In Innovative Routing Technique in Mobile Ad Hoc Networks

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Abstract:

A wireless ad hoc network consists of a collection of mobile nodes interconnected by multihop wireless paths with wireless transmitters and receivers. Such networks can be spontaneously created and operated in a self-organized manner, because they do not rely upon any preexisting network infrastructure. As the nodes have mobility, the major challenge in this type of networks is to search for a path i.e., routing between the communications end points.

Ant colony optimization (ACO) is a technique to resolve problems like routing in ad hoc networks depending on food searching behavior of ants. In this paper, we studied the previous models and compared with new ones that use more realistic scenarios. A proportional evaluation has been done by calculating metrics end-to-end delay, throughput, packet delivery factor, routing overhead for AntHocNet and AODV routing algorithms.

Introduction:

Wireless networks are formed with interconnecting devices communicating wirelessly within a relatively limited area. An ad hoc network consists of mobile nodes which communicate with each other using wireless medium without any fixed infrastructure. "Ad hoc" is a Latin word that means "for this purpose only". An ad hoc network is a special network that is set up for a particular application. A Mobile Ad hoc Network (MANET) is a self configuring network of mobile routers connected by wireless links –the union of which forms an arbitrary topology. An Ad hoc network is often defined as an "infrastructure less" network means that a network without the usual routing infrastructure, link fixed routers and routing backbones. A MANET is a distributed network that does not require centralized control, and every host works not only as a source and a sink but also as a router.

This type of dynamic network is especially useful for military communications or emergency search and rescue operations, where an infrastructure cannot be supported. The nodes that make up a network at any given time communicate with and through each other. In this way every node can establish a connection to every other node that is included in the MANET.

Swarm Intelligence:

Swarm intelligence is the property of the system whereby the collective behaviors of unsophisticated agents interacting locally with their environment cause coherent functional global patterns to emerge. Swarm intelligence provides a basis with which it is possible to explore collective problem solving without centralized control or the provision of a global model. Based on this generalized concept of a swarm, French researchers have actually been able to simulate the termite's nest-building behavior on a computer by applying a very simple "stigmergic algorithm".

Ants show their collectiveness in finding the food source. A group of ants indirectly communicate by just modifying the environment. No direct communication between them takes place. All the ants work towards global objective of collecting food. Common goal is more important than any individual goals. They optimize their behavior to achieve the common goal.

ANT COLONY OPTIMIZATION:

ACO routing was originally inspired by mechanisms found in biology: it is based on principles that are present in the foraging behavior of ants in nature, and on the ACO frame work for optimization that was derived from these principles. ACO routing algorithms work in a highly distributed way, and have properties such as adaptivity, robustness and scalability. This makes them particularly interesting to deal with the challenges in adhoc routing.

It has been observed that ants from e.g. the family of Argentine ants Linepithema Humile are able to find the shortest path between their nest and a food source.

Previous Work:

Gianni Di Caro, Frederick Ducatelle and Luca Maria Gambardella [1], proposed Ant algorithms for distributed discrete optimization. It is an algorithm for routing in Mobile Ad hoc networks. AntHocNet is a hybrid algorithm, which combines reactive path setup with proactive path probing, maintenance and improvement. The algorithm is based on the nature-inspired ant colony optimization framework. Frederick Ducatelle [2] carried various tests on urban scenario using QualNet simulator. In an extensive set of simulation experiments, he compared AntHocNet with AODV, a reference algorithm in the field. He showed that this algorithm can outperform AODV on different evaluation criteria. AntHocNet's performance advantage is visible over a broad range of possible network scenarios, and increases for larger, sparser and more mobile networks.

Ad Hoc On-Demand Distance Vector Routing Protocol:

The Ad Hoc on-Demand Distance Vector Routing (AODV) routing protocol for mobile ad hoc and other wireless ad hoc networks provides on-demand route discovery. It is a reactive routing protocol, meaning that it establishes a route to a destination only on demand.

Whenever the nodes need to send data to the destination, if the source node doesn't have routing information in its table, route discovery process begins to find the routes from source to destination. A node requests a route to a destination by broadcasting a Route Requests (RREQ) message to all its neighbors.

Anthocnet:

AntHocNet is a hybrid algorithm, containing both reactive and proactive elements. The algorithm is reactive in the sense that it only gathers routing information about destinations that are involved in communication sessions. It is proactive in the sense that it tries to maintain and improve information about existing paths while the communication session is going on.

Routing information is stored in pheromone table. Forwarding of control and data packets is done in a stochastic way, using these tables.Link failures are dealt with using specific reactive mechanisms, such as local route repair and the use of warning messages.

Results:

Metrics for RWP

Protocol	Nodes	Pause time(sec)	Data rate(Mbps)	End to End delay(ms)	Routing Overhead	Packet Delivery Factor	Throughput (kbps)
ANTHOCNET	50	0	0.5	561.461	12.07	0.1378	218.76
		200		301.227	17.091	0.1108	175.76
		0	2	170.596	10.499	0.0923	182.75
		200		107.189	24.826	0.0612	121.16
	100	0	0.5	465.875	26.130	0.1046	170.47
		200		614.146	16.342	0.1055	167.34
		0	2	95.5514	51.927	0.0503	99.50
		200		171.693	78.286	0.0368	77.06
AODV	50	0	0.5	559.778	0.223	0.3080	488.65
		200		655.249	0.271	0.2339	371.05
		0	2	215.054	0.056	0.1912	378.49
		200		181.70	0.172	0.1291	255.68
	100	0	0.5	399.672	0.423	0.3363	533.40
		200		613.685	0.216	0.3398	538.92
		0	2	167.79	0.156	0.1979	391.90
		200		201.116	0.124	0.1890	367.91

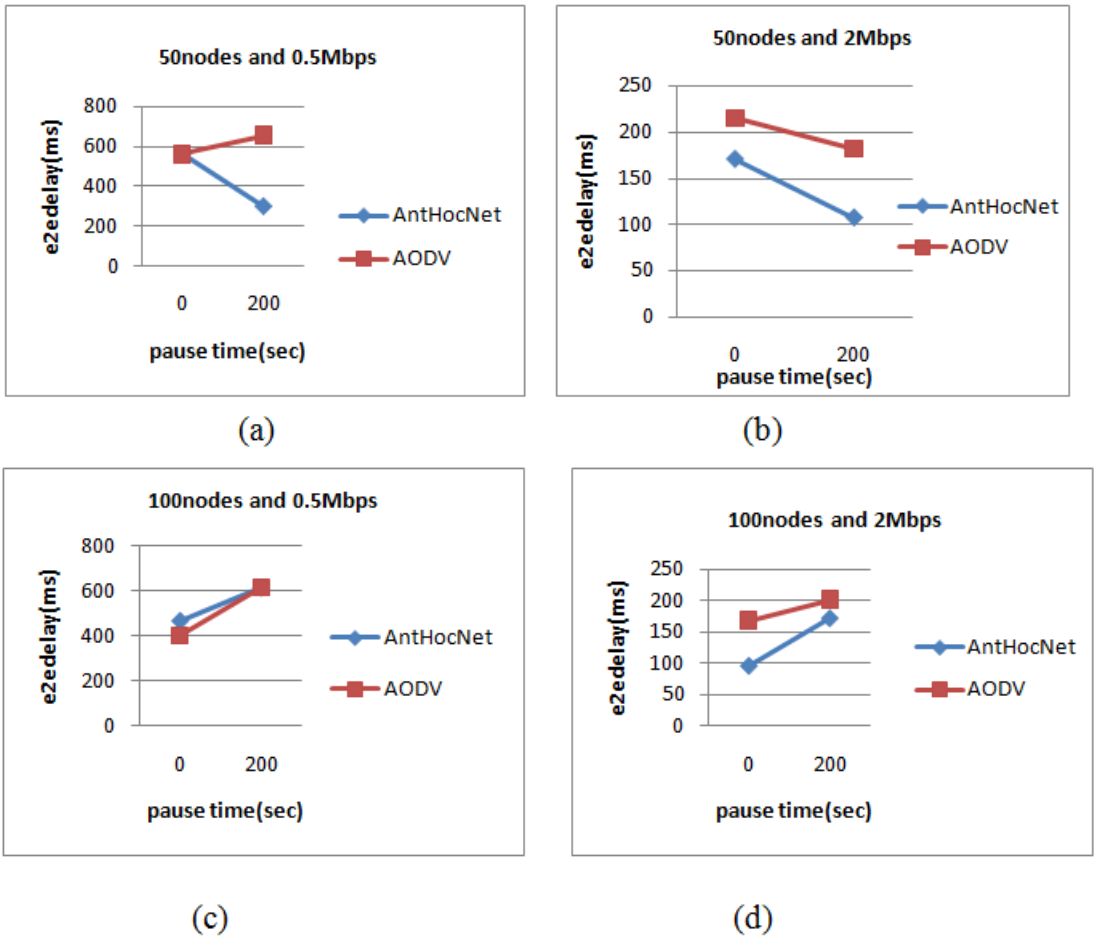

Figure:End-to-End delay for RWP

From the figure (a),(b),(c),(d) it can be observed that when the pause time reaches simulation time AntHocNet outperforms AODV.

CONCLUSION:

The performance of two popular routing protocols AntHocNet and AODV is evaluated by comparing the parameters packet delivery Ratio, end-to-end delay, throughput and Routing overhead. From the results it can be concluded that AntHocNet has higher performance at higher data rates, at higher number of nodes and higher pause time in UDP traffic type.

In case of UDP traffic model results of end to end delay and packet delivery factor shows that AntHocNet's performance is good when compared to that of AODV's by gradually increasing data rates and number of nodes. The routing overhead and throughput shows that AODV's performance is better when compared to that of AntHocNet's at lower data rates.

The simulation is done for different mobility models. It has been observed that RWP model best suits for the application such as students in a class. The RPGM model best suits for the applications like battlefield and students in a campus than the other models The TIMM model is used for calculating the node mobility across the buildings.

The Manhattan model is mainly used for calculating the mobility in the city streets. By modifying the TCL script the energy consumption is calculated for AODV at 50 and 100 nodes and it has been observed that the protocol consumes more energy when the number of nodes increases.

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