope of computer communications well beyond a single access point. This can be achieved by the function of routers, nodes outside of their normal role of workstations. The most serious of these is the mobility of the nodes [1]. Because the user is able to move freely, and due to mobile situation in short period of time the network topology may changed. To adjust the network according to the mobile conditions of the nodes, there is a need of automatic techniques or algorithms for easy communication. It is also noted that if the number of users has reached to the maximum limit of the network, then the transfer of data between the users are difficult.

Most of the publication routing algorithms proposed. They are generally based on routing solutions to traditional wired network connections. Both protocols are proposed reactive and proactive. Examples of both types are shown in the understanding of the methods known in the art. Swarm Intelligent solutions are then analyzed in both wired and wireless networks. He pointed out the differences and similarities between the approaches and general application SI shows the way. These are the ideas that are close to the supply of IT, but not the same. This includes routing probability, gossip, and routing and routing agents' leather reinforcement.

There are a lot of things, with the help of the intelligent network routing algorithm swarm like termites. The termites probabilistic approach differs from the current practice of routing, which is based on a deterministic algorithm charts. Instead, termites depend on a global solution to this problem due to the impact of routing a plurality of packets. Each of these packets received and distributed in the network, known as a pheromone that passes through the network; visit during the trip. In contrast to the traditional approach to the route search network floods, termites in an environment of communication and transmission use a random walk to find a way. This approach leads to the road in many places, to avoid the cost of most packages.

Linux Router

Linux can be a great router "poor man". Pour will take a bit more than a typical startup configuration of the router hardware, but when it happens, there will be little alert stop, at least in our experience. The big advantage of the Linux router is that anyone can change its personal computer to Linux router or gateway after doing some basic configurations. This will helps to make its wireless network for optimization of data traffic. The configuration in Linux router is called ClearOS. This is a very easy choice for router configuration that is so flexible. It can be configure as per requirement of the desired network [2].

ClearOS is used mostly because it is free of cost unlike other Linux distributions. ClearOS also provided very attractive interfaces. Most of its installation and applications can be installed directly from the Internet. The Linux router with ClearOS provided all the basic support of networking. It also offer trustworthy routing of data with great support.

LITERATURE REVIEW

It is also noted that cognitive networks work on intelligence basis. The work has been started on these networks few years ago. A comprehensive work in this regard is done in ARAGORN project [3], this project was financed by SFP (Seventh Framework Program). This project was based on both cognitive networks and cognitive radio. The COST action IC0902 was based on cognitive networks [4], which are considered as standardization for intelligent networks.

REASONING AND LEARNING

There is a dispute that a cognitive network cannot communicate between inter node communication networks [5]. In wireless networks, it is analyzed that it is not necessary all time an information may exchange between base station and wireless devices/nodes. On the other hand many researchers think that in a cognitive network, all the devices should communicate between each other, as they become the part of the network, information sharing is necessary to enhance the performance of any wireless networks. They consider as the communication is stronger the network will be. But as the opposite thinking many researchers believes that the information between every node is not compulsory for better performance.

For first order logic used in wireless networks a famous approach is discussed in [6] and agent can carry knowledge for each iteration to enhance the throughput of the network. It is very difficult to divided the wireless networks on the basis of fixed knowledge. This is because agent will not ready to handle the unseen situation in a network. The limited knowledge about network environment also cause problems on certain changes in the network topologies.

Newman et al., in his research uses this technique to build a cognitive engine for making decisions in a cognitive networks [7], in which he used optimal parameters for routing. Similarly, Friend et al. take this case in dynamic wireless environment for optimize allocation of dynamic spectrum [8]. Instead of using existing multi agent system, the researcher aims to use population of the network for quick decisions. In this he use game theory to analyze the network traffic. For capturing the behavior of the cognitive network he makes effective use of game theory.

Algorithm Design Guidelines

Routing Algorithms could be on the other side which may be grouped on the premise of the outline theory of their engineers. The scientists in every group have been prepared with a specific configuration and investigation regulation which practically rules out cross-preparation of thoughts from different groups. In this subsection, we quickly give an outline of these groups that will help in comprehending the configuration standards of various sorts of directing calculations.

The Networking group has spearheaded the work in the packet switching systems. The foundations of this work do a reversal to the advancement of ARPANET and a novel directing calculation, which depends on an asynchronous calculation [9]. Later on numerous element and multi-way following so as to steer calculations have been created the exemplary procedure for directing convention advancement: non-insightful connection state bundles are utilized to gather data about the expenses of neighbors and after that to spread them in the entire system. Hence, they all experience the ill effects of the same inadequacies: “wrong” or “out-of-request” nearby gauges have a worldwide effect and to implement Dijkstra’s limited algorithm, its calculations require a worldwide framework model [10]. The calculations could be delegated worldwide and deterministic steering calculations.

The routing group with artificial intelligence works in two unique regions: Machine Learning and Agent-based Learning. The primary group utilizes Reinforcement Learning (RL) [11] methods, treated as a sub-technique of Machine Learning, keeping in mind the end goal to propose steering calculations for packet switched systems. Such calculations are versatile, deterministic, local, dynamic and decentralized. Agent based learning techniques brought about particular steering calculations. The real favorable circumstances of such calculations are compressed as takes after:

- The calculations don’t require from the earlier worldwide system framework model, rather they use a neighborhood framework model that was observed by the concerned operators.
- Then the system state is accumulated by the operators in a decentralized manner and the comparing data was leaved on went by hubs. This empowers all of them to settle on directing choices in a decentralized manner, without the need of a worldwide controller.
- The calculations can adjust self-sufficiently to make changes in the system or in activity designs.
- The administration of a system comes as an advantage of utilizing such kind of mobile agents

The real accentuation of some routing techniques is on planning savvy operators for doing steering, management and administration of systems in a self-ruling way. The multi-operators frameworks give a decent infra-structure to plan and improvement of such portable specialists [12], be that as it may, the knowledge is accomplished at the expense of complex configuration ideal models [13].

The Natural Computing research has two noteworthy bearings: Evolutionary figuring [14] and Swarm Intelligence. Developmental figuring takes the advancement process in living cells as a premise for creating calculations/ frameworks. Hence, transformative directing calculations utilize the developmental administrators of determination, traverse and transforming the on-line techniques which can be used to adapt the changes in system situations. DGA (Distributed Genetic Algorithm) is a commonly used prior directing calculation. The second rising territory, group Intelligence, thinks about various self-arranging forms in Nature and uses their standards as a motivational allegory to propose novel answers for various overwhelming traditional experimental issues. The curiosity comes back again by the way that some frameworks need one focal administrator that ordinarily plans distinctive assignments in the framework, by uprightness of its entrance to the worldwide framework. Despite what might be expected, these populace based frameworks have basic substances that have just nearby information yet together they shape an astute framework. ABC , AntNet [15], and BeeHive [16] fit in with this routing algorithms category. Nature enlivened directing calculations are generally versatile, decentralized, neighborhood and alert.

Carrillo et al. [17] have discussed his preparatory study on the adaptability of AntNet, that is only in view of a straightforward hypothetical definition. It is never be confirmed by getting broad trials on a network using larger topologies. Their hypothetical model declared AntNet as a versatile network model. How-ever, the discoveries cannot be accurate without their trial check, which is the genuine

weakness in their work.

Zhong and Evans discuss their study in [18] in which they sketched out imperative assaults that insect operators, dispatched by noxious hubs, could make. They did call attention to that utilizing declarations is not an attainable choice for the AntNet calculation as a result of the handling unpredictability of the methodology. Nonetheless, they didn't give a specialized answer for the issue which must be in real position in that framework. Their thought is to provide a confirmation subterranean insect that takes after a suitable way to take any required destination of a neighbor which increases his integrity over a limit. The dividing so as to out time that could be ascertained either the round excursion time by two, or by the measurement of the contrast among the time used by the passageway at the destination point and the propelling time that is observed at the source point, expecting that tickers are splendidly synchronized utilizing GPS administration.

MATERIAL AND METHODOLOGY

In today modern life the use of wireless networks have attain a great attraction because in wireless environment the nodes or user can move freely without any physical connection the network resources. The air is used as medium in the wireless networks. Due to the unconditional environment of the networks more and more portable devices can be connected. Due to free medium a wireless network can be extended to the maximum coverage. The throughput is considering a basic element in this environment.

Swarm Intelligence

For analyzing and designing a simple network nodes system, swarm intelligence (SI) framework can be used [19]. The property of a system will reflect the overall performance of the designed system. The result depends on the properties of a system integrated and works in a system, however it is not dependent on the designer or programmer. The above approach is mainly inspired from the behavior of different living things mainly from ant movements, termite activities, bee behavior and other insect interaction with each other. These ideas may be following while designing a man made models for good optimization and results based on artificial intelligence/biological systems. In these models many small components (workers) work together to accomplish a big task, which may be impossible if done by individuals. For robust performance the colony behavior can be copied without any failure or loss, if done by individuals. These biological systems can adapt in wireless network environment as needed.

Linux Routers Candidate Routing Algorithm

This section was basically written to give the satisfactory answers to the rough and negative behavior of the traditional networking community. There is a mindset that such kind of behavior of network cannot be useful in real networks, although their fascinating character has been admired, because these are only evaluated in the simulators only. The reason to simulate these routing protocols is that in real world it costs lot to produce something from the beginning, when these are tested and verified can be used in the real world without any hesitation. The disapproval by the traditional community is that these protocols do not follow or take into notice the rules of engineering. Therefore, the installation of such protocols will take much more hardware and software resources in real world. This will be non-beneficial as economically it is costly for the telecommunication market where all the time competition of quality as well as low price exists between different vendors of routers. But when this protocol was practically implemented into the reality then it has helped to strength and maintains the rough attitude of the traditional networking community.

It is an accepted dilemma of current networking industry that the engineers are lacking the skills of designing and development of naturally inspired routing protocols. Eight years ago AntNet was planned and four years ago DGA was projected, and up till now those are just proposed projects not implemented into real network it has reduced the significant for any kind of new idea in the market to be supported financially or morally. That is why there is no commitment to accept such ideas which are planned by the natural inspiration routing protocols in real networks. The need of the hour is to overcome such kind of thinking and attitude of networking industry.

Keeping such attitude in view we should try to design and develop such kind of naturally inspired protocols that after simulation be easy to implement as early as possible with low cost factors. Also during the designing and simulation process we should not use such kind of software which is not available for the implementation in real world networks.

Following points can take to the good results:

Need of developing a viable economic networking system of artificial intelligence basis that is currently ignored in the routing schemes.

Make it ensure that the developer who is designing the algorithm should keep concentration on the real working network environment. That is the candidate algorithm should not follow the features those are not feasible in the actual router practically.

The resource constraints should keep in mind so that it may easily use artificial intelligence based routing.

Be ensures that the artificial intelligence based routing procedures should show better performance and results in the simulated as well as in the real environment.

It must facilitate cross environmental ideas to keep it flexible to adopt a variety of design approaches. It will welcome new trends in complex networking environment suitable for new century.

Designing a Routing Protocol Approach based on Artificial Intelligence

In a router working in real network an engineering of dynamic approach is quite important for better utilization of network [20]. Our work in thesis critically analyzes the existing work done on the selected domain of artificial intelligence used in routing of the complex network for increasing the throughput. We also follow the software engineering approach of reusability to reuse the working parts and make a good technique. By adopting this approach designer is capable to develop a protocol by keeping in view the top issues and implementation details of a network. By combing the nature inspired approach an intelligence based framework is designed.

Routing Framework Structural Design

A routing framework performance is mainly relies on its structural design and functioning cost of an operating system (OS), for example interrupt handling and context switching [21]. This framework structure explains the division of important parts for kernel and user space. A framework structure should support optimal performance in a network. The major studies has been done by Pasquale and Kay [22] that represent the interrupt cost and copy contents in user and kernel space. In this design the overheads for a context-switching must as low as the protocols processing cost.

Kernel Space Routing Framework For Monolithic Environment

Routing tables, maintenance, route discovery and packet switching are important elements of a routing framework. High security has been observed in this routing framework for best performance. So, implementation of module in the kernel and after that to debug the error if any from the kernel is a very smart/thriving task. It is because of kernel has limited space and its functionality is also limited. As the math and standard template library are parts of user space not available in the kernel space. Due to this reason the implementation may required more time as well as during debugging process.

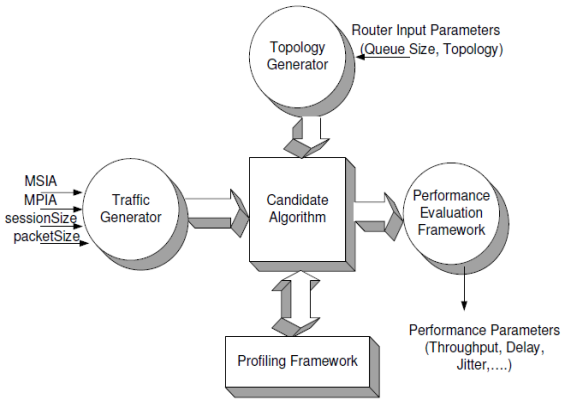

Figure 1: Evaluation Performance Framework

User Space Routing Framework For Monolithic Environment

In this technique a routing framework along with its components are implemented in the user space as a single process. The structure of this framework is illustrated in figure 2. The module for a user space is very flexible as it has good structure and libraries. Due to this feature the time of realizing in a router for routing framework is reduced by this model. It is very easy process of debugging in user space and is significantly straightforward. The services and features of routing framework for user space is completely decoupled the kernel space for its code maintenance. But due to the context switching on the arrival of each packet, the performance of the routing framework is not good. If the preference does not given by CPU scheduler to the routing framework process it will results in poor performance of the algorithm due to this scheduling latency. Due to these reasons the network router packet switching rate will reduces significantly. It is also be noted that routing framework also face some serious security concerns in user space as well.

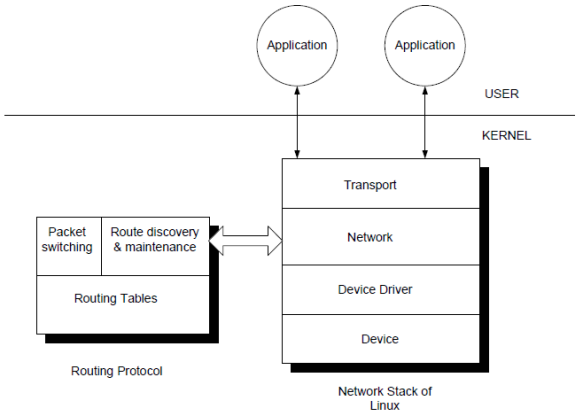

Figure 2: Monolithic implementation in user space

Routing Framework For Hybrid Environment

In this approach, the data path is separated from the control path. In the similar fashion, the maintenance elements and the route discovery has been shifted to the user space. But the packet switching and routing tables kept remain in the kernel space. Using proc file system, the two modules communicate with each other. The features like easy implementation and handling of complex agent's behavior are combines in this approach with some reliable packet-switching of data in the kernel access space. In this approach for routing decisions, there is no need of two context-switches. This approach is illustrated in figure 3. In this framework, the agent's processing frequency under high load is considerably lesser as compared to the packet switching. So, the algorithm performance will not significantly degrade. In natural inspired routing the agent processing is the most important element and it is completely decouples it from the relevant kernel version. Due to these features, such type of routing frameworks is very easier to maintain.

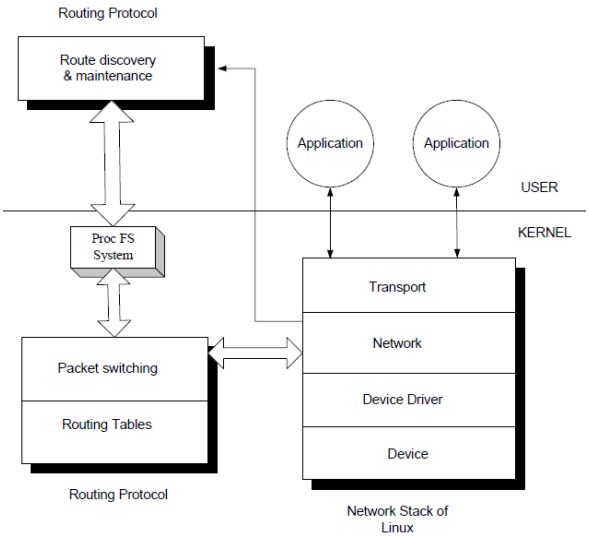

Figure 3: Hybrid implementation

Design Issues of System

A distributed system is based on a routing framework consists of software and hardware resources. Detail knowledge of system design techniques are required for development of a routing framework for computer networks.

There is need of optimal requirements of engineering approach that must be followed in routing framework. In this framework space, time and computation are the major resources.

RESULTS AND DISCUSSIONS

Our natural framework is consists of two layers one of them is independent of algorithm and other is dependent on algorithm. In independent layer, services and structures are implemented by inspiring natural routing protocol. The natural inspired protocols is consists of agents, routing table and packet switching. In dependent part framework structures and features are implemented in the routing algorithm. The result of routing table in Linux router is shown in figure 4.

```
root@dev2:~# ip route show
10.0.0.0/24 dev eth1  proto kernel  scope link  src 10.0.0.15
192.168.0.0/24 dev eth0  proto kernel  scope link  src 192.168.0.15
root@dev2:~# route -n
Kernel IP routing table
Destination     Gateway         Genmask         Flags Metric Ref    Use Iface
10.0.0.0        0.0.0.0         255.255.255.0   U     0      0        0 eth1
192.168.0.0     0.0.0.0         255.255.255.0   U     0      0        0 eth0
root@dev2:~# netstat -rn
Kernel IP routing table
Destination     Gateway         Genmask         Flags   MSS Window  irtt Iface
10.0.0.0        0.0.0.0         255.255.255.0   U         0 0          0 eth1
192.168.0.0     0.0.0.0         255.255.255.0   U         0 0          0 eth0
root@dev2:~#
```

Figure 4: Linux Routing Table

These experiments were conducted in the Linux router real network, in these experiments parameters or values were given same corresponding to virtual machine values. The results or output that we received from the above experiments was really beneficent because when we increase the number of repetition then its performance was also increased. This is the best feature of an intelligence based routing protocol that learns from the external working structure and increases the output accordingly.

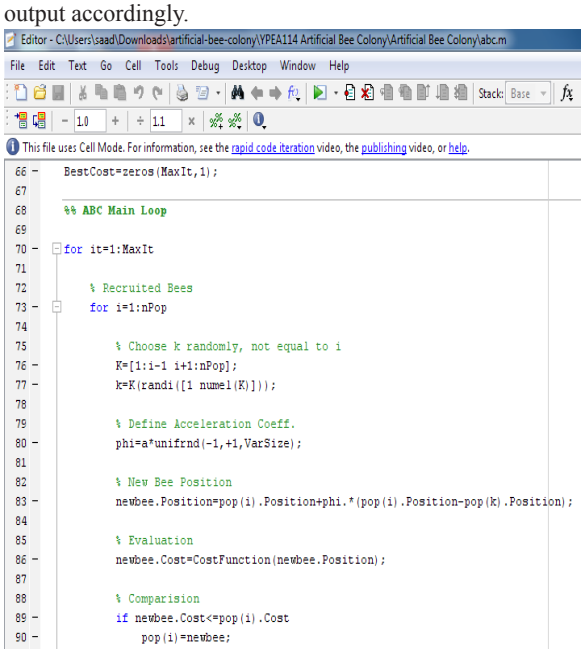

Figure 5: Code for Candidate Algorithm evaluation

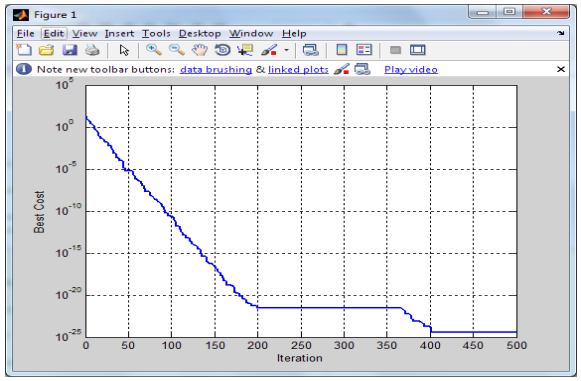

Figure 6: Results with 500 iterations

From the above diagrams it is clear that when we increase the number of iterations or repetitions the packets are delivered with the increase in the number of iterations. It means that algorithm will learn like intelligent baby as time passes in the wireless network. It will increase the output of our resulting routing algorithm. Some packets are delayed as a result in the queue. But this delay is due to the importance of different results in the real world networks and the simulation sessions.

CONCLUSION

From our experiments it can be concluded that our candidate algorithm for Linux router behave intelligently. As the number of iteration increase the routing cost will gradually reduced. It is different natural colony systems, as it can perceive similar results and new network route for efficient delivery of packets ultimately increasing the overall throughput of the network. Our candidate algorithm design is best suitable for single, multiple as well as hybrid level network approaches. The guideline of our candidate algorithm is base on routing intelligence which will show improvements in results with the passage of time. It is best fit for low memory and with low storage space.

REFERENCES

[1] Suh, Changsu, Zeeshan Hameed Mir, and Young-Bae Ko. “Design and implementation of enhanced IEEE 802.15. 4 for supporting multimedia service in Wireless Sensor Networks.” *Computer Networks* 52.13 (2015): 2568-2581.

[2] Heldenbrand, David, and Christopher Carey. “The linux router: an inexpensive alternative to commercial routers in the lab.” *Journal of Computing Sciences in Colleges* 23.1 (2010): 127-133.

[3] Community Research and Development Information Service for Science, Research and Development (7th FWP), \Adaptive recon gurable access and generic interfaces for optimisation in radio networks (ARAGORN),” Jan. 2008. http://www.ict-aragorn. eu.

[4] European Science Foundation, \Action IC0902: Cognitive radio and networking for cooperative coexistence of heterogeneous wireless networks,” May 2009. http://w3.acost.esf.org/index.php?id=110& action_ number=IC0902.

[5] R. W. Thomas, L. A. DaSilva, and A. B. MacKenzie, \Cognitive networks,” in 1st IEEE Int. Symposium on New Frontiers in Dynamic Spectrum Access Networks (DySPAN), pp. 352{360, 2005.

[6] P. Langley, J. E. Laird, and S. Rogers, \Cognitive

architectures: Research issues and challenges," Cognitive Systems Research, vol. 10, pp. 141{160, June 2009.

[7] T. R. Newman, B. A. Barker, A. M. Wyglinski, A. Agah, J. B. Evans, and G. J. Min-den, \Cognitive engine implementation for wireless multicarrier transceivers," Wireless Communications and Mobile Computing, vol. 7, no. 9, pp. 1129{1142, 2007.

[8] Ahmad, Shabir, et al. "Available online www. jsaer. com." *Journal of Scientific and Engineering Research* 2.2 (2015): 99-109.

[9] C. Moschovitis, H. Poole, T. Schuyler, and T. Senft. History of the Internet: A Chronology, 1843 to the Present. ABC-CLIO, 1999.

[10] Chen, Jing-Chao. "Dijkstra's shortest path algorithm." *Journal of Formalized Mathematics* 15 (2003): 144-157.

[11] Sandholm, Tuomas W., and Robert H. Crites. "Multiagent reinforcement learning in the iterated prisoner's dilemma." *Biosystems* 37.1 (1996): 147-166.

[12] Omicini, Andrea, and Franco Zambonelli. "Coordination for Internet application development." *Autonomous Agents and Multi-agent systems* 2.3 (1999): 251-269.

[13] Wedde, Horst F., and Muddassar Farooq. "A comprehensive review of nature inspired routing algorithms for fixed telecommunication networks." *Journal of Systems Architecture* 52.8 (2006): 461-484.

[14] 14- Kari, Lila, and Grzegorz Rozenberg. "The many facets of natural computing." *Communications of the ACM* 51.10 (2008): 72-83.

[15] Dhillon, Santpal Singh, and Piet Van Mieghem. "Performance analysis of the AntNet algorithm." *Computer Networks* 51.8 (2007): 2104-2125.

[16] Wedde, Horst F., Muddassar Farooq, and Yue Zhang. "BeeHive: An efficient fault-tolerant routing algorithm inspired by honey bee behavior." *Ant colony optimization and swarm intelligence*. Springer Berlin Heidelberg, 2004. 83-94.

[17] Biesmeijer, Jacobus C., and E. Judith Slaa. "Information flow and organization of stingless bee foraging." *Apidologie* 35.2 (2004): 143-157.

[18] Zhong, Weilin, and David Evans. "When ants attack: Security issues for stigmergic systems." *University of Virgina, Department of Computer Science, Tech. Rep. CS-2002-23* (2002).

[19] Fleischer, Mark. "Foundations of swarm intelligence: From principles to practice." *arXiv preprint nlin/0502003* (2005).

[20] Ahmad, Shabir, Shafiq Hussain, and Muhammad Farooq Iqbal. "A FORMAL MODEL PROPOSAL FOR WIRELESS NETWORK SECURITY PROTOCOLS." *Science International* 27.3 (2015).

[21] Han, Sangjin, et al. "PacketShader: a GPU-accelerated software router." *ACM SIGCOMM Computer Communication Review* 41.4 (2011): 195-206.

[22] Ahmad, Shabir, and Bilal Ehsan. "The Cloud Computing Security Secure User Authentication Technique (Multi Level Authentication)." *IJSER* 4.12 (2013): 2166-2171.