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Modeling and performance simulation of PRIME in wireless ad-hoc network

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Abstract

Two nodes communicate directly if they are in the transmission range, otherwise they reach via a multi-hop route. Each MANET node must therefore be able to function as a router to forward data packets on behalf of other nodes. Because of their unique benefits and versatilities, MANETs have a wide range of applications such as collaborative, distributed mobile computing , disaster relief, war front activities and communication between automobiles on highways most of these applications demand multicast or group communication. In network when process private and unique resource needed then unicast give more advantages. A framework for integrated multicast and unicast routing in mobile ad hoc networks (MANETs) is introduced. It is based on interest-defined mesh enclaves that are connected components of a MANET spanning the sources and receivers of unicast or multicast flows. The Protocol for Routing in Interest defined Mesh Enclaves (PRIME). Major challenges for Ad-hoc network is link failure and mobility. Mobility models are use to evaluate effect of link failure and mobility, here this paper work used mobility models are Random waypoint mobility model, Reference Point Group mobility model, Manhattan mobility model, Gauss Markov mobility model and Heterogeneous mobility model . Most of the researchers to analyze the effect of mobility model on routing protocol not focused on to variable number of node and constant pause time. That will be generating the different result on scenario base work for evaluating the extended Performance of PRIME. Ns-2 simulator used for carried out the simulation.

Keyword: MANET, PRIME, Hello packet

Introduction

An ad-hoc network has a certain characteristics, which imposes new demands on the routing protocol. The most important characteristics are the dynamic topology, which is a consequence of node mobility. Nodes can change position quite frequently, which means that need a routing protocol that quickly adapts to topology changes. The node in an ad-hoc network can consist of laptops and personal digital assistants and are often very limited in resources such as CPU capacity, storage capacity, battery power and bandwidth, so the routing protocol should try to minimize control traffic, such as periodic update messages. In ad-hoc wireless network routing protocols divided into different categories: source-initiated (reactive or on-demand), table-driven (pro-active), hybrid, location-aware (geographical), multipath, unicast, multicast, geographical multicast, hierarchical, and power-aware [1]. But researchers continuously working on existing problem that are not solved by

available routing protocol, and this is the reason to adding number of routing protocol under respective categories. The categories of routing protocols are also upgrading according to the problems solving by new or existing routing protocol. A major challenge in the ad-hoc network is link failure and mobility [3]. Packet delivery ratio, Throughput, End-to-end delay, Routing overhead and Power consumption these are basic performance metric to evaluate the performance of routing protocol, that performance metrics affected by the mobility and link failure problems. To evaluate the effect mobility and link failure on routing protocol performance used the different mobility models; some of them are Random waypoint mobility model, Reference Point Group mobility model, Manhattan mobility model, Gauss Markov mobility model and Heterogeneous mobility model [2, 3]. Random waypoint is the commonly used mobility model in these simulations. Random waypoint is a simple model that may be applicable to some scenarios. Unicast and multicast these are the two categories of routing protocol in ad-hoc network. Unicast transmission is the sending of messages to a single network destination identified by a unique address or Unicast is a one-to one connection between the client and the server. Multicast is the delivery of a message or information to a group of destination computers simultaneously in a single transmission from the source or Multicast is a true broadcast. The multicast source relies on multicast-enabled routers to forward the packets to all client subnets that have clients listening. The tradition unicast routing protocol is AODV, DSR and Multicast routing protocol ODMRP, MAODV. A wide range of applications such as collaborative, distributed mobile computing (e.g., sensors, conferences), disaster relief (e.g., flood, earthquake), war front activities and communication between automobiles on highways most of these applications demand multicast or group communication. In network when process private and unique resource needed then unicast give more advantages. Integrates the feature of unicast and multicast routing protocol in single routing protocol is in PRIME (**P**rotocol for **R**outing in **I**nterest defined **M**esh **E**nclaves) [4], The PRIME establishes meshes that are activated and deactivated by the presence or absence of interest in individual destination nodes and groups and confines most of the signaling overhead within regions of interest (enclaves) in such meshes. As per the above discussion mobility and link failure is major issue for any routing protocol. So that evaluate the performance metric of any routing protocol on mobility and link failure issues is primary need. Researcher evaluate the effect mobility and link failure on different protocol but most of them not focused on to variable number of node and constant pause time. In [2], with variable number of node and constant pause time evaluate the impact of random way point mobility model effect on AODV, DSR and DSDV. In [3], use random way point, reference point group and manhattan mobility model to analyze the impact of mobility models on the multicast routing protocol ODMRP, MAODV, ADMR. In [4], use both unicast and multicast traffic with two mobility model random way point and group mobility model, fixed pause time and less min max velocity for analysis.

Background

Routing protocols in ad hoc networks in [1] vast survey on routing protocols, this is only one study that cover maximum number of protocol and create its taxonomy. This study also compares several representative protocols according to categories. While different classes of protocol operate under different scenarios, they usually share the common goal to reduce control packet overhead, maximize

throughput, and minimize the end-to-end delay. The main differentiating factor between the protocols is the ways of finding and/or maintaining the routes between source–destination pairs. To deploy an ad hoc network with an optimal performance, it requires a very careful analysis of the scenario and its requirements, and the appropriate choice of the routing protocol from the dozens applicable in the context. In [2], Performance Evaluation of Mobility Speed over MANET Routing Protocols, the major challenge of ad ad-hoc network are mobility and link failure that affect the protocol performance that studied here. In [2], primary focused much on to variable number of node and constant pause time that very less evaluated. Used random way point mobility model; routing protocol AODV, DSDV and DSR; Cbr traffic, constant pause time 0 and varying speed 2-40 m/s. performance metrics evaluate here are End-to end delay throughput, Average end-to end delay, Packet delivery faction ratio, Routing packet overhead, Normalized routing load, Packet loss ratio. In [3], Impact of Mobility on the Performance of Multicast Routing Protocols in MANET, problems were found in the analysis of the unicast routing protocol when the mobile node moves with greater speed there are more chances for link breakage and result in less packet delivery ratio and the routing overhead increases with the speed of the mobile nodes. That motivates to evaluate the effect of mobility model on multicast routing protocol. Used three mobility model Random waypoint mobility model, Reference Point Group mobility model and Manhattan mobility model; multicast routing protocol ODMRP, MAODV and ADMR; Evaluate the performance metric Packet delivery ration and routing overhead. In [4], novel approach proposed PRIME: an Interest-Driven Approach to Integrated Unicast and Multicast Routing in MANETs, existing routing protocols for MANETs support either unicast routing or multicast routing; and the dissemination of signaling traffic in MANETs is not closely linked to the interest that nodes have on destinations and is structured as either strictly on-demand, strictly proactive, or the use of both types of signaling by dividing the network into zones. The limitation of PUMA is that all nodes must receive periodic signaling packets regarding each multicast group, regardless of the interest nodes may have in the group. PRIME: Integrates the feature of unicast and multicast routing protocol in single routing protocol. The PRIME establishes meshes that are activated and deactivated by the presence or absence of interest in individual destination nodes and groups and confines most of the signaling overhead within regions of interest (enclaves) in such meshes.

Algorithm 1: ENCLAVE(MA)

```
1  if AddressType(MA.D) = multicast then
2      if rc ∨ sd ∨ mm ∨ pn then
3      else
4          if r mod R = 0 then
5              r + +;
6          else
7              r + +;
8              return false;
9  else
10     if pn ∨ sd then
11     else
12         return false;
13 return true;
```

In[4], performance evaluation of PRIME use two mobility model random way point and group mobility; consider less max-min velocity is 1-10 m/s,10s pause time; performance metric used end – to-end delay, delivery ratio, control and total overhead and group delivery ration. PRIME is the only protocol that provides adequate performance in a large network of 1000 nodes with combined multicast and unicast.

Previous work done

The vast review study of routing protocol in [1], that cover all traditional and new proposed routing protocol. review the collection of technologies

which have been proposed for routing in ad hoc networks. There are literally hundreds of different ad hoc routing protocols proposed. Proposed work focused on creates taxonomy of the ad hoc routing protocols, and to survey and compare representative examples for each class of protocols. Strive to uncover the requirements considered by the different protocols, the resource limitations under which they operate, and the design decisions. Proposed work organizes the discussed routing protocols into following categories based on their underlying architectural framework that are Source-initiated (Reactive or on-demand), Table-driven (Pro-active), Hybrid, Location-aware (Geographical), Multipath, Hierarchical, Multicast, Geographical Multicast, Power-aware. While different classes of protocol operate under different scenarios, they usually share the common goal to reduce control packet overhead, maximize throughput, and minimize the end-to-end delay. Some routing protocol missed by the proposed work in all categories of routing protocol. Future scope of proposed work is to extend the existing taxonomy presented in proposed work with new routing protocols and compare with all previous existing routing protocol. That will be a helpful instrument for making the decision to select the protocol as there requirement of allocation and research. In [2], much of the initial proposed work was based on using random waypoint as the underlying mobility model and Constant Bit Rate (CBR) traffic consisting of randomly chosen source-destination pairs as the traffic pattern with traditional routing protocols like DSR, DSDV, and AODV. Mainly evaluate the following metrics: packet delivery ratio, end to end delay and routing overhead found that on-demand protocols such as DSR and AODV performed better than table driven ones such as DSDV at high mobility rates, while DSDV performed quite well at low mobility rate. DSR outperforms AODV in less demanding situations, while AODV outperforms DSR at heavy traffic load and high mobility. However, the routing overhead of DSR was found to be lesser than that of AODV. Random waypoint is too simple and general model, recent research has started focusing on alternative mobility models and protocol independent metrics to characterize them. Some conducted a scenario based performance analysis of the MANET protocols. To differentiate between scenarios used, the study introduced the relative motion of the mobile nodes as mobility metric. In literature of proposed work found on effect of mobility model on tradition routing protocol not focused on to variable number of node and constant pause time. That will be generating the different result on scenario base work for evaluating the best protocol as per the requirement of the application. In [2], primary focused much on to variable number of node and constant pause time that very less evaluated. Used random way point mobility model; routing protocol AODV, DSDV and DSR; Cbr traffic, constant pause time 0 and varying speed 2-40 m/s. performance metrics evaluate here are End-to end delay throughput, Average end-to end delay, Packet delivery faction ratio, Routing packet overhead, Normalized routing load, Packet loss ratio. In [2], used only traditional routing protocol for performance evaluation and not declare clear winner of the compressions. only it overcome the previous performance evaluation by evaluating the performance of traditional routing protocol on basis of effect of unvarying pause time and effect of varying number of nodes. This work may be extending with different new than traditional routing protocol and evaluate the performance with existing scenario. In review the literature of [3], performance of traditional unicast routing protocols such as DSR, DSDV, AODV and TORA with different mobility models. Some other

frameworks are also proposed for analysis of impact of mobility pattern on unicast routing protocol by considered other mobility model like Freeway mobility, Manhattan and RPGM. Random Waypoint mobility model is mostly use for analyzed the unicast routing protocol with CBR traffic by randomly choosing source and destination pair presented. Most of this performance study commonly evaluated the packet delivery ratio and routing overhead. The effect of the different mobile node movement pattern in random based mobility model group (Random Waypoint Mobility Model, Random Walk Mobility Model and Random Direction Mobility Model) on the performance of a unicast routing protocol AODV. A framework to analyze the impact of mobility model for unicast routing and on-demand routing is proposed. Impact of Mobility on the Performance of Multicast Routing Protocols in MANET, problems were found in the analysis of the unicast routing protocol when the mobile node moves with greater speed there are more chances for link breakage and result in less packet delivery ratio and the routing overhead increases with the speed of the mobile nodes. That motivates to evaluate the effect of mobility model on multicast routing protocol. Used three mobility model Random waypoint mobility model, Reference Point Group mobility model and Manhattan mobility model; multicast routing protocol ODMRP, MAODV and ADMR; Evaluate the performance metric Packet delivery ration and routing overhead [3]. Three basic approaches of mesh-based multicast routing are characterized by the On-Demand Multicast Routing Protocol (ODMRP), the Core Assisted Mesh Protocol (CAMP), and the Protocol for Unified Multicasting through Announcements (PUMA). In ODMRP group membership and multicast routes are established and updated by the sources on demand. CAMP avoids the need for network-wide disseminations from each source to maintain multicast meshes by using one or more cores per multicast group. Only cores flood the network with signaling information about multicast groups and a receiver- initiated approach is used for receivers to join a multicast group by sending unicast join requests toward a core of the desired group. PUMA also uses a receiver-initiated approach in which receivers join a multicast group using the address of a core that is broadcast to the network proactively. PUMA eliminates the need in CAMP for an independent unicast routing protocol by implementing a distributed algorithm to elect one of the receivers of a group as the core of the group and to inform each router in the network of at least one next-hop to the elected core of each group. The limitation of PUMA is that all nodes must receive periodic signaling packets regarding each multicast group, regardless of the interest nodes may have in the group. In [4], novel approach proposed PRIME: an Interest-Driven Approach to Integrated Unicast and Multicast Routing in MANETs, existing routing protocols for MANETs support either unicast routing or multicast routing; and the dissemination of signaling traffic in MANETs is not closely linked to the interest that nodes have on destinations and is structured as either strictly on-demand, strictly proactive, or the use of both types of signaling by dividing the network into zones. PRIME: Integrates the feature of unicast and multicast routing protocol in single routing protocol. The PRIME establishes meshes that are activated and deactivated by the presence or absence of interest in individual destination nodes and groups and confines most of the signaling overhead within regions of interest (enclaves) in such meshes. The control overhead (CO) induced by PUMA and PRIME remains constant. PRIME attains similar or better delivery ratios and

significantly lower delays and communication overhead than the traditional approaches. The performance of PRIME improves when link quality and queue lengths are taken into account in the selection of routes within enclaves. PRIME benefits much more from the use of link and node parameters in route selection than traditional on-demand or proactive routing protocols because it contains route signaling while selecting less congested and more robust paths.

Existing methodology

Routing protocols in ad hoc networks: survey [1], vast survey on routing protocols, as per here investigation this is only one study that cover maximum number of protocol and create the taxonomy. This study also compares several representative protocols according to categories. While different classes of protocol operate under different scenarios, they usually share the common goal to reduce control packet overhead, maximize throughput, and minimize the end-to-end delay. The main differentiating factor between the protocols is the ways of finding and/or maintaining the routes between source–destination pairs. To deploy an ad hoc network with an optimal performance, it requires a very careful analysis of the scenario and its requirements, and the appropriate choice of the routing protocol from the dozens applicable in the context. Performance Evaluation of Mobility Speed over MANET Routing Protocols [2], the major challenge of ad ad-hoc network are mobility and link failure that affect the protocol performance that studied here. In [2], primary focused much on to variable number of node and constant pause time that very less evaluated. Used random way point mobility model; routing protocol AODV, DSDV and DSR; Cbr traffic, constant pause time 0 and varying speed 2-40 m/s. performance metrics evaluate here are End-to end delay throughput, Average end-to end delay, Packet delivery faction ratio, Routing packet overhead, Normalized routing load, Packet loss ratio. Impact of Mobility on the Performance of Multicast Routing Protocols in MANET [3], a framework proposed to analyze the impact of mobility model for unicast routing and on-demand routing is proposed. Impact of Mobility on the Performance of Multicast Routing Protocols in MANET, problems were found in the analysis of the unicast routing protocol when the mobile node moves with greater speed there are more chances for link breakage and result in less packet delivery ratio and the routing overhead increases with the speed of the mobile nodes. That motivates to evaluate the effect of mobility model on multicast routing protocol. Used three mobility model Random waypoint mobility model, Reference Point Group mobility model and Manhattan mobility model; multicast routing protocol ODMRP, MAODV and ADMR; Evaluate the performance metric Packet delivery ration and routing overhead. PRIME: an Interest-Driven Approach to Integrated Unicast and Multicast Routing in MANETs [4], existing routing protocols for MANETs support either unicast routing or multicast routing; and the dissemination of signaling traffic in MANETs is not closely linked to the interest that nodes have on destinations and is structured as either strictly on-demand, strictly proactive, or the use of both types of signaling by dividing the network into zones. The limitation of PUMA is that all nodes must receive periodic signaling packets regarding each multicast group, regardless of the interest nodes may have in the group. PRIME: Integrates the feature of unicast and multicast routing protocol in single routing protocol. The PRIME establishes meshes that are activated and deactivated by the presence or absence of interest in individual destination nodes and groups and confines most of

the signaling overhead within regions of interest (enclaves) in such meshes. performance evaluation of PRIME use two mobility model random way point and group mobility; consider less max-min velocity is 1-10 m/s,10s pause time; performance metric used end –to-end delay, delivery ratio, control and total overhead and group delivery ration. PRIME is the only protocol that provides adequate performance in a large network of 1000 nodes with combined multicast and unicast.

Analysis and Discussion

A vast review on routing protocols, study cover maximum number of protocol and create the taxonomy. This study also compares several representative protocols according to categories. While different classes of protocol operate under different scenarios, they usually share the common goal to reduce control packet overhead, maximize throughput, and minimize the end-to-end delay. The major challenges of ad ad-hoc network are mobility and link failure that affect the protocol performance that studied here. In [2], primary focused much on to variable number of node and constant pause time that very less evaluated. Used random way point mobility model; routing protocol AODV, DSDV and DSR; Cbr traffic, constant pause time 0 and varying speed 2-40 m/s. performance metrics evaluate here are End-to end delay throughput, Average end-to end delay, Packet delivery faction ratio, Routing packet overhead, Normalized routing load, Packet loss ratio. A framework proposed to analyze the impact of mobility model for unicast routing and on-demand routing is proposed. Impact of Mobility on the Performance of Multicast Routing Protocols in MANET, Used three mobility model Random waypoint mobility model, Reference Point Group mobility model and Manhattan mobility model; multicast routing protocol ODMRP, MAODV and ADMR; Evaluate the performance metric Packet delivery ration and routing overhead [3]. PRIME: Integrates the feature of unicast and multicast routing protocol in single routing protocol [4]. The PRIME establishes meshes that are activated and deactivated by the presence or absence of interest in individual destination nodes and groups and confines most of the signaling overhead within regions of interest (enclaves) in such meshes. performance evaluation of PRIME use two mobility model random way point and group mobility; consider less max-min velocity is 1-10 m/s,10s pause time; performance metric used end –to-end delay, delivery ratio, control and total overhead and group delivery ration. PRIME is the only protocol that provides adequate performance in a large network of 1000 nodes with combined multicast and unicast.

- Effect of Unvarying Pause Time: Pause time can be defined as time for which nodes waits on a destination before moving to other destination. Proposed work used a constant pause time as a parameter as it is measure of mobility of nodes. Low pause time means node will wait for less time thus giving rise to high mobility scenario.
- Effect of Varying Number of Nodes: Number of nodes may be another varying parameter as it plays important role in performance. Proposed work simulations show various performance parameters versus no. of nodes, proposed work tested the different routing protocols by varying the number of nodes to account for system scalability.

Both the parameter affects the performance metric of the any routing protocol. In [4], performance of the PRIME by using use two mobility model random way point and group mobility; max-min velocity is 1-10 m/s,10s pause time; that simulation

parameter not much more satisfied the high mobility constraint, so that the performance metric may affected if change the pause time, varying node and mobility model any one of them. Existing analysis of PRIME only few metrics were evaluated end –to-end delay, delivery ratio, control and total overhead and group delivery ration, here the scope of evaluating the other metric like power consumption. And also evaluate the Impact of different mobility model on PRIME with constant pause time and varying node i.e. high speed that in existing evaluation.

Proposed Methodology

PRIME: Integrates the feature of unicast and multicast routing protocol in single routing protocol [4]. The PRIME establishes meshes that are activated and deactivated by the presence or absence of interest in individual destination nodes and groups and confines most of the signaling overhead within regions of interest (enclaves) in such meshes. performance evaluation of PRIME use two mobility model random way point and group mobility; consider less max-min velocity is 1-10 m/s,10s pause time; performance metric used end –to-end delay, delivery ratio, control and total overhead and group delivery ration. PRIME is the only protocol that provides adequate performance in a large network of 1000 nodes with combined multicast and unicast. As per above analysis proposed to Evaluate the Impact of different mobility model on PRIME with constant pause time and varying node.

Total nodes	100	Node placement	Random
Simulation area	1800 × 1800m^2	Simulation time	150s
MAC Protocol	802.11	Tx. power	15dbm
		Tx. Rate	2000000bps
Data source	MCBR and CBR	Pkts. per src.	1000
Mobility model	Random waypoint	Pause time	10s
		Min.-Max. Vel.	1-10m/s
Mobility model	Group mobility	Node pause time	10s
		Grp. pause time	10s
Grp. Min-Max Vel.	1-10m/s	Node Min-Max Vel.	1-10m/s

As per above table used parameter to evaluate the performance in [4], to Evaluate the Impact of different mobility model on PRIME with constant pause time and varying node. Proposed the changes in parameter used for performance evaluation are mobility model, pause time, group pause time, min-max velocity, total number of node, bandwidth, packet size, Tx power and packet rate. After changing the parameters considering performance metric for evaluation packet delivery ratio, routing overhead, power consumption, throughput, end- to-end delay, control and total overhead and group delivery ration. Changes of parameter for simulation are as follows:

Mobility models:

- Random Way Point Mobility Model
- Reference Point Group Mobility Model,
- Manhattan Mobility Model,
- Gauss Markov Mobility Model
- Heterogeneous Mobility Model

Pause time and Group pause time:

- 0s

Min-max velocity:

- 2-40m/s

Total number Node:

- 20-40-60-80-100

Possible outcome and result

The performance metrics affected by proposed methodology are as follows:

- Packet delivery ratio
- Routing overhead
- Power consumption
- Throughput
- End- to- end delay
- Control total overhead
- Group delivery ration

Generally due to high mobility and link failure any protocol degrade the performance, so that PRIME also has the possibility to degrade the performance in high mobility environments.

Conclusion

This study analyzed the impact of different mobility model on PRIME with constant pause time and varying number of node. First reviewed the protocol that Integrates the feature of unicast and multicast routing protocol in single routing protocol is PRIME, also studied the impact of mobility model on tradition routing protocol of unicast and multicast routing protocol i.e. DSDV, AODV, DSR, ODMRP, MAODV and ADMR. Review found that major challenge of ad-hoc network is mobility and link failure, the effect of mobility and link failure on routing protocol evaluated by different mobility model as Random Way Point Mobility Model, Reference Point Group Mobility Model, Manhattan Mobility Model, Gauss Markov Mobility Model and Heterogeneous Mobility Model. Review also found that most of the research not focused on the constant pause time and varying number of node to evaluate the impact of the different mobility model on that routing protocol. Generally due to high mobility the performance metric of any routing protocol will be affected. Under that PRIME study found that performance of PRIME was not evaluated on constant pause time, it perform by considering pause time 0s, also found that the simple Random Way Point Mobility Model and group mobility model were used, existing parameter for performance evaluation of PRIME mainly not focused different mobility model, constant pause time and high mobility environment. In this paper proposed, this work will be evaluating the performance of PRIME on environment that not performs as state above. As the general evaluation impact of mobility affected the performance of routing protocol, the performance metric that will be affected above stated problems in PRIME are packet delivery ratio, routing overhead, power consumption, throughput, end- to- end delay, control total overhead, group delivery ration.

Applications

Applicability of unicast and multicast routing protocol feature need in ad-hoc network in single routing protocol then used the PRIME.

Future Scope

This proposed work explores the limitation of PRIME on different mobility models with high mobility environment. Extend this study and proposed some framework to remove the limitation of the PRIME on high mobility environment.

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